Environmental Impact Statement Report for the Proposed PNR Clark Phase 2 (Malolos Clark Railway) Project

VOLUME I: MAIN REPORT

(Draft Final Report)

July 2018

Department of Transportation (DOTr)

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
AAQ	Ambient Air Quality
AD	Ancestral Domain
ADB	Asian Development Bank
A&D	Alienable and Disposable
AFP	Armed Forces of the Philippines
AIDS	Acquired Immunodeficiency Syndrome
APG	Angiosperm Phylogeny Group
APS	Auxiliary Power Supply
APSI	Air Pollution Source Installation
AR5	IPPC’s Fifth Assessment Report
As	Arsenic
ATP	Automatic Train Protection
AWARE	Airport Weather Advanced Readiness Toolkit
BAFs	Bureau of Agriculture and Fisheries Standards
BCDA	Bases Conversion Development Authority
BD	Basic Design
BFP-SRU	Bureau of Fire Protection – Special Rescue Unit
BMB	Biodiversity Management Bureau
BOD	Biochemical Oxygen Demand
BRGY	Barangay
BS	British Standard
BSWM	Bureau of Soils and Water Management
BT	Battery
Ca	Calcium
CADC	Certificate of Ancestral Domain Claim
CADT	Certificate of Ancestral Domain Title
CALC	Certificate of Land Claims
CALT	Certificate of Ancestral Land Title
CARI	Contractor’s All Risk Insurance
CARP	Comprehensive Agrarian Reform Program
CBTC	Communication Based Train Control
CCA	Climate Change Adaptation
CCC	Climate Change Commission
CCTV	Closed-circuit Television
Cd	Cadmium
CDC	Clark Development Corporation
CDM	Clean Development Mechanism
CE	Critically Endangered Species
CEMMAP	Contractor’s Environmental Management Plan
CENRO	City Environment and Natural Resources Office
CIA	Clark International Airport
CIAC	Clark International Airport Corporation
Cl	Chloride
CLLEx	Central Luzon Link Expressway
CLUP	Comprehensive Land Use Plan
CLUDP	Comprehensive Land Use and Development Plan
CMR	Compliance Monitoring Report
CMVR	Compliance Monitoring and Validation Report
Cn	Cyanide
CNC	Certificate of Non-Coverage
CNO	Certificate of No Overlap

CO	Carbon Monoxide
CP	Compressor
CPDO	City Planning and Development Office
CPL	Central Plain of Luzon
Cr	Chromium
Cr^{+6}	Chromium Hexavalent
CR	Critically Endangered
CS	Conservation Status
CSEZ	Clark Special Economic Zone
CTC	Centralized Train Control
CWD	Civil Works Division
DA	Department of Agriculture
DAO	DENR Administrative Order
DAP	Development Academy of the Philippines
DAR	Department of Agrarian Reform
dB	Decibel
dBA	A-weighted decibels
DC	Direct Current
DD / DED	Detailed Design Stage / Detailed Engineering Design Stage
dbh	Diameter at Breast-Height
DENR	Department of Environment and Natural Resources
DepEd	Department of Education
DIA	Direct Impact Area
DILG	Department of Interior and Local Government
DMU	Diesel Multiple Unit
DO	Dissolved Oxygen
DOH	Department of Health
DOST	Department of Science and Technology
DOTC	Department of Transportation and Communications
DOTr	Department of Transportation
DPWH	Department of Public Works and Highways
DRR	Disaster Risk Reduction
DSPEWPC	Department of Sustainability, Environment, Water and Population Communities
DSR	Digital Space Radio
DSWD	Department of Social Welfare and Development
DTI	Department of Trade and Industry
ECA	Environmentally Critical Area
ECC	Environmental Compliance Certificate
ECP	Environmentally Critical Project
EDSA	Epifanio delos Santos Avenue
EF	Emission Factor
EGF	Environmental Guarantee Fund
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EIAMD	Environmental Impact Assessment and Management Division
EIS	Environmental Impact Statement
EISR	Environmental Impact Statement Report
E&M	Electrical and Mechanical Systems
EMB	Environmental Management Bureau
EMC	Electro Magnetic Compatibility
EMF	Environmental Monitoring Fund
EMI	Electro Magnetic Interference
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan

EMU	Electric Multiple Unit
EN	Endangered Species
ENRO	Environment and Natural Resources Officer
EO	Executive Order
EPRMP	Environmental Performance Report and Management Plan
ERA	Environmental Risk Assessment
ERP	Emergency Response Plan
ESD	Engineering Support Division
ESRD	Environment, Social and ROW Division
EQPL	Environmental Quality Performance Level
FBI	Field Based Investigation
FMEA	Failure Modes and Effects Analysis
FMB	Forest Management Bureau
FPIC	Free, Prior and Informed Consent
FV	Field Validation
GAF	Grievance Action Form
GCR	Greater Capital Region
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GPS	Global Positioning System
GRDA	General Residential Development Area
GRM	Grievance Redress Mechanism
GTI	Geoshpere Technologies Inc.
GW	Ground Water
HCO^3	Bicarbonate
HIV	Human Immunodeficiency Virus
HG	Total Mercury
HSEC	Health, Safety and Environment Committee
Hz	Hertz
IBA	Important Bird Area
IC	Industrial, Commercial
ICC	Indigenous Cultural Communities
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEA	International Energy Agency
IEC	Information Education and Communication
IEE	Initial Environmental Examination
IESAM	Institute of Environmental Science and Management
IFC	International Finance Corporation
IGBT	Insulated Gate Bipolar Transistor
IIA	Indirect Impact Area
IP	Indigenous Peoples
IPC	Indigenous Peoples Communities
IPCC	Intergovernmental Panel on Climate Change
IPRA	Indigenous Peoples Rights Act
IRR	Implementing Rules and Regulations
IRRI	International Rice Research Institute
ISF	Informal Settler Families
IUCN	International Union for Conservation of Nature
IV	Importance Value
JICA	Japan International Cooperation Agency
K	Potassium
KBA	Key Biodiversity Area
KW/H	Kilowatt per hour
LAeq	Equivalent continuous sound pressure level
LC	Least Concern

LCD	Liquid Crystal Display
LED	Light Emitting Diode
LGU	Local Government Unit
LIAC	Local Inter-Agency Committee
LLDA	Laguna Lake Development Authority
LPA	Low Pressure Area
LRT	Light Rail Transit
LRTA	Light Rail Transit Authority
MBAS	Methylene Blue Active Substances
MCLUPZO	Manila City Comprehensive Land Use Plan and Zoning Ordinance
MCRP	Malolos Clark Railway Project
MCRRS	Manila-Clark Rapid Railways System
MENRO	Municipal Environment and Natural Resources Office
Mg	Magnesium
MGB	Mines and Geosciences Bureau
MH	Merchantable Height
MLUP	Municipal Land Use Plan
MMDA	Metro Manila Development Authority
MMFR	Mount Makiling Forest Reserve
MMSP	Metro Manila Subway Project
MMT	Multi-partite Monitoring Team
MMUTIS	Metro Manila Urban Transportation Integrated Study
MNTC	Manila North Tollways Corporation
MOA	Memorandum of Agreement
MPDO	Municipal Planning and Development Office
MPN	Most Probable Number
MRF	Materials Recovery Facility
MRT	Metro Rail Transit
MSWMB	Municipal Solid Waste Management Board
MT	Metric Ton
Na	Sodium
NAAQGV	National Ambient Air Quality Guideline Values
NAMRIA	National Mapping and Resource Information Authority
NBC	National Building Code
NBSAO	National Biodiversity Strategy and Action Plan
NCC	New Clark City
NCCA	National Commission for Culture and the Arts
NCCAP	National Climate Change Action Plan
NCIP	National Commission on Indigenous Peoples
NCR	National Capital Region
NECP	Non-Environmentally Critical Project
NFSCC	National Framework Strategy on Climate Change
NGO	Non-Government Organization
NHA	National Housing Authority
NHCP	National Historical Commission of the Philippines
NIPAS	National Integrated Protected Areas System
NLEX	North Luzon Expressway
NLRC	North Luzon Railways Corporation
NM	National Museum
NMTT	Navotas-Malabon-Tenejeros-Tullahan River
NO^2	Nitrogen Dioxide
NO^3	Nitrate
NPCC	National Pollution Control Commission
NSCR	North South Commuter Railway Project

NSRP	North South Railway Project – South Line (Commuter)
NTP	Notice to Proceed
O^3	Ozone
OCC	Operation Control Center
OCD	Office of Civil Defense
ODA	Overseas Development Assistance
O&G	Oil and Grease
OSH	Occupational Safety and Health
OTS	Other Threatened Species
OWS	Other Wildlife Species
PA	Philippine Army
PAF	Project Affected Families
PAGASA	Philippine Atmospheric Geophysical and Astronomical Services Administration
PAP	Project Affected Persons
PAR	Philippine Area of Responsibility
PAST	Paleontological Statistical Software
PAWB	Protected Areas and Wildlife Bureau
Pb	Lead
PC	Pre-cast
PCSD	Project Control Support Division
PD	Presidential Decree
PDR	Project Description Report
PEISS	Philippine Environmental Impact Statement System
PEMAPS	Project Environmental Monitoring and Audit Prioritization Scheme
PENRO	Provincial Environment and Natural Resources Office
PEPRMP	Programmatic Environmental Performance Report and Management Plan
PET	Polyethylene Terephthalate
PH	Public Hearing
pH	Potential of Hydrogen
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PHP	Philippine Peso
PM	Particulate Matter (in microns)
PMO	Project Management Office
PNP	Philippine National Police
PNR	Philippine National Railways
PNS	Philippine National Standard
PNSC	Philippine National Structural Code
PNSDW	Philippine National Standard for Drinking Water
PO^4	Phosphate
PO	People Organizations
POP	Persistent Organic Pollutant
PPCC	Philippine Plant Conservation Committee
PPE	Personal Protective Equipment
PRI	Philippine Railway Institute
PSCCA	Philippine Strategy in Climate Change Adaption
PT	Pantograph
PTAC	Pilotage Trading and Construction
PUD	Planned Unit Development
PWU	Philippines Women's University
Qh	Recent deposits
QVP	Quaternary Volcanic Pyroclastic
RA	Republic Act

RAP	Resettlement Action Plan
REG	Region
RF	Rainfall
RHU	Rural Health Unit
RIC	RAP Implementation Committee
RIE	Residential, Institutional, Educational
ROW	Right-of-Way
RPM	Revised Procedural Manual
RS	Residency Status
RSD	Rolling Stock Division
SAFDZ	Strategic Agriculture and Fisheries Development Zone
SB	Sangguniang Bayan
SCPW	Society for the Conservation of Philippine Wetlands Inc.
SCTEX	Subic-Clark-Tarlac Expressway
SDP	Social Development Plan
SEMS	Social and Environmental Management Systems
SIC	Semi-conductor
SLEX	South Luzon Expressway
SMR	Self-Monitoring Report
SNC	Philippines Second National Communication on Climate Change
SO^2	Sulfur Dioxide
SO^4	Sulfate
SPS	Safeguard Policy Statement
SPT	Standard Penetration Test
SRTM	Shuttle Radar Topography Mission
STOA	Supplemental Toll Operating Agreement
STP	Sewage Treatment Plant
STPP	Sucat Thermal Power Plant
SW	Surface Water
SWMP	Solid Waste Management Plan
TBM	Tunnel Boring Machine
TC	Trailer Car
TCLP	Toxicity Leaching Procedure
TCU	Total Color Unit
TD	Tropical Depression
TDS	Total Dissolved Solids
TESDA	Technical Education and Skills Development Authority
TH	Total Height
TMS	Train Management System
TOR	Terms of Reference
TS	Tropical Storm
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
TY	Typhoon
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States Dollar
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VL	Vibration Level
VU	Vulnerable Species
VVVF	Variable Voltage and Variable Frequency
WACS	Waste Analysis Characterization Study
WB	World Bank

WBCP	Wild Bird Club of the Philippines
WBCSD	World Business Council for Sustainable Development
WFP	Work and Financial Plan
WHO	World Health Organization
WQG	Water Quality Guidelines
WRI	World Resources Institute
WSS	Water Sampling Site

EXECUTIVE SUMMARY

1. This Executive Summary provides a general overview of the proposed PNR Clark Phase 2 (Malolos - Clark Railway) Project (MCRP) and its purpose and need; briefly describes the Project's Environmental Impact Assessment (EIA) Process; summarizes the major impacts for key resources and aspects associated with the proposed activities and corresponding preventive, mitigating and compensatory measures; summarizes the monitoring plan; and lists key consultation and coordination activities to include issues and concerns that emerged.

A. PROJECT FACT SHEET

Project Name	Proposed PNR Clark Phase 2 (Malolos - Clark Railway) Project	
Project Location	Alignment: Malolos, Bulacan Calumpit, Bulacan Apalit, Pampanga Minalin, Pampanga Sto. Tomas, Pampanga San Fernando, Pampanga Angeles, Pampanga Mabalacat, Pampanga Bamban, Tarlac Capas, Tarlac	Stations: Calumpit, Bulacan Apalit, Pampanga San Fernando, Pampanga Angeles, Pampanga Clark, Mabalacat, Pampanga Clark International Airport (CIA) New Clark City (NCC), Capas, Tarlac Depot: Mabalacat, Pampanga
Project Type	Railway	
Project Area	Line: 72.5km x 30m Station: 7 Stations (180-220m x 60m per station) Depot: Approximately 40 hectares	
Project Capacity	Six (6) Commuter Trains at 1,600 passengers/train Eight (8) Express Trains at 400 passengers/train	
Project Technology	Electric Multiple Unit (EMU) Train	
Major Components of the Project	The components of the Project are: (1) Main Railway Line, (2) Stations, (3) Maintenance Depot, (4) E & M System and (5) Rolling Stock	
Project/Investment Cost	PhP 285.589 Billion (JPY 602.593 Billion @ PhP 1.00 = JPY 2.11)	
Project Duration	The project is targeted to be operational by April 30, 2022 or approximately a period of four (4) years for pre-construction and construction activities	
Profile of the Proponent		
Name of Proponent	Department of Transportation (DOTr)	
Address	DOTr Head Office, Pinatubo Street corner Osmeña Street, Clark Freeport Zone, Angeles City, Pampanga	
Authorized Signatory/ Representative	Atty. Timothy John Batan Undersecretary for Railways	
Contact Details	Telephone No: (02)790-8300	
Profile of the Preparer		
EIA Preparer	GEOSPHERE Technologies, Inc.	
Address	19D Eisenhower Tower, Eisenhower St., Greenhills, San Juan, Metro Manila	
Contact Person	Engr. Ledicia T. Dela Cruz Managing Director	
Contact Details	Landline: (+632) 724-5665; 724-5667 Fax Number: (+632) 723-4250 Email Address: gti0722@geospheretech.com	

Background of the Proposed MCRP

2. In 1997, the Manila-Clark Rapid Railways System (MCRRS) Project of North Luzon Railway Corporation (Northrail) was subject to EIA Study as required under the Philippine Environment Impact Statement System (PEISS) set forth in Presidential Decree (PD) 1586. This was granted an Environmental Compliance Certificate (ECC) (ECC No. 9907-036-120D) by the Environmental Management Bureau of the Department of Environment and Natural Resources

(EMB-DENR) on November 14, 2000 for the Phase 1-A1 line from Clark to Valenzuela with a length of 80km. Subsequently, another ECC (ECC No. 0706-014-7110) was issued by EMB-DENR on December 18, 2007 for the Valenzuela to Caloocan Segment for Phase 1 Section 1 with a length of 6.482 km.

3. The MCRRS Project, however, was discontinued, and in 2013, a new Feasibility Study was prepared for the North South Commuter Rail (NSCR) Project under Japan International Cooperation Agency (JICA) funding, that would run from Malolos to Tutuban. It was agreed with EMB-DENR, that an integrated Environmental Performance Report and Management Plan (EPRMP) would be prepared for the NSCR Project. This will consolidate the ECCs for Malolos to Valenzuela and Valenzuela to Caloocan and incorporate the Caloocan to Tutuban segment into a single unified ECC. Consequently, on April 28, 2015, an ECC (ECC-CO-1503-00143) was issued by the EMB-DENR for the NSCR Project, which superseded ECC No. 9907-036-120D and ECC No. 0706-014-7110.

4. In the discussion with the EMB-DENR on January 4, 2017 and March 24, 2017, the proposed MCRP will be subject to an EIA Study. The EMB-DENR recommends that the DOTr will apply for a new ECC for the proposed MCRP to include the segment between New Clark City (NCC) and the Clark International Airport (CIA) together with the CIA-Malolos segment by preparing an Environmental Impact Statement Report (EISR).

B. LEGAL AND INSTITUTIONAL FRAMEWORK ON EIA

5. Any private or public projects or activities which are likely to have foreseen adverse effects on the natural and social environment are subject to the PEISS. The list of laws and guidelines related to PEISS are shown in **Table ES-1**.

Table ES-1 Important Laws and Manuals of PEISS

Laws and Regulations of Environmental Impact Assessment (EIA)
• Presidential Decree No. 1152 (1977): Philippines' Environmental Code. Comprehensive environmental management with mitigation measures were addressed and concept of the environmental impact assessment was introduced for the first time.
• Presidential Decree No. 1586 (1978): PEISS was established to conduct EIA study for the environmentally critical projects and the projects in the environmentally critical areas.
• Presidential Proclamation No. 2146 (1981) and No. 803 (1996): Proclaiming Environmentally Critical Areas and types of projects as Environmentally Critical Projects and within the scope of PEISS establish under PD No. 1586.
• DENR Administrative Order No. 30 Series of 2003 (DAO 03-30): Providing the implementing rules and regulations for the Philippine Environmental Impact Statement (EIS) System of PD No. 1586.
• DENR Administrative Order No. 2017-15:Guidelines on Public Participation under the Philippine Environment Impact Statement System
• EMB Memorandum Circular 2007-002: Revised Procedural Manual for DAO 03-30
• DENR Memorandum Circular 2010-14: Standardization of Requirement and Enhancement of Public Participation in the Streamlined Implementation of the PEISS
• EMB Memorandum Circular 2010-002: Clarification to DENR Memorandum Circular No. 2010-14 and Other EIS System Policy Issuances
• EMB Memorandum Circular 2010-004: Guideline for Use of Screening and Environmentally Critical Area Mapping Systems
• EMB Memorandum Circular 2011-005: Incorporating Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) concerns in the PEISS
• EMB Memorandum Circular 2014-005: Guidelines of Coverage Screening and Standardized Requirement under the PEISS amending relevant portions of EMB MC 2007-002
Responsible Government Authorities
• DENR - government entity responsible for the environmental administration
• DENR-EMB - responsible for the issuance of decision making documents such ECC and Certificate of Non-Coverage (CNC) for PEISS
Environmental Impact Assessment System of JICA and ADB
• JICA Guidelines for Social and Environmental Considerations (April 2010) -
• ADB Safeguard Policy Statement (July 2009) – governs environment and social safeguards of ADB operations
Environmental Impact Assessment System in the Philippines
• 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.

Environmental Standards

- Presidential Decree 1152, otherwise known as the "Philippine Environment Code (1977)": Recognizes the establishment of specific environment management policies and prescribing environmental quality standards
- Ambient Air Quality
  - Philippine Standards:
    - DENR Administrative Order (DAO) No. 2000-81: Implementing Rules and Regulations of RA No. 8749 which establishes the National Ambient Air Quality Standards for suspended particulate matters (TSP, PM10), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3) and lead (Pb)
    - DAO No. 2013-13: Establishes the provisional national ambient air quality guideline values for PM2.5
  - International Standards:
    - World Health Organization Air Quality Guidelines for PM, O_3, NO_2 and SO_2 (2005)
- Surface Quality
  - Philippine Standards:
    - DENR Administrative Order (DAO) No. 2016-08
  - International Standards:
    - Environmental water quality standards for protecting human health, Japan DENR Administrative Order (DAO) No. 2016-08
- Effluent Quality
  - Philippine Standards:
    - DENR Administrative Order (DAO) No. 2016-08
  - International Standards:
    - IFC Indicative Guideline Values for Treated Sanitary Sewage Discharges (2007)DENR Administrative Order (DAO) No. 2016-08
    - Japan National Effluent Standards (2015)
- Groundwater Quality
  - Philippine Standards:
    - DENR Administrative Order (DAO) No. 2016-08
    - Department of Health (DOH) Administrative Order (DAO) No. 2017-0010
  - International Standards:
    - WHO Guidelines for Drinking-Water Quality (2011)
- Noise
  - Philippine Standards:
    - National Pollution Control Commission (NPCC), Section 78, Table 1
    - NPCC Memorandum Circular No. 1980-002
  - International Standards:
    - Guidelines for Community Noise, World Health Organization (WHO), 1999.
- Vibration
    - British standards BS 5228-2:2009
- Soil Fertility
  - Philippine Standards:
    - Bureau of Soils and Water Management Soil Fertility Rating
  - International Standards:
    - Dutch Target and Intervention Values (2000)
- Soil Contamination
    - Dutch Target and Intervention Values (2000)
    - US EPA Regional Screening Levels (0.1)

Other Environmental Laws and Regulations Concerning the Project

- International treaties, agreements and related documents
  - Biodiversity
    - Convention on Biological Diversity, 1992
    - Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973
    - Convention on Wetlands of International Importance, 1971
    - Convention on the conservation of Migratory Species of Wild Animals, 1983
    - Cartagena Protocol on Biosafety, 2000 (to the Convention on Biological Diversity)
    - Nagoya Protocol on Access to Genetic Resources & the Fair & Equitable Sharing of Benefits Arising from their Utilization-Supplementary Agreement to the Convention of Biological Diversity
  - Climate Change
    - Montreal Protocol on Substances that Deplete the Ozone Layer, 1987
    - Vienna Convention for the Protection of the Ozone Layer, 1985
    - London Amendment (to the Montreal Protocol), 1990
    - United Nations Framework Convention on Climate Change, 1994
    - Kyoto Protocol to the United Nations Convention on Climate Change 1998
    - Paris Agreement Adopted in the 21st Session of the Conference of Parties to the United Nations Framework Convention on Climate Change, 2015

- United Nations Convention to Combat Desertification, 1994
- Pollution
  - Basel Convention on the Control of Transboundary Movements of Hazardous wastes and their Disposal, 1992
  - Stockholm Convention on Persistent Organic Pollutants 2001
  - Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemical and Pesticides in International Trade, 2004Montreal Protocol on Substances that Deplete the Ozone Layer, 1987
- Historical/Cultural Heritage
  - UNESCO Convention Concerning the Protection of the World Cultural and National Heritage, 1972
- Forestry
  - International Tropical Timber Agree, 1994
- Social
  - Convention on the Elimination of all Forms of Discrimination against Women, 1979
  - International Convention on the Elimination of all forms of racial discrimination 1965
  - International Covenant on Civil and Political Rights 1976
  - International Covenant on Economic, Social and Cultural Rights 1976
  - Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment 1987
  - Convention on the Rights of the Child 1990
  - International Convention on the Protection of the Rights of all migrant Workers and members of their families, 1996
  - International convention for protection of all persons from enforced Disappearance 2010
  - Convention on the Rights of Persons with Disabilities 2008

- National Strategy and Plan relevant to Environment and Social Consideration
  - Biodiversity
    - Philippines: National Biodiversity Strategy and Action Plan (NBSAO) 1997
    - Philippine Biodiversity Conservation Priorities, 2002
    - A National Wetland Action Plan for Philippines 2011-2016
    - Philippine Plant Conservation Strategy and Action Plan 2003
  - Climate Change
    - Second National Communication Plan on Climate Change
    - Philippine Energy Plan 2009- 2030
    - Philippine Strategy on Climate Change Adaptation 2010-2022
    - National Framework strategy on Climate change 2010 - 2022
    - National Climate Change Action Plan, DILGConvention on the Elimination of all Forms of Discrimination against Women, 1979
  - Social
    - Philippine Development Plan 2017-2022
    - Philippine Environmental Partnership Program
    - Government Poverty Reduction Programs and Plans
    - Philippine Plan for Gender responsive Development Plan 1995-2025
    - National Plan of Action for Children 1991
    - 22 point platform and policy Pronouncements on Labor and employment 2010

- Other related Laws and Regulations
  - Biodiversity
    - Republic Act (RA) No.7586 (1992), National Integrated Protected Areas System (NIPAS) Act
    - RA No. 9147 (2001), Wildlife Resources Conservation and Protection Act
    - Executive Order (EO) No. 247, Prescribing Guidelines and Establishing a Regulatory Framework for the Prospecting of Biological and Genetic resources, there by-products and derivatives for Scientific Purposes and for other Purposes
    - DENR Administrative Order (DAO) No. 2004-15 Establishing the List of Terrestrial Threatened Species and their Categories and the List of other Wildlife species pursuant to RA 9147 otherwise known as the Wildlife Resources and Conservation Act of 2001
    - DAO 2007-24, Establishing the National List of Threatened Plants and their categories and the List of other Wildlife Species
  - Climate Change and Disaster Risk Reduction
    - RA 9729 (2009), Climate Change Act
    - Climate Change Commission (CCC) AO No. 2010-01, IRR of RA 9729
    - EO No. 174, Institutionalizing Philippine Greenhouse Gas Inventory Management and Reporting System
    - RA 10121 (2010), Philippine Disaster Risk and Management Act
    - RA 10174 (2012), People's Survival Fund
    - EMB Memorandum Circular (MC) 2011-005, EIA Technical Guidelines Incorporating Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) concerns

- Pollution Control (Water)
  - PD No. 1067 (1976), Water Code
  - RA 9275 (2004), Clean Water Act
  - DAO No. 2005-10, IRR of the Clean Water Act
- Pollution Control (Waste)
  - RA No. 6969 (1990), Toxic Substances, Hazardous and Nuclear Wastes Control Act
  - PD No. 856, Sanitation Code
  - DAO 2006-10, Guidelines on the Categorized Final Disposal Facilities
  - DAO 2006-09, General Guidelines on the Closure and Rehabilitation of Open Dumpsites and Controlled Disposal Facilities
  - DAO 2013-22, IRR of RA 6969
  - RA 9003, Ecological Solid Waste Management Act
  - DAO 1994-28, Interim Guidelines for the Importation of Recyclable Materials containing Hazardous Substances
  - DAO 1997-28, Amending Annex A of DAO 1994-28
  - DAO 2001-34, IRR of RA 9003
- Forestry
  - Presidential Decree (PD) No. 705 (1975), Forestry Reform Code
  - PD 953 (1976), Requiring the planting of trees in certain places and penalizing the unauthorized cutting, destruction, damaging and injury of certain trees, plants, and vegetation
  - EO No. 193 s. 2015, Expanding the Coverage of the National Greening Program (NGP)
- Historical/ Cultural Heritage
  - RA No. 10066 (2009), Providing for the Protection and Conservation of the National Cultural Heritage, Strengthening the National Commission for Culture and Arts (NCCA) and its Affiliated Cultural Agencies and for Other Purposes
  - RA No. 10086 (2010), Strengthening Peoples' Nationalism through Philippine History by changing the nomenclature of the National Historical Institute into the National Historical Commission of the Philippines (NHCP), Strengthening its powers and functions, and for other purposes

- Permits to be Obtained for the Project Operation
  - NHCP Endorsement on Historical Structures (Old PNR structures)
  - Tree Cutting permit
  - Wastewater Discharge Permit
  - LLDA Clearance for Development Projects
  - Permit To Operate for Power Generator Sets (APSI)
  - ECC for Construction Work Areas/Batching Plants
  - Quarry Permit
  - Permit for structures over water bodies

C. EIA PROCESS DOCUMENTATION

EIA Team

6. The EIA Study was conducted by a multidisciplinary team of specialist and consultants of GEOSPHERE Technologies, Inc. who have strong background in environmental assessments, in close coordination with the DOTr. The composition of the EIA Team is presented in **Table ES-2**.

Table ES-2 EIA Team Composition

Environmental Components/Task	Team Member	EMB Registry No.
Team Lead	Ledicia T. dela Cruz	IPCO-287
Peer Review	Noelina B. Miran	-
EIS Report Integration	Fritzie Jane P. Salido	IPCO-114
Geology and Hydrology	Reynar Rollan	IPCO-294
Soils and Land Use	Marmelou Popes	-
Terrestrial Flora	Enrico Replan	-
Terrestrial Fauna	Judeline Dimalibot	IPCO-176
Water Quality	Vanderleaf Capalungan	-
Freshwater Ecology	Ma. Vivian Camacho	IPCO-213
Meteorology, Air Quality and Noise	Reynaldo S. Tejada	IPCO-036
Air Quality, and Noise	Rogey A. Miedes	-
Vibration Survey and Assessment	Emmanuel G. Ramos	IPCO-117
Environmental and Social Safeguard (Socio-Cultural and Gender)	Felixberto Roquia, Jr.	IPCO-028

7. From the DOTr's side, the project management was spearheaded by Engr. Cristina Quinalayo, DOTr Environmental, and Social Considerations Officer. The sworn statements of accountability of the proponent and preparer are presented in **Annex ES-1**.

EIA Schedule

8. The EIA Study was conducted for a period of five (5) months commencing from the conduct of Information, Education and Communication (IEC) and Public Scoping activities. Technical Scoping was conducted with the EMB and EIA Review Committee (EIARC) members on February 9, 2018 and based on the agreed scope of work, the collection of primary data was conducted. Data collected were processed, analyzed and evaluated for impact assessment and formulation of Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP). The data and information were written into an EISR and the final version of the EISR will be submitted to the EMB-Central Office for ECC application. The major activities undertaken to complete the EIA were listed in **Table ES-3**.

Table ES-3 EIA Study Schedule

Activity	Date
IEC Activities	December 11, 2017 to January 10, 2018
Public Scoping	January 22 and 23, 2018
Technical Scoping	February 9, 2018
Primary and Secondary Data Gathering	February 6-March 23, 2018
Geology and Geological Hazards	February 12, 2018
Pedology	January 27 – February 16, 2018
Terrestrial Ecology	February 3-7, 2018
Hydrology/Hydrogeology	February 12, 2018
Groundwater Quality	February 8 and 21, 2018
Freshwater Quality	February 6-8, 2018
Freshwater Ecology	February 6-7, 2018
Air Quality	January 27 – February 7, 2018
Noise and Vibration	January 27 – March 6, 2018
Perception Survey	February 6 – March 30, 2018
Preparation of EISR	January – May 2018
Submission of EISR to EMB	May 11, 2018
First EIARC Meeting	June 7, 2018
Public Hearing	June 26, 27, and 29, 2018

EIA Study Area

9. The EIA Study area for the proposed MCRP covers ten (10) municipalities/cities of Central Luzon, namely, Malolos and Calumpit in the Province of Bulacan; Apalit, Minalin, Sto. Tomas, San Fernando, Angeles, and Mabalacat in the Province of Pampanga; and Bamban and Capas in the Province of Tarlac.

EIA Methodologies

10. The EIA for the proposed MCRP conforms to the Revised Procedural Manual for DAO 2003-30 and DAO 2017-15 in the conduct of the following activities, to wit: (i) IEC and Scoping, (ii) collection of primary and secondary data, (iii) identification/prediction/assessment of environmental impacts, (iv) formulation of EMP and the (v) development of EMoP. The baseline information are mainly primary and secondary data which were obtained from the local government units (LGUs) and other government agencies. Data collected were based from the approved EIA Scoping and Screening Form presented in **Annex ES-2**, which was finalized during the Technical Scoping Meeting conducted at the EMB-DENR Central Office, DENR Compound, Visayas Avenue, Diliman, Quezon City on February 9, 2018. **Table ES-4** shows the pertinent data, sources, and methodologies used for the conduct of EIA Study for the proposed MCRP.

Table ES-4 The EIA Methodology

Environmental Components	Methodology and Approach on Baseline Survey	Methodology and Approach on Impact Assessment
LAND		
Land Use and Classification	• Review of Comprehensive Land Use Plan (CLUP) of Malolos, Calumpit, Apalit, Sto. Tomas, San Fernando, Angeles, Mabalacat, Bamban and Capas.	• Assessment of the compatibility of the proposed MCRP vis-à-vis approved land use plan and zoning classification.
Geology	• Conduct of field surveys • Review of available reports, geologic literature and information from Mines and Geosciences Bureau (MGB), Philippine Institute of Volcanology and Seismology (PHIVOLCS), Philippine Atmospheric, Geophysical and Astronomical Services (PAGASA), and National Mapping and Resource Information Authority (NAMRIA)	• Assessment of construction and operation impacts based on the construction and operation activities of the proposed MCRP, and the susceptibility of the project area to natural hazards.
Pedology	• Review of existing literature and maps of the project area. • Conduct of field surveys and collection of soil samples	• Assessment of impacts based on the construction and operation activities of the proposed MCRP to the existing environment.
Terrestrial Ecology	• Conduct field surveys at the proposed Project site.	• Assessment of impacts based on the construction and operation activities of the proposed MCRP to the existing ecosystem
WATER		
Hydrology and Hydrogeology	• Review of CLUPs of the host LGUs and other secondary data from existing literature and maps of the project area from MGB, NAMRIA, and PHIVOLCS. • Conduct of field surveys	• Assessment of impacts based on the construction and operation activities of the proposed MCRP to the existing environment and the susceptibility of the project area to flooding.
Water Quality	• Collection of groundwater and surface water samples for analysis of physical, chemical, microbiological, micro-nutrient and heavy metal analyses at Mach Union Laboratory, Inc. in Las Piñas City. Levels of DO, salinity, conductivity, TDS and Temperature were measured on-site. • Assessment of groundwater quality and surface water quality using the Philippine National Standards for Drinking Water of 2017 (PNSDW, 2017) and Water Quality Guidelines and General Effluent Standards of 2016 (DAO 2016-08), respectively.	• Assessment of impacts based on the construction and operation activities of the proposed MCRP to the existing environment.
Freshwater Ecology	• Collection of primary and secondary data. • Characterization of trophic composition at 15 sampling stations in the rivers and creeks along the alignment. The phytoplankton samples were collected using 10µ-mesh plankton net and placed in clear plastic bottles preserved with Lugol's solution. The zooplankton samples, on the other hand, were collected using a 40µ-mesh net and placed in plastic bottles preserved with 7-10% formalin. Benthic organisms were collected from the sediments and strained using various mesh size sieves and preserved using alcohol.	• Assessment of impacts based on the construction and operation activities of the proposed MCRP to the existing ecosystem.
AIR		
Meteorology and Climatology	• Collection and review of existing literature and maps of the project area from CIA Station of PAGASA	• Assessment of impacts based on the construction and operation activities. • Calculation of GHG emissions using emission factor-based estimation method prescribed in The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, Revised Edition, World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI), 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories and 2014 IPCC Assessment Report. • Projection of monthly average temperatue and rainfall and frequency of extreme events under

Environmental Components	Methodology and Approach on Baseline Survey	Methodology and Approach on Impact Assessment
		medium range emission scenario using the data from PAGASA Climate Change in the Philippines, 2011
Air Quality and Noise Level	• Conduct of ambient air quality monitoring at the nine (9) established sampling stations to measure the Carbon Monoxide (CO), Ozone (O_3), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Total Suspended Particulates (TSP), Particulate Matter of less than 10 μm (PM_{10}), Particulate Matter of less than 2.5 μm ($PM_{2.5}$) and Lead (Pb) concentration in the project area and its vicinity. • Conduct of Noise level measurement during morning, daytime, evening, and nighttime using Extech Noise Data Logger at the fifteen (15) established sampling stations.	• Assessment of construction impacts on noise using the prediction model developed in the Technical Handbook for Environmental Impact Assessment of Roads (2007). • Assessment of operation impacts on noise using the prediction model by Japanese Formula discussed in the “Proposal of a Prediction Model for Noise of Conventional Railway, Noise Control Engineering 20(3), 1996, Institute of Noise Control Engineering, Japan” and “EIA report for Osaka Outer Ring for East-Osaka Urban Rapid Transit, 1999, Osaka Prefecture”.
Vibration	• Conduct of vibration measurement during morning, daytime, evening, and night time using Vibron Seismometer which is a seismic data recorder connected to geophones at the fifteen (15) established sampling stations	• Assessment of construction impacts on vibration using the prediction model developed in the Technical Handbook for Environmental Impact Assessment of Roads (2007). • Assessment of operation impacts on vibration using the actual vibration measurements of similar project with the same train structure and operation (i.e. East-Osaka Urban Rapid Transit)
PEOPLE		
Socioeconomic and Public Health	• Conduct of IEC for the Municipal/City and Provincial LGUs • Conduct of Public Scoping • Conduct of Socio-economic, Health and Perception Survey at the host Barangays • Review of the CLUP and Socio-economic Profile of the host LGUs • Review of available secondary data, relevant studies, and other information from Philippine Statistics Authority (PSA). • Gathering and review of relevant primary data critical to the study; • Literature review on the potential impacts and risks of railway project on health of people living in surrounding communities, to confirm established relationships between hazards of railway operations and health risks and effect to people. • Review of CLUP of the host LGUs in the preparation of the Indicative SDP, and IEC Framework.	• Asssement of impacts based on the results of IEC, Public Scoping, FGD, survey of PAFs and construction and operation activities of the proposed MCRP.

Public Participation Activities

11. An extensive and comprehensive IEC campaign about the Project and the EIS System was conducted to ensure a meaningful and active participation of well-informed stakeholders – affected residents, host communities, LGUs, relevant agencies, the EMB and the local DENR in the EIA process.

IEC and Initial Perception Survey

12. The IEC Sessions presented in **Table ES-5** were conducted to provide updated information about the proposed MCRP and encourage the concerned stakeholders to participate in the EIA Study.

Table ES-5 IEC Conducted for the EIA Study of the Proposed Project

Date and Time	Session	Venue	Number of Participants		
			Male	Female	Total
December 11, 2017, 10:00AM	Malolos and Calumpit, Bulacan LGUs	Malolos Sports Convention Center	16	7	23
December 11, 2017, 3:30PM	Provincial LGUs of Bulacan	Governor's Office, Provincial Capitol, Malolos, Bulacan	7	5	12
December 13, 2017, 2:00PM	Apalit, Pampanga LGUs	Mayor's Office, Municipal Hall, Apalit, Pampanga	13	5	18
December 14, 2017, 5:00PM	Sto. Tomas and San Fernando, Pampanga LGUs	Heroes Hall, San Fernando, Pampanga	6	7	13
December 14, 2017, 1:00PM	Clark Development Corporation (CDC)	DOTr – Central Office, S. Osmeña St., Clark Freeport Zone, Angeles, Pampanga	13	2	15
December 20, 2017, 1:00PM	Angeles, Pampanga LGUs	City Hall, Angeles, Pampanga	12	9	21
December 22, 2017, 10:00AM	Provincial LGUs of Pampanga	Bren Z. Guiao Convention Center, San Fernando, Pampanga	6	4	10
January 4, 2018, 10:00AM	Mabalacat LGUs	City Hall, Mabalacat, Pampanga	13	1	14
January 4, 2018, 2:00PM	Capas, Tarlac LGUs	Municipal Hall, Capas, Tarlac	7	6	13
January 5, 2018, 10:00AM	Bamban, Tarlac LGUs	Municipal Hall, Bamban, Tarlac	13	9	22
January 10, 2018	Minalin, Pampanga LGUs	Municipal Hall, Minalin, Pampanga	7	6	13
January 10, 2018	Provincial LGUs of Tarlac	Provincial Capitol, Tarlac City, Tarlac	5	7	12

13. The initial Perception Survey was conducted after the IEC in Angeles, Mabalacat and Capas. Survey questionnaires were distributed to the participants after the IEC sessions. The survey covers the demographic characteristics, source of income, livelihood, health and sanitation, education, employment, their knowledge and attitude towards the proposed MCRP.

Focus Group Discussion

14. The Focus Group Discussion (FGD) Sessions presented in **Table ES-6** were conducted to provide information as well as to gather the concerns/issues of the concerned sectors about the proposed MCRP, particularly on the resettlement of the affected PAFs and relocation of the affected establishments and structures.

Table ES-6 FGD Sessions

City/ Municipality	Province	Date	Time	Venue	Sector	No. of Participants		
						Female	Male	Total
Angeles	Pampanga	16 April 2018	2:00 PM	Angeles Elem. School, Brgy. Pulungbulu	Vulnerable / Household	12	17	29
					Business	3	4	7
San Fernando	Pampanga	17 April 2018	9:00 AM	City College of San Fernando, San Juan	Vulnerable / Household	9	7	16
					Business	1	2	3
Calumpit	Bulacan	19 April 2018	9:00 AM	F. Mendoza Memorial Elem. School	Vulnerable / Household and Business	13	13	26
Malolos	Bulacan	19 April 2018	2:00 PM	City of Malolos Integrated School	Vulnerable / Household	5	2	7
					Business	1	0	1
Santo Tomas	Pampanga	20 April 2018	9:00 AM	Santo Tomas Municipal Hall	Vulnerable / Household	22	9	31
					Business	0	1	1
Minalin	Pampanga	20 April 2018	2:00 PM	*To be verified*	Business (Fishpens)	0	2	2

Source: JICA Design Team

Public Scoping

15. Public Scoping was conducted in two (2) cluster areas on January 22 and 23, 2018 which details are presented in **Table ES-7**. The Public Scoping was facilitated by the representatives from the EIA Division of the EMB-Central Office to provide information about the proposed MCRP and to collect site-specific issues, concerns and inputs to the EIA Study.

Table ES-7 Schedule, Venue and Participants of the Public Scoping

Date and Time	Venue	Participants	No. of Participants		
			Female	Male	Total
January 22, 2018; 1:00 PM	The Pavilion Hiyas ng Bulacan Convention Center, Malolos, Bulacan	• EMB EIA - Central Office • EMB – Region 3 Representatives • DENR Provincial Environmental and Natural Resources (PENRO) Bulacan • MGB Region 3 Representatives • Malolos LGUs (City Councilors, Representative from the Office of the Mayor, Vice Mayor of Malolos, Department Heads, concerned Barangay Chairmen, Kagawad, and Representatives of the Councilors) • Malolos Residents • Calumpit LGUs (Representatives from the Office of the Mayor and Vice Mayor, Department Heads, concerned Barangay Chairmen, Kagawad) • Calumpit Residents • DOTr • JICA Design Team (JDT) • Geosphere EIA Team	43	42	85
January 23, 2018; 1:00 PM	Xevera Basketball Court, Xevera Subdivision, Brgy. Tabun, Mabalacat, Pampanga	• EMB EIA - Central Office • MGB Region 3 Representative • DENR – PENRO Pampanga • DENR – PENRO Tarlac • Apalit LGUs (Mayor, Vice Mayor, Councilors, Department Heads and concerned Barangay Chairmen and Kagawad) • Apalit Residents • Sto. Tomas LGUs (Mayor, Vice Mayor, Councilors, Department Heads, concerned Barangay Chairmen and Kagawad) • Sto. Tomas Residents • San Fernando LGUs (concerned Barangay Chairmen) • Angeles LGUs (Representative from the Office of the Mayor and Vice Mayor, Councilors and their Representatives, Department Heads, concerned Barangay Chairmen and Kagawad) • Mabalacat LGUs (Department Heads, concerned Barangay Chairmen and Kagawad) • Mabalacat Residents • Capas LGUs (Representative from the Office of the Mayor and Vice Mayor, Department Heads) • Capas Residents • Bamban LGUs (concerned Barangay Chairmen and Kagawad) • Bamban Residents • DOTr • JDT • GEOSPHERE EIA Team	37	72	109

Perception Survey

16. The perception survey was conducted to the host and affected LGUs of the proposed MCRP. The respondents of the survey were represented the barangay council, multi-sectoral representatives (women representatives, men group representative, senior citizen, church group representative) and other authority figures of the community. **Table ES-8** presents the schedule of the perception survey and the number of respondents. The sample of the perception survey questionnaire is presented in **Annex ES-3**.

Table ES-8 Schedule and Number of Respondents of Perception Survey

Date	Respondents				
	Municipality/City	Barangay	Male	Female	Total
February 6 – March 30, 2018	Malolos	Guinhawa, Longos, San Gabriel, Catmon and Bulihan	26	43	69
	Calumpit	Pio Cruzcosa, San Marcos, Palimbang, Iba Este, Caniogan, Iba O Este, Corazon, Sucol, Balungao and Gatbuca	41	90	131
	Apalit	Capalangan, Sulipan and San Vicente	21	8	29
	Minalin	Lourdes San Isidro, Santa Catalina, San Nicolas, San Isidro, San Pedro	38	31	69
	Sto. Tomas	Moras De La Paz, San Nicolas, San Vicente, Sapa (Santo Niño), San Matias, and Poblacion	38	31	69
	San Fernando	Lourdes, Santo Niño, Dolores, Maimpis, Quebiawan, San Isidro, Malpitic, Sindalan and Baliti	79	59	138
	Angeles	Tabun, Pulungbulu, Claro M. Recto, Sta. Teresita, and Malabañas	28	30	58
	Mabalacat	Lakandula, San Joaquin, Poblacion, Dolores, and Tabun	35	22	57
	Bamban	San Vicente, Santo Niño, San Nicolas, San Roque, Anupul, and Lourdes	55	22	77
	Capas	Aranguren, Cutcut II, Cristo Rey, Maruglu, Sto. Rosario and Cubcub	45	36	81
		Total	406	372	778

D. EIA SUMMARY

Summary of Alternatives

Siting

17. For the segment between Malolos to Clark, two (2) route options were considered: (1) PNR Right-of-Way (ROW); and (2) NLEX ROW. The PNR ROW has a total length of 50.5 km from Malolos to Clark and the alignment is basically located in agricultural areas and developed areas. The NLEX ROW with a total length of 52.2 km starts at 5.8 km before San Simon Interchange after coming out from the PNR alignment in the town center of Calumpit, Bulacan. The PNR ROW was chosen as it is recommended with major positive points such as lower costs with less construction delay factors (such as affected houses, land acquisition, and affected trees) as compared to the NLEX ROW.

18. For the segment between CIA to NCC, two (2) alternatives are being considered: Option A has the longer distance using the existing arterial road of Bases Conservation and Development Authority (BCDA) and requires lesser tunnel; and Option B is maximizing BCDA property and has a shorter disctance but requires more tunnels.

19. For the depot, two (2) sites were considered: Option 1 is located along Sacobia River near CIA with an area estimated more than 40 hectares; and Option 2 is located Northwest of Xevera Subdivision with an approximate area of 42 hectares.

Technology and Design

20. For the track structure, Elevated Structure Option was considered for Malolos-NCC section (excluding Clark-CIA section) over the Reinforce Soil Wall Structure Option after evaluation of impacts such as flooding and intersection with existing roads. Underground Option was chosen for the Clark-CIA section.

21. For the rolling stock option, The DOTr will utilize an EMU Train, which run quieter than diesel and locomotive-drawn multiple units.

Summary of Baseline Environmental Condition

22. The summary of the baseline environmental condition of the proposed MCRP area is presented in **Table ES-9**.

Table ES-9 Summary of Key Environmental Impacts and Management Plan

Environmental Component	Description
LAND	
Land Use and Classification	
Existing Land Use	• Majority of the land in Malolos are used for agriculture and fisheries. The lands adjacent to the PNR ROW are used for residential and commercial, with some institutional facilities due to its close proximity to the McArthur Highway. • Predominantly, the land in Calumpit is used for agricultural use. Majority of the land adjacent to the PNR ROW is used for industrial, commercial and residential. • All lands in Apalit are classified as alienable and disposable (A&D) land due to the flat terrain. These consist mostly of broad plains that are slight to moderately susceptible to flooding, swamps, and marshes, and alluvium, which is suitable for fishpond use. Majority of the land adjacent to the PNR ROW are used for agricultural, aquaculture and residential purposes. • The land in Minalin is predominantly for fisheries. Majority of the land adjacent to the PNR ROW is used for aquaculture/fishpond and agriculture. • The land in Sto. Tomas is predominantly comprised of agricultural land. Majority of the land adjacent to the PNR ROW are used for agricultural, aquaculture and residential. • In San Fernando, the dominant land use is represented by residential and agricultural types. Majority of the land adjacent to the PNR ROW are used for residential, agricultural, and industrial uses, with some institutional facilities. • The predominant land use in Angeles is residential. Majority of the land adjacent to the PNR ROW are used for residential with some institutional facilities. • The land uses of Mabalacat are classified as built-up, agricultural, commercial, industrial, infrastructure, institutional, residential, river, and road. Majority of the land adjacent to the proposed MCRP are used for residential, agriculture, special economic zone, and ancestral domain areas. • Bamban is comprised of extensive military reservation, agricultural land and SACOBIA Resettlement Area. Majority of the land adjacent to the proposed MCRP are used for agriculture and a military reservation. • In Capas, the predominant types of land use are for military reservation. Majority of the land adjacent to the proposed MCRP are agricultural areas and open spaces.
Environmental Critical Area	• The proposed MRCP falls within an area with High Risk to typhoon passage. In terms of flooding, the segments from San Fernando Station to Malolos Station have high susceptibility. • The proposed alignment of the MCRP will traverse Manila Bay which is designated as IBA and KBA in Malolos, Minalin and Sto. Tomas. • The areas set aside as aesthetic or potential tourist spots that will be encroached by the proposed MCRP are the old PNR Stations, Gov. Macario Arnedo Park and Death March Marker in San Fernando, Pampanga and the Grotto of Our Lady of Lourdes in Bamban, Tarlac. • There are three (3) historical and cultural heritage declared by NHCP located in close proximity to the proposed MCRP, namely, Bayan ng Kalumpit (100m), Artillery Memorial (600m) and Church of Apalit (2,600m). • Old PNR and other structures were also identified within the proposed project alignment. • The segment of the proposed MCRP passes through agricultural areas in Bamban and Capas, Tarlac. • There are fishponds or aquaculture areas located in Apalit, Minalin and Sto. Tomas, which are adjacent to the PNR ROW. Biodiversity Management Bureau (BMB) confirmed that the fishpond are man-made and that the significance to the ecology is low. • The proposed MCRP will be intersected by rivers and streams at 43 locations. These include San Fernando River, Pampanga River, Angat River, and their respective tributaries.
Land Tenure	• The proposed MCRP alignment will not traverse any Ancestral Domain area according to the letter from NCIP-Tarlac Provincial Office dated April 24, 2018. However, further investigation will be needed on the location of the proposed Mabacat Depot due to its close proximity to CADT 025-A. • The alignment goes through some areas within BCDA jurisdiction in Pampanga and Tarlac. The BCDA currently runs several infrastructure projects in the north, such as the NCC in Tarlac and CIA airport expansion. • The railway station in CIA is inside the airport premises and operated by the Clark International Airport Corporation (CIAC). • PNR ROW has been proliferated by around 1,200 Informal Settler Families (ISFs).

Environmental Component	Description
	• The MCRP will affect an estimated total of 200 legal landowners for the section that alignment will run outside of PNR ROW and BCDA property.
Visual Aesthetics	• Mount Pinatubo is located approximately 25 kilometers west of the proposed MCRP. • The fishponds in Apalit, Minalin and Sto. Tomas may provide a recreation and tour destinations to bird watchers during migratory season.
Existing Solid Waste Management and Related Land Management Scheme of the Host LGUs	• The host LGUs have dump trucks for garbage collection and MRF for sorting. • All residual wastes generated are being disposed in Metro Clark Sanitary Landfill located at Sitio Kalangitan, Barangay Cutcut II, Capas, Tarlac
Geology/Geomorphology	
Surface Landform/ Geomorphology/ Topography/ Terrain/Slope	• The proposed MCRP traverses the foot slopes of the Bataan Volcanic Chain and the Central Plain of Luzon (CPL). The CPL corresponds to a long natural depression, which extends from Lingayen in the north to Manila Bay in the south. It is bounded on the west and east by the Bataan Volcanic Chain and Sierra Madre Range, respectively
Subsurface Geology/ Underground Condition	• The geologic formations within a 10 km corridor which could potentially affect the proposed MCRP (1) the Recent Deposits (Qh) and (2) the Quaternary Volcanic Pyroclastics (QVP). • The segments from Angeles Station to Mabalacat Depot are dominated by lahar components. • Farther south and east towards the Malolos Station, Qh is predominantly of alluvial origin. This represents deposits of San Fernando River, Pampanga River and Angat River and their tributaries. • The segment from San Fernando to Apalit is dominated by the clayey fraction of the Qh as indicated by the swampy condition of this area. • Where the proposed MCRP alignment passes through built up areas, the Qh is locally covered by pavements, embankments or partially consolidated fill. • QVP and its weathered derivatives underlie the segment after the Mabalacat River crossing up to the NCC Station. • The major earthquake generators relevant to the proposed MCRP include the Philippine Trench, the Philippine Fault, West Marikina Valley Fault, and the Manila Trench. • The gently sloping to hilly sections of the segment from Mabalacat Depot to NCC Station has low to moderate susceptibility to landslides • The rocks underlying the segments from Mabalacat to Capas are underlain by consolidated volcanic deposits deemed to fall under medium soil category. The segments from Mabalacat Depot to Malolos Station are underlain by unconsolidated sediments which are deemed to fall under the soft soil category. Accordingly, the peak ground accelerations correspond to 0.4 g and 0.7 g, respectively • The nearest active fault to the proposed MCPR route is the West Valley Fault, which is about 34 km southeast of the Malolos Station. Based on the earthquake hazard assessment conducted by PHIVOLCS, the proposed MCRP route is safe in terms of ground rupture hazard. • The nearest active volcano from the proposed MCRP is Mt. Pinatubo. Based on the volcanic hazard assessment issued by PHIVOLCS, the proposed MCRP falls under Zone 4 which has been considered safe from lahars.
Pedology	
Soil Type	• The proposed MCRP will traverse at eight (8) types of soil namely: (1) Bigaa Clay Loam, (2) Quingua Silt Loam, (3) San Fernando Clay, (4) Lapaz Fine Sand, (5) Angeles Fine Sand, (6) Angeles Coarse Sand, (7) Angeles Sandly Loam and (8) Tarlac Loam.
Soil Erodibility	• The erodibility of the soils along the alignment is generally little to no erosion due to topography, land cover and water content of the soil.
Soil Quality	• The levels of pH, Organic Matter, Phosphorus, Potassium, Magnesium and macronutrients (available Iron, Copper, Manganese and Zinc) in all sampling stations are adequate except for the pH in Stations S-1 and S-2 and Organic Matter in Stations S-1, S-3, S-4 and S-9. The lowest level of nitrogen was recorded in Stations S-3 and S-7 at 240 mg/k while the highest level of nitrogen was recorded in Stations S-9 at 2,000 mg/kg. The lowest level of calcium was recorded in Station S-8 at 1.38 cmol/kg while the highest level was recorded in Station S-2 at 310.76 cmol/kg. • The levels of Lead in Stations S-2 and S-3 exceed the Target Value of the Dutch Standard but way below the Intervention Value. On the other hand, the levels of Lead in Stations S-1 and S-4 to S-9 are way below the Target Value of the Dutch Standard. The levels of Mercury in Stations S-1 and S-5 to S9 are below the detectable limits of the analysis. The levels of Mercury in Stations S-2 to S-4 are way below the Target Value of the Dutch Standard. The level of Cadmium in Station S-4 is within the Target Value of the Dutch Standard. Levels of Cadmium in Stations S-1 and S-6 are below the Target Value. In Stations S-2, S-3, S-5, S-7, S-8 and S-9, the levels of Cadmium exceed the exceeds the Target Value but way below the Intervention Value of the Dutch Standard except for Station S-3, which is closer to the Intervention Value. The levels of Arsenic in Stations S-2 to S-9 are way below the Target Value of the Dutch Standard. The

Environmental Component	Description
	level of Arsenic in Station S-1 exceeds the Target Value but way below the Intervention Value of the Dutch Standard. The levels of Chromium Hexavalent in Stations S-3, S-5, S-6, and S-9 are within the Target Value of the Dutch Standard. • Soil samples collected in Station SC-1 is classified as Quingua Silt Loam. The pH of the soil sample is 3.7. Arsenic, Barium, Copper, Cadmium, Lead, and Selenium were detected but the levels are way below the Dutch Target and Intervention Values and the USEPA Guidelines for Industrial Soil. Manganese and Oil and Grease were also detected at 2.58mg/kg and 8.57mg/kg respectively. • Soil sample collected in Station CS-2 is classified as Tarlac Clay Loam. The pH of the soil sample is 8.5. Arsenic, Barium, Copper, Iron, Cadmium, Chromium, Mercury, Selenium, and Nickel were not detected in the soil samples. Zinc, Lead, and Cyanide were detected but the levels are way below the Intervention Value of Dutch Standard and USEPA Guidelines for Industrial Soil. Manganese and Oil and Grease were also detected at 0.207mg/kg and 2.3mg/kg, respectively.
Terrestrial Ecology	
Terrestrial Flora	• Almost two thirds of the areas along the railway alignment are occupied by agricultural landscapes and settled areas. • The associated vegetation or landscapes along the proposed MCRP are grasslands, open shrub and wooded lands , and Man-made Wetlands (Including fishponds). • One hundred eight (108) morpho-species, 107 genera belonging to 45 families were documented in five (5) transect plots established within the MCRP. Dominant families in the said transect plots were Fabacae, Moraceae, Anacardiaceae, Lamiaceae, Euphorbiaceae, Annonaceae, Malvaceae, Poaceae, Convulvolaceae and Asteraceae. The most frequently occurring tree species were Artocarpus altilis (Park.) Fosb, Ficus ulmifolia Lamk, Muntigia calabura L., Premna odorata Blanco, Leucaena leucocephala (Lam.) de Wit, Gmelina arborea Roxb., and Macaranga tanarius (L.) Muell.-Arg. • The diversity index of the area ranged from low to moderately low, while evenness indices varied from very low to low. • About 42 species (5.5%) were found to be Philippine endemics or have natural habitat confined only in the country. • Eighty four percent (84%) of the total number of species recorded in the area are indigenous to the Philippines and exhibit different economic and ecological importance. • Five (5) species recorded from MCRP Railway alignment, namely, Antipolo, Piling liitan, Is-is, Narra and Molave are listed under either the Philippine Red List (DAO 2007-01) or the IUCN Red List of Threatened Species
Terrestrial Fauna	• A total of 89 fauna species were observed at recorded during the survey for the proposed MCRP. It is composed of 71 species of birds, 3 species of mammals (2 volant and 1 non-volant) and 15 species of amphibians and reptiles (5 species of frog, 5 species of lizards and 5 species of snakes). • All (100%) of the bird species are of Least Concern. • All captured and recorded species are native species and introduced species of mammals that are highly adapted to disturbed areas especially areas near human settlements. • No endemic species of amphibians and reptiles were recorded.
WATER	
Hydrology	• The MCRP alignment was intersected by rivers and streams at 43 locations. • The MCRP segments from Malolos to CIA and up to the Mabalacat Depot will traverse a flat area which corresponds to the lower section or floodplains of major river systems of Central Luzon. The segments from Mabalacat Depot to San Fernando will intersect the main channels and tributaries of the rivers originating from the western upper slopes of Mt. Pinatubo. • The hilly to mountainous segment from Mabalacat Depot to NCC Station is drained by east flowing rivers and streams. The main drainage system corresponds to the Bamban River which intersected north of the Mabalacat Depot. • The segments from San Fernando to Malolos are drained by the lower reaches of the west flowing San Fernando River, Pampanga River, Angat River and their respective tributaries. • The segments within Tarlac are not susceptible to flooding due to their elevated and sloping conditions.
Hydrogeology	• The MCRP alignment will traverse an area classified as "Local and Less Productive Aquifers. • The segment from Malolos Station to Mabalacat Depot is underlain by unconsolidated sediments which hosts an unconfined aquifer from a minimum depth of 1 m. • Within the undulating to rolling segments from Mabalacat Depot to NCC Station, groundwater occurs under unconfined conditions within the interstices of consolidated pyroclastics and tuffaceuous sedimentary rocks.
Groundwater Quality	• The color ranged <5-10 TCU or within the DENR Guidelines for Class A Water of not more than 50 TCU and 10 TCU of PNSDW 2017. • The temperature ranged 27.6 to 30.8 ºC, with two (2) cases of non-conformance with the 26-30 ºC of DENR Guidelines for Class A Water at stations GW-2 (Calumpit) and GW-3 (Apalit). • The pH ranged 6.35 to 7.93, with three (3) cases of non-conformance with the 6.5-8.5 range of both PNSDW and DENR Class A guideline at Stations GW-5 (Angeles), GW-6 (Mabalacat), and GW-8

Environmental Component	Description
	(Bamban Spring). • The conductivity of the groundwater samples ranged 307-1,571 µS/cm. All the samples indicated fresh groundwater. • The Total Dissolved Solids (TDS) of the groundwater samples ranged151-770 mg/L, with three (3) cases of non-conformance at Stations GW-1 (Calumpit Dug Well), GW-2 (Calumpit), and GW-3 (Apalit). • The Calcium in groundwater samples ranged 10-130mg/L. • The magnesium in groundwater samples ranged 5.6-43mg/L. • The potassium in groundwater samples ranged 0.29-23mg/L • The bicarbonate (HCO3) in groundwater samples ranged 86.3-405mg/L • The Sodium of the groundwater samples ranged from 3.4-160 mg/L are in conformance with the 200 mg/L maximum allowable limit of PNSDW. • The Chloride in groundwater samples ranged 3.6-321 mg/L with two (2) cases of non-conformance at Stations GW-1 (Calumpit Dug Well) and GW-3 (Apalit). • The Sulfate in groundwater samples ranged 8-87 mg/L or within the 250 mg/L maximum allowable limit of PNSDW and DENR Guidelines for Class A Water. • The Nitrate (as N) in groundwater samples ranged 0.13-6 mg/L or within maximum allowable limit of 50 mg/L of PNSDW and WHO Guideline. • The Cadmium, Lead and Mercury are not detectable in all sampling stations. The concentrations of Arsenic in all sampling stations are within the 0.01 mg/L maximum limit of PNSDW and WHO Guidelines and 0.1 mg/L maximum limit of DENR Guidelines for Class A Water. The concentrations of Chromium Hexavalent in all sampling stations are within the 0.05 mg/L maximum limit of PNSDW and WHO Guidelines and 0.01 mg/L maximum limit of DENR Guidelines for Class A Water. • The concentrations of free cyanide in all sampling stations were within the 0.05 mg/L maximum limit of PNSDW and 0.07 mg/L maximum limit of DENR Guidelines for Class A Water. • Fecal coliforms and total coliforms ranged from <1 to > 8 MPN/100 ml. Four (4) cases of detection, which do not pass the PNSDW and WHO Guidelines were noted in Station GW-1, GW-2, GW-7, and GW-8.
Surface Water Quality	• The color in all stations categorized under Class C waters were within the 75 TCU maximum allowable limit of DENR guidelines. For SW-14 (Bamban River), the color was also within the 50 TCU maximum allowable limit of DENR guidelines for Class A waters. • All stations categorized under Class C waters were within the 80 mg/L and 50 mg/L maximum allowable limits of DENR guidelines and Japan standards, respectively, except for stations SW-5 (Malalam River), SW-13 (Sacobia River), and SW-15 (Cutcut River Tributary). For SW-14 (Bamban River), the TSS was within the maximum allowable limits of 50 mg/L and ≤ 25 mg/L for DENR guidelines and Japan standards, respectively, for Class A waters. • All stations categorized under Class C waters were within the acceptable range of 25°C to 31°C of the DENR guidelines, except for SW-13 (Sapang Balen Creek), which slightly exceeded the range at 31°C. For SW-14 (Bamban River), the temperature was within the acceptable range of 26°C to 30°C of DENR guidelines for Class A waters. Japan has no water quality standard for temperature. • All stations categorized under Class C waters were within the acceptable pH range of 6.5 to 9.0 of the DENR guidelines and pH range of 6.5 to 8.5 of the Japan standards, except for SW-11 (Quitanguil River) and SW-13 (Sapang Balen). For SW-14 (Bamban River), the pH was within the acceptable range of pH 6.5 to 8.5 of both DENR guidelines and Japan standards for Class A waters. • Half of the stations have DO concentrations below the minimum acceptable value of 5 mg/L of both DENR guidelines and Japan standards for Class C Waters. For SW-14 (Bamban River), the DO was higher than the minimum acceptable range of 5 mg/L and 7.5 mg/L for DENR guidelines and Japan standards, respectively, for Class A Waters. • All stations categorized as Class C waters have BOD higher than the maximum acceptable value of 7 mg/L and 5 mg/L for DENR guidance and Japan standards, respectively. For SW-14 (Bamban River), the BOD was higher than the minimum acceptable ranges of 3 mg/L and 2 mg/L for DENR guidelines and Japan standards, respectively, for Class A waters. • For stations categorized under Class C waters, the highest total coliform was 17 million MPN/100mL measured at SW-10 (Paranum Creek Tributary), while the lowest total coliform was <1.8 MPN/100ml recorded at SW-11 (Quitanguil River). There is no DENR guideline for total coliform. For SW-14 (Bamban River), the total coliform was higher than the maximum acceptable level of 1,000 MPN/100mL based on Japan standard for Class A waters. • Conductivity measurements ranged from 220 to 4,190 µS • All stations categorized under Class C waters have chloride concentrations lower than the maximum acceptable limit of 350 mg/L of the DENR guidelines, except for SW-3 (Bagbag River), SW-2 (Labangan River) and SW-15 (Cutcut River Tributary). For SW-14 (Bamban River), the chloride concentration was lower than the maximum acceptable value of 250 mg/L for DENR guidelines for Class A waters. • All stations have nitrate concentrations below the maximum acceptable values for both the DENR guidelines (7 mg/L) and Japan Standard (10 mg/L) for Classes A and C waters. • All stations have phosphate concentrations above the maximum acceptable limit of 0.163 mg/L of DENR

Environmental Component	Description
	guidelines for Classes A and C waters, except for SW-2 (Labangan River), SW-3 (Bagbag River), SW-4 (Pampanga River). • The organophosphate concentration of all the samples was <0.00001 mg/L and was below the 0.003 mg/L and 0.001 mg/L DENR Standards for Class C and Class A waters, respectively. • Eight (8) stations have copper concentrations above the maximum acceptable limit of 0.02 mg/L of the DENR guidelines for both Classes A and C waters. • All stations categorized as Class C waters have arsenic concentrations below DENR guidelines and Japan standards of 0.02 mg/L and 0.01 mg/L, respectively. Arsenic concentration at SW-14 (Bamban River) measured at 0.0034 mg/L was below the maximum acceptable limit of 0.01 mg/L of both DENR guidelines and Japan standards. • All stations categorized as Class C waters have cadmium concentrations below the DENR guidelines and Japan standards of 0.005 mg/L and 0.01 mg/L, respectively. For SW-14, the cadmium concentration of 0.0084 mg/L was higher than the DENR guideline value for Class A waters, set at 0.003 mg/L, but lower than the Japanese standard of 0.01 mg/L. • The chromium hexavalent concentrations ranged from <0.002 to 0.004 mg/L. • All stations categorized as Class C waters have lead concentrations below the DENR guideline of 0.05 mg/L except for SW-1 (Bulihan River). Compared to Japan standards of 0.01 mg/L, however, eight (8) stations were above the standard. For SW-14, the cadmium concentration of <0.006 mg/L was lower than the DENR guideline and Japan standard value for Class A waters, both set at 0.01 mg/L. • Mercury concentration for all samples was below the 0.002 mg/L DENR Standard and ≤0.0005 mg/L Japan Standard for Class C waters, and also below the 0.001 mg/L DENR Standard and ≤0.0005 mg/L Japan Standard for Class A waters. • All stations categorized under Class C waters have oil and grease concentrations lower than the maximum acceptable limit of 2 mg/L of the DENR guidelines, except for SW-5 (Malalam River), SW-6 (Masaluso River) and SW-9 (Abacan River). For SW-14 (Bamban River), the oil and grease concentration was higher than the maximum acceptable value of 1 mg/L for DENR guidelines for Class A waters. • Free cyanide concentrations ranged from 0.00962.-0.0714 mg/L. • All stations categorized under Class C waters have phenol concentrations within the maximum acceptable limit of 0.05 mg/L of the DENR guidelines. For SW-14 (Bamban River), the phenol concentration was higher than the maximum acceptable value of <0.001 mg/L of DENR guidelines for Class A waters. • All stations categorized under Class C waters have surfactant concentrations within the maximum acceptable limit of 1.5 mg/L of the DENR guidelines. For SW-14 (Bamban River), the surfactand concentration was slightly higher than the maximum acceptable value of 0.20 mg/L of DENR guidelines for Class A waters.
Freshwater Ecology	• At least 17 taxa representing three algal divisions comprised the phytoplankton community at 15 stations combined, at the vicinity of the proposed MCRP. Chlorophyta (green algae) was the most abundant phytoplankton division representing 592% of the total count, followed by Bacillariophyta (diatoms) comprising 35.7% of the total phytoplankton. Cyanophyta (blue-green algae) had low mean density, representing 5.1% of the total phytoplankton. Of the 17 identified phytoplankton taxa, eight belong to Chlorophyta, six taxa to Bacillariophyta, while three taxa to Cyanophyta. • Mean phytoplankton densities were variable among surveyed stations, with values ranging from 4 cells/l to 248 cells/l. • The zooplankton community at 15 surveyed stations combined at the vicinity of the proposed MCRP, comprised a total of 28 taxa representing three animal phyla. The community was largely dominated by Rotifera, comprising 90.3% of the total count, while low proportions were recorded for Arthropoda (9.5%) and Protozoa (0.1%). Rotifera had the highest taxa richness comprising 22 taxa, while only five taxa were recorded for Arthropoda, and a single taxon for Protozoa. • Zooplankton mean abundances were high at SW-5 and SW-6, with values of 2,712 inds./l and 1,151 inds./l, respectively. • The freshwater macrobenthos community at 15 stations combined at the vicinity of the proposed MCRP comprised at least 14 taxa representing three animal phyla. Arthropoda, particularly Insecta, largely dominated the macrobenthos community representing 68.1% of the total count, followed by Mollusca with an overall relative abundance of 31.6%. • Stations SW-2, SW-4, SW-5, SW-6 and SW-8 were reported as fishing area (minor fishing activity) by the locals. The fish caught are used for domestic consumption only. • Tilapia, Bangus, Dalag Shrimps, Crabs and Turtles have been reported as frequent catch at the site.
AIR	
Climatology and Meteorology	• Bulacan, Pampanga, and Tarlac where the proposed MCRP is to be located fall under a Type I climate classification as indicated in the Climate Map of the Philippines. • The meteorological data recorded at Clark Airport Station from January 1 to December 31, 2016 show that the prevailing wind at the project sites is from Northwest, East, and North, which comprise 10%, 9% and 8%, respectively. • The mean annual relative humidity recorded at the PAGASA Stations in Clark Airport is 75%. The months of July to September are the most humid.

Environmental Component	Description
	• The monthly average rainfall at the project site ranges from 17.4 mm to 429.4 mm, with an annual average of 2026.8 mm. Least number of rainy days per month occurs in November to April; while the highest number or rainy days per month occur in May to October, which cause flooding in low-lying areas. • The annual mean average temperature recorded at CIA Station is 26.9 °C with January being the coldest month having an average temperature of 25.3°C, while the month of April is the warmest with an average temperature 28.6 °C. • The recorded annual extreme high temperature is 37.0°C occurred in April 23, 2010 and May 10, 2002 while the lowest temperature is 15.8 °C occurred in January 15, 2009. The amount of annual average extreme greatest rainfall is 274.5 mm occurred in July 22, 2012 while the annual average extreme highest wind is 47 meters per second westerly direction occurred in June 13, 2010. • The most number of cyclones occur during the months of June to December.
Air Quality	• The TSP, PM10, PM2.5, SO2, NO2, CO, and Pb in all sampling stations are way below the DENR Standards. Concentrations of PM10 in Stations AAQ4, AAQ5 and AAQ7 exceeded the WHO AAQ Guideline Value of 50 µg/NCM. Likewise, concentration of PM2.5 in Station AAQ4 exceeded the WHO AAQ Guideline Value of 25 µg/NCM, while concentrations of SO2 in Stations AAQ2 and AAQ3 exceeded the WHO AAQ Guideline Value of 20 µg/NCM.
Noise Level	• The ambient noise levels observed in all stations were above the NPCC standard values and the WHO guideline values for their respective classifications. The most frequently observed sources of noise were vehicles passing near the monitoring station, followed by voices of people talking nearby. Most of the ambient noise monitoring stations were located at urban areas, with the exception of N15 - NCC Entrance, which is located at a residential area with few houses near ricefields.
Vibration	• Observations of vibration at the areas along the proposed MCRP indicate that sites vary in levels of vibration from a low of 1.1 mm/s to a high of 32 mm/s. The areas with the highest levels of vibration are in the Depot Site (Brgy. Dolores), La Pieta Memorial Cemetery, Sindalan Memorial Park, Quebiawan Elementary School, Sto. Tomas/Brgy. Sto. Niño, and Mabalacat Cemetery. Road traffic appears to dominate the cause of high levels of vibration. At these areas, the range of vibration levels may reach beyond 10 mm/s which may be considered unpleasant by people if subjected to continuous motion. The sites with the lowest level of vibration are the Apalit Station and Lakandula, where vibration levels range only between 2.5 mm/s to 5.0 mm/s.
PEOPLE	
Demography	• In terms of population of the host LGUs, there are slightly more males than females, with 50.37% males and 49.63% females. • Majority of the PAPs (34.15) are 18-40 years old. About 1 in 10 of the PAP are either (1) 6 year old or less (12.7%), (2) 7-12 years old (11.1%), while a small proportion are either (1) 13-16 years old (6.9%) (2) 17-20% (7.5%), and (3) 81 years old and above (6.9%). • Majority of the PAPs in all affected LGUs belong to the working age population and may thus form part of the labor force.
Literacy Rate and Education Attainment	• In 2015, 99.45% of the total household population 10-year old and over of the host LGUs of the proposed MCRP are basically literate. • The proportion of literate females is higher (50.29%) than their male counterparts (49.71%). • The population five (5) years old and over of the host LGUs (1,570,831) consist largely of high school educated population at 659,051 persons or 41.96% of the total population, followed by elementary educated population at 428,203 or 27.26% of the total population.
Migration and Informal Settlers	• The number of ISFs within the PNR ROW is 1,080, which is 81.3 % of total affected families (1,329). This is 4 times the number of legal PAFs.
Indigenous People	• There are two (2) ethnic tribes near the vicinity of the proposed MCRP, namely, Aeta and Abelling. • As of 2010 Census of NCIP Region 3 for Tarlac, the registered CADT-025 has an IP population of 2,973
Historical and Cultural Heritage	• A total of twelve (12) locations with old PNR structures were identified during the site investigations with JICA Study Team and PNR in February 2018
Power Supply	• Manila Electric Company (MERALCO) is Bulacan's main power distributor and provider. • MERALCO provides electrical power in two (2) barangays of Apalit, namely Balucuc and Calantipe. In other ten (10) barangays of Apalit, as well as the whole Minalin and Sto. Tomas, the electrical power is provided by Pampanga Electric Cooperative, Inc. (PELCO) III. • The power supply in San Fernando is provided mainly by the San Fernando Electric Light & Power Company, Inc. (SFELAPCO). • The power supply in Angeles is provided mainly by Angeles Electric Corporation (AEC). • The electricity supply in Mabalacat is provided mainly by the electric cooperative PELCO II. • The power supply in Bamban and Capas is provided mainly by Tarlac Electric Cooperative (TARELCO).
Water Supply	• Most PAPs (99.6%) have access to water. Among these, almost half (54.8%) have access through the water service providers (i.e. Maynilad, MWSS, or local service providers). • There are still a few (8.7%) who use deep wells and some (18%) who buy from water vendors.
Open Space and Recreational Area	• The most common sports facilities present in the host LGUs are basketball court distributed in almost all barangays. In support the sports and recreation facilities of the municipality, some school has a park,

Environmental Component	Description
	playground of athletic activities.
Educational Facilities	• Malolos has 38 public elementary schools. • Calumpit has a lot of schools, mostly in elementary and secondary levels. It also has private colleges and the most well-known of it is Colegio De Calumpit. • Apalit has 15 elementary and six (6) secondary public schools. • Minalin has 12 public elementary schools, and 3 public secondary schools; 2 private elementary schools and 2 private secondary schools. • Sto. Tomas has 13 elementary (8 public and 5 private) schools, three (3) secondary (2 public and 1 private), and one (1) tertiary/vocational school. • San Fernando has 37 elementary (37 and 28 private) schools and 16 tertiary level schools. • Angeles has one (1) city college, seven (7) private universities, 43 public elementary schools, 67 private elementary schools, 13 public secondary schools, and 35 private secondary schools. • Mabalacat has 40 public elementary schools, 16 public secondary schools, and 31 private schools. • Bamban has a total of 24 public schools, 22 of which offered elementary education while the other two (2) offered secondary education. • Capas has 31 public elementary schools and eight (8) public high schools.
Communication	• The communication service facilities in the host LGUs include postal, internet, land-based and cellular phones as well as print media, broadcast and television.
Peace and Order	• The city police of Malolos has a new headquarters beside the Malolos City Sports and Convention Center in Bgy. Bulihan. Likewise, there are three (3) outpost and one (1) traffic outpost located in front of the Malolos Public Market. The fire fighting unit on the other hand has sixteen (16) firemen, with two (2) fire trucks. Barangay Tanod and Private Security also provide protective services in the city. • The Municipal Police Station of Calumpit is situated within the vicinity of the municipal hall. Calumpit Police Station is composed of 27 PNCO and 3 PCO under the overall supervision of Police Superintendent and equipped with three (3) Mobile Patrols and six (6) Motorcycle Patrol Unit. • Apalit has 31 police personnel and 10 firemen. • The Minalin Police Headquarters is located in barangay San Nicolas with 20 personnel, 2 serviceable vehicles and with only 2 MC. Minalin has 102 peace and order volunteers. • Sto. Tomas has police force of 44. There are also16 personnel of the Fire Protection office. Auxiliary protective services such as escort, crowd control, neighborhood patrol, etc. are also provided by Barangay Tanods which number from 10-15 Tanods per barangay. • Angeles City Police Office (ACPO) is located at Camp Tomas J. Pepito, Barangay Sto. Domingo. The ACPO has a complement of 490 policemen, 55 of which are Police Commissioned Officers and 435 are Police Non-Commissioned Officers. ACPO has a total of sixty – four (64) vehicles, ten (10) of these are mobile cars, twelve (12) are patrol jeeps, and forty-one (42) are motorcycles.
Sewerage	• Among the host municipalities and cities, the sewerage system located in the CSEZ is the sole existing complete sewerage system in the study area. • The sewerage system is being managed by the Clark Water Corporation (CWC) and has two separate subsystem for storm drainage and sewage. • The present sewage effluent is being treated in the biological wastewater treatment plant with a capacity of 8,023m^3/day to accommodate the effluent of about 16,280 population and receive the effluent from a number of industrial, commercial and institutional houses/buildings with the CSEZ. • The rest of the municipalities and cities have no sewerage system and the effluent is discharge directly into the nearest stream.
Existing Solid Waste Management and Related Land Management Scheme of the Host LGUs	• The host LGUs have dump trucks for garbage collection and MRF for sorting. • All residual wastes generated are being disposed in Metro Clark Sanitary Landfill located at Sitio Kalangitan, Barangay Cutcut II, Capas, Tarlac
Public Health and Safety Profile	
Public Health Services	• Malolos currently operates seven (7) health centers. • Calumpit has two (2) Rural Health Units (RHUs) and five (5) hospitals. • Apalit has two (2) RHU, three (3) private primary hospitals, seven (7) medical clinics, and three (3) optical clinics which are being operated with sufficient doctors and other health personnel. • Minalin has one (1) RHU and one (1) Barangay Health Unit (BHU). There is no hospital in Minalin. • Sto. Tomas has one (1) RHU located in the Poblacion and on (1) private hospital locates at Moras dela Paz. The RHU is complemented by seven (7) Barangay Health Stations scattered in the barangays. • San Fernando operates 11 hospitals, two (2) public hospitals and nine (9) private hospitals. There are four (4) RHUs and 42 Barangay Health Centers, which serve the public health needs of the City's constituency. • Angeles has nine (9) private hospitals and one (1) government-owned. There are thirty-eight (37) licensed

Environmental Component	Description
	clinics, nine (16) birthing homes including the six (6) RHUs of the government and twenty (29) diagnostic laboratories. The six (6) RHUs are situated strategically to cover the thirty three (33) barangays. • The major health facilities in Mabalacat City include one (1) government hospital, two (2) private hospitals, three (3) RHUs and 23 Barangay Health Stations (BHS). There are a total of 29 public health facilities and 20 private health facilities. • Bamban has an existing hospital which is the Divine Mercy Hospital. Bamban also has two (2) Rural Health Units and seven (7) Barangay Health Stations. • Capas has one (1) public hospital, two (2) RHUs and 12 Barangay Health Stations.
Morbidity and Mortality	
Morbidity and Mortality by LGUs	• The top leading causes of morbidity in Malolos as of 2012 are Acute Upper Respiratory Infection (AURI)/Acute Respiratory Infection (ARI), Skin Disease, Diarrhea, Urinary Tract Infection, and Gastrointestinal Tract Infection. The top leading causes of mortality include heart disease, pneumonia, PTB and CVA followed by CA, DM, enteritis, accident, prematurity and rental failure. • The top leading causes of morbidity in Calumpit are Acute Respiratory Infection, Skin Disease, Urinary Tract Infection, Diarrhea, Chronic Obstructive Pulmonary Disease, and Gastrointestinal Tract Infection. The top leading causes of mortality include heart disease, pneumonia, Pulmonary Tuberculosis, Cardiovascular Disease, Diabetes Mellitus, enteritis, and accident. • The top leading causes of morbidity in Apalit as of 2014 are Acute Respiratory Infection, Wounds, Cardiovascular Disease, Skin Diseases, Diarrhea, COPD, Musculo-Skeletal Disease, Animal Bite, Urinary Tract Infection, and Pneumonia. Acute Respiratory Infection is consistently the leading cause of morbidity in Apalit from 2012 to 2014. Cardiovascular diseases have consistently been the top cause of mortality from 2012-2014. • The top leading causes of morbidity in Minalin are Acute Respiratory Infection, Cardiovascular Disease, Skin Diseases, Diarrhea, Chronic Obstructive Pulmonary Disease, Animal Bite, Urinary Tract Infection, and Pneumonia. The top leading causes of mortality are Cardiovascular Disease, Asthma, Cancer (all kinds), Diabetes Mellitus, Organ Failure, Pneumonia, and Pulmonary Tuberculosis. • For the year 2009-2011, the leading cause of mortality recorded in the Apalit is Acute Respiratory Infection. • In 2009, the top leading causes of mortality in San Fernando are Heart Diseases, CVA, Cancer (all forms), Kidney Failure, Pneumonia (all forms), Pulmonary TB, Sepsis, Hypertension, Multiple Organ Failure and Vehicular Accident. • Acute respiratory infection is consistently the leading cause of morbidity in Angeles from 2013 to 2015. Heart Disease is the top cause of mortality in 2013 and 2015. But in 2014, it went down to second giving way to Diabetes Mellitus. • Acute respiratory infection is consistently the leading cause of morbidity in Mabalacat from 2011 to 2013. The top causes of mortality in Mabalacat in 2013 include heart diseases, cancer (all forms), cerebrovascular disease, hypertension, diabetes mellitus, kidney disease, Pneumonia, Chronic Obstructive Pulmonary Disease, Multiple Organ Failure, and Pulmonary Tubercolosis. • The top leading causes of morbidity in Bamban are Diarrhea, Bronchitis, Influenza, Acute Respiratory Infection, Pneumonia, Chicken Poz, Measles, and Hepatitis. The top leading causes of mortality in Bamban are Cardiovascular Disease, Pneumonia, Cancer (all form), Bronchial Asthma, Pulmonary Tuberculosis, Still Birth, and Cardiac Arrest. • The top leading causes of morbidity in Capas as of 2017 are Acute Upper Respiratory Infection, Hypertension, Acute Gasrtro Enteritis, Diabetes Mellitus, Urinary Tract Infection, Infected Wound, Pulmonary Tuberculosis, Acute Gastritis, Skin Diseases, and Bronchial Asthma. • The top leading causes of mortality in Capas are Cerebro Vascular Disease, Cancer (all form), Diabetes Mellitus, Vehicular Accident, Chronic Obstructive Pulmonary Disease, Renal Failure, Pulmonary Tuberculosis, Gunshot Wound, Bronchial Asthma, and Pneumonia.
Morbidity and Mortality of PAFs by LGUs	• Most of the PAPs have members who experienced flu (34.4%), hypertension (12%) and diabetes (5.1%). However, majority of the PAPs (36.2%) report other factors (apart from illness) as causes of death among the members (Table 3.1.18). In particular, 22.1% of the PAFs have members who died due to heart problems while 21.2% reported that some died due to hypertension. A few (3.8%) reported dengue as one of the casues, while other reported casees include: pneumonia (0.8%), flu (0.8%), diarrhea (0.3%), malaria (0.1%) and typhoid fever (0.1%).
Environmental, Health and Sanitation Profile	
Health and Sanitation per LGU	• Based from 2010 Census of Population and Housing of the PSA, eight (8) out of ten (10) host municipalities/cities of the proposed MCRP mainly source their drinking water from their own faucet tapped from the community water system. • On the other hand, Malolos and Bamban use bottled water as the main source of their drinking water. Other households of the host LGUs source their drinking water from the shared faucet tapped community water system, own use tubed/piped deep well, shared tubed/piped deep well, tubed/piped shallow well, dug well, protected spring, unprotected spring, lake/river/rain and peddler. • Most of the garbage generated by the host LGUs are collected by the garbage trucks and dispose to the sanitary landfill in Capas, Tarlac. Other households dispose their garbage by dumping in individual pit (not

Environmental Component	Description
	burned), burning, composting, burying, and feeding to animals. • Majority (96.61%) of the total households of the host LGUs are using water-sealed toilet of which 85.29% or 258,184 households have their own water-sealed toilet with septic tank, and 5.30% or 17,650 households use shared toilet with septic tank. About 6.02% of the total households use water-sealed toilet with pipe leading to depository other the septic tank. However, there are still households that do not have sanitary toilet facilities.
Access to Water and Sanitation Aceess of PAFs per LGU	• At least 5 out of 10 PAFs have access of water through piped connection as indicated in Table 3.4.22. This proportion is higher in other LGUs such as Malolos (66.7%), Calumpit (57.4%) and Angeles (56.8%). The remaining proportion of the population obtain water from shared community faucet (20.4%), other sources (13.7%), and deep well (8.7%). Those who have a relatively high proportion with shared water connection may pertain to informal settlers who are sharing the said resources with neighbors – as seen in San Fernando, Angeles and Calumpit. • At least 7 out of 10 (79%) have their own water-sealed toilet. The remaining have acces to toilets through other means (8.3%) or through community or shared toilet facilities (7.3%), with a few (3.1% or 23 families) with no toilets. Families with no toilets in their place of residence are in San Fernando (55 PAFs), Angeles (14 PAFs) and Calumpit (7 PAFs).
Community Concerns	• Although the community issues vary per LGU, majority of the PAPs' concerns are related to flooding and garbage collection – two environmental issues, which, if not mitigated, may pose risks to the PAPs. In particular, most PAFs in Malolos (33.3%) and Angeles (11.2%) cited flooding as one of the community issues. In Calumpit, Santo Tomas and San Fernando, flooding is one of the major issues – with 43.4%, 43.8% and 22.6% indicating this as one of the issues, respectively. Apart from these, other issues commonly cited include: (1) drugs (10.2%), job/ employment (7.0%) and safety/security (6.4%).
Socio-economic Profile	
Local Economy	• Malolos is a first class city and capital of Bulacan. Its major economic activities are commerce and industry. Malolos is rapidly becoming commercialized and industrialized due to its proximity to Metro Manila and for lying between Manila and Clark, Pampanga. • Calumpit is a first class urban municipality and its major economic activities are commerce and agriculture. • Apalit is a first class municipality in and its economic activities are agriculture, commerce and trade, industry, and tourism. • Minalin is a fourth class municipality and its economic activities are agriculture, commerce and trade, and tourism. • Sto. Tomas is a fourth class municipality and its economic activities are agriculture, industry, commerce and trade, and tourism. • San Fernando is a first class city and capital of Pampanga. Its economy has taken the turn from a predominantly agricultural economy (35 years ago) to one oriented toward Industry and Services. Employment in the city is shown to concentrate in the Services Sector with about 75 percent of the City's labor force accounted. The Industry sector comes in second in employment share with 36 percent, while Agriculture, Fishery and Forestry (AFF) accounts for the least share with 9 percent. • Angeles is a first class highly urbanized city in the region of Central Luzon. Investors continue to be convinced of the viability of Angeles as a viable location to operate businesses. For 2015, the top businesses in the city in terms of their number, as classified by the Business Permit and License Division following that of the City Treasurer's Office, are (1) Retailer, (2) Services, (3) Real Estate, closely followed by (4) Food/Nocturnal, then (5) Manufacturer and lastly (6) Farm. • Mabalacat is a first class city and its economy revolves around its primary sector (agriculture, fisheries, livestock, and poultry), secondary sector (business establishments), and tertiary sector (commerce and trade, industries, and tourism). • Bamban is a second-class municipality and its economic activities are agriculture, industry, and commerce and trade. • Capas is a first class municipality and its economic activities are commerce and trade, agriculture, industry and tourism.
Labor Force and Employment Profile by Host LGUs	• In the absence of available data on employment at municipality/city level, the regional level data from the Philippine Statistics Authority (PSA) were used in the study. The Labor Force Participation Rate (LFPR) of Region 3 for 2015 is 60.90%. It is slightly lower than years 2014 and 2013 with 62.30% LFPR and 62% LFPR, respectively. • Malolos and Calumpit contribute gainful workers of about 11.49% of the total gainful workers of Bulacan. Apalit, Minalin, Sto. Tomas, San Fernando, Angeles and Mabalacat have gainful workers of about 56.319% of the total gainful workers of Pampanga. Bamban and Capas have gainful workers of about 15.04% of the total gainful workers of Tarlac. Majority of the gainful workers are males.
Income of PAFs by LGUs	• The highest proportion of PAPs (16.5%) receive an income of P12,000 to 15,999 per month. This pattern can be observed in Caluumpit and Apalit, as well as in the City of San Fernando, with 14.1%, 33.3% and 17.4%, respectively. However, in the Cities of Malolos and Angeles, majority earn at least P30,000-P49,999 per month. This pattern suggests that PAPs in some municipalities (i.e. Calumpit, Apalit) may be less well-off compared to the other cities (i.e. Malolos, Angeles). However, in the City of San Fernando,

Environmental Component	Description
	the income pattern is more diverse, with PAPs earning at least 12,000-15,999 (17.4%) and a proportion earning P30,000 to P49,999 (12.9%). The trend in may also be observed in Calumpit.
Public Access	
Road Networks and Transportation	• Manila North Road, also known as McArthur Highway, is the oldest inter-regional highway that connects Northern and Central Luzon provinces from the national metropolis. The Central Luzon section of the MacArthur Highway starts at Km 17+270 in Meycauayan City in Bulacan and ends at Km 168+275 in San Manuel, Tarlac, giving a total length of 151.005 km. The 5.44 kilometer portion in Angeles City starts at Km 81+260 (boundary with the City of San Fernando) and ends at Km 86+700 (boundary with Mabalacat City). • North Luzon Expressway (NLEX) formerly known as North Diversion Road is a limited-access toll expressway that connects Metro Manila to the provinces of the Central and Northern Luzon Regions. NLEX begins in Quezon City specifically at a cloverleaf interchange with Epifanio Delos Santos Avenue (EDSA), and then passes through Caloocan City and Valenzuela City in Metro Manila, Meycauayan, Marilao, Bocaue, Guiguinto, Plaridel and Pulilan in Bulacan, San Simon, City of San Fernando, Mexico and Angeles City in Pampanga. The expressway currently ends at Mabalacat and merges with the MacArthur Highwayand the Subic-Clark-Tarlac Expressway (SCTEx), which continues northward into the rest of Central and Northern Luzon for the former and westward for the latter. • SCTEx is a 94-kilometer four-lane expressway that serves as a direct and exclusive road connection between major development areas of Central Luzon (Subic, Clark, Tarlac). Its southwestern terminus is at the Subic Bay Freeport Zone in Zambales, then passes through the interchanges with the NLEX near the CSEZ in Angeles City, and Central Techno Park in Tarlac City, Tarlac; and its northeaster terminus is in La Paz, Tarlac.
Access Points that may be blocked by the Proposed MCRP	• Based on the summarized access points which may be blocked by the proposed MCRP, (a) G. Valdez Street and P. Villanueva Street and (b) Santo Entierro Street in Angeles need to be considered. The LGU of Angeles in particular cited that the 30m ROW should consider access either through G. Valdez Street or P. Villanueva Street near the proposed station location.
Perception Survey	
Respondents' Profile	• More than half (52.19%) of the respondents are male while 47.81% are female. Malolos and Calumpit have more male than female respondents, while Apalit, Minalin, San Fernando and Bamban have more female respondents. Angeles, Mabalacat, Sto. Tomas and Capas have equal male-female respondents ratio. • Majority of the respondents (66.07%) were born in the barangay where they currently reside, while a notable number of respondents came from other municipalities/cities and/or provinces (23.65%) • 27.25% of the respondents were in the 41-50 years old, and respondents within working age bracket account for a little over 31.49% of the total. • Most of the respondents (64.52%) are Kapampangan. • The respondents are mostly Roman Catholic, 91.90%, while only a few are either Protestant, Aglipayan or INC. • Most of the respondents had formal education they acquired from community schools, and majority (38.17%) of them attended high school. This is higher than those who attended college with 37.92%. Comprising 14.14% of the total respondents, some were able to attend technical-vocational courses. • About 68.64% of the respondents confirmed that they are married, while 20.82% are single. The remaining percentage is shared by those who are widowed and separated. This only shows that marriage remains an important social institution in the municipalities surveyed. • Majority (49.23%) of the respondents have 1 to 3 children. • 19.82% of the respondents have been residents of their respective municipalities for 41 to 50 years. • Majority (52.95%) of the respondents belong to traditional families where husbands are the primary providers of income, which 54.21% are earning from their regular salaried jobs. Most of the respondents 31.75% earn P5,000 - 9,999 in a month, near to or lower than the minimum wage rate of approximately P11,300. • With regards to the problems in the community, wastes (23.08%), poor public service (10.46%) are the most common concerns among respondents, while sentiment on traffic congestion and flood are next in rank. While the possible solutions of the 26.25% of the respondents is to implement. • Majority either own (58.23%) or rents (15.94%) the property where they reside. • Majority (47.56%) of the respondents do not cultivate crops, and the rest cultivates common crops such as vegetables and sweet potato. Rice is still cultivated but owing to the urban environment of the impact areas, the production percentages are low. • Majority (42.69%) of the respondents have been ill at least one (1) time in the last year. • Fever is the common (36.66%) cause of illness among the respondents, followed by upper respiratory diseases (26.28%). Among the PAFs, 31.72% of the respondents get medical treatment in the hospital, slightly more than those that get treatment at barangay health centers (28.30%). A significant percentage also opts for treatment at private clinics (28.30%), while a few ill gets treated by herbalist, or simply at home (self-treatment). • Most respondents rely on community water system for their drinking water supply (63.37%) and for their

Environmental Component	Description
	household chores like laundry and washing (63.24%). • Respondents (50.77%) use either water-sealed sanitary toilet facilities, and 46.66 % use either flush, the rest are either utilizing hole on the ground.
Perception Survey Results	• Majority (85.07%) of the respondents are aware of the project through various means. About 60.80% of the respondents were made aware of the project through information disseminated in the barangays. Majority (85.60%) of the respondents were in favor of the proposed project. Most respondents from Malolos, Calumpit and Apalit were in favor of the project. • 36.61% of the respondents were anticipating that the project will provide a much faster commute from Malolos to Clark, and 34.40% believes the project will result to less traffic congestion. About 44.27% of the respondents were concerned that the project will demolish the houses near the railway. The largest percentage came from Sto.Tomas with 67% of the respondents expressing concern over the impact of the project on the settlers near the railway.

Summary of Key Environmental Impacts and Management Plans

23. The main impacts of the proposed MCRP are relocation of the residents living along the ROW and generation of dust, noise, and vibration. More importantly, this project will help improve the condition of traffic by providing a faster and less polluting public mass transport. **Table ES-10** presents the summary of key environmental impacts of the proposed MCRP and the corresponding management plan and mitigating measures.

Table ES-10 Summary of Key Environmental Impacts and Management Plan

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Residual Effects
PRE-CONSTRUCTION			
LAND			
Land use and Classification	Incompatibility with the existing land use	• DOTr will coordinate with the lot owners, LGUs, other relevant agencies and concerned stakeholders in acquiring and/or securing the ROW	Change in land use classification of areas utilized as part of ROW
	Potential conflict with other government infrastructure projects	• Coordinate with BCDA, DPWH (for depot site), and other relevant agencies and develop designs with compatible, non-overlapping structures	Possible acquisition of additional private lots outside BCDA
	Overlap with areas with CADT/CADC, or areas occupied by cultural communities or tribes	• Coordinate with NCIP for the conduct of FBI to determine the possible overlap with CADT/CADC and update design to eliminate overlap	None
PEOPLE			
People	Involuntary Resettlement of project affected persons (PAPs) (at least 1,329 households)	• DOTr will implement RAP in coordination with NHA, LGUs, and concerned stakeholders and relevant agencies that provide relocation site with complete facilities, amenities and basic services as well as livelihood for income restoration of head-of-household PAPs of ISFs and vulnerable groups.	• Resettlement of project affected persons (PAPs) (at least 7,692 households); • Enhanced living and livelihood conditions of resettled PAFs of ISFs and vulnerable groups
CONSTRUCTION			
LAND			
Land Use and Classification	Impairment of aesthetic view	• Maintain the construction site/ yards tidy and clean and rehabilitate after construction • Provide temporary screens/ walls to minimise the visual clutter. • Design the project facilities to harmonise with the surrounding environments (shape, colour, size, etc.)	• Minimal impairment of aesthetic view
Geology/ Geomorphology	Inducement of subsidence, liquefaction, landslide, mud/debris flow	• Design and construct appropriate foundation and structures based on the combination of geotechnical, geodetic and hydrologic study, and seismicity studies, and in compliance with the National Building Code and the Structural Code of the Philippines and internationally accepted guideline.	• None
Pedology	Degradation of soil quality (soil contamination)	• Prepare and implement solid waste management plan and proper disposal in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969.	• None

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Residual Effects
Terrestrial Ecology	Loss of flora and fauna within ROW and Depot site	• Prior to any clearing activity, conduct 100% inventory of the affected trees along the alignment and secure tree cutting permit in compliance with DENR MC No. 2012-02. • Minimize vegetation clearing to areas to be developed only and implement the tree and vegetation management plan as part of the construction plan • Areas not part of the development within the ROW, around the stations and depot will be prioritized for replanting activity to create buffer zone to improve wildlife habitat.	• Minimal loss of flora and fauna within ROW and Depot site • Buffer zones to be created will serve as favourable habitat for nurturing wildlife
WATER			
Hydrology	Inducement of flooding	• Design and install drainage to accommodate the surface water runoff from the project and avoid any flooding in the area caused by the project. • Regular inspection and prompt maintenance of the drainage system, all installed structures and facilities and improve/ enhance capacity when possible.	• Improved drainage system in areas along the MCRP alignment
Water Quality	Degradation of surface water quality	• Install wastewater treatment, portable sanitary facilities at construction sites/yards • Install temporary erosion ponds or silt traps around the major work areas. • Plan and implement construction activities in consideration to the water course, embankment, and wet/dry season.	• Minimal surface water quality degradation
AIR			
Air Quality	Degradation of air quality	• Adjust construction activities in consideration to weather system, identifying periods of high winds and drought that aggravated dust transport. • Control vehicle movement maintaining the speed limit within the construction site to <10kph • Conduct regular cleaning and clearing of construction access / sites surfaces of spoils and debris from construction equipment and vehicles and wetting of ground soil in the construction site when necessary.	• Minimal degradation of air quality
Acoustic Noise	Increase in ambient noise level	• Plan and implement construction activities in consideration to time, duration, and scale to optimize the use construction equipment, machineries, and vehicles in accordance to the noise emission standard. • Design and install effective noise barriers and absorbers along the alignment especially in areas with sensitive facilities and install noise control devices such as mufflers and noise suppressors to all construction equipment and machineries.	• Minimal increase in ambient noise levels, confined to local construction sites away from noise-sensitive receptors and limited to daytime period and short duration
Ground vibration	Increase in ambient vibration level	• Plan and implement construction activities in consideration to time, duration, and scale to optimize the use construction equipment, machineries and vehicles. Schedule high vibration generating activities during daytime to reduce disturbance to nearby communities. • Select construction equipment and machineries matching the scale of the construction and with minimal vibration generation if possible	• Minimal increase in vibration levels, confined to local construction sites away from sensitive receptors and limited to daytime period and short duration
PEOPLE			
People	Generation of Livelihood Opportunities and improvement of Safety	• Prioritize in hiring local qualified residents in coordination with the LGUs and employ workers in consideration to gender equality and to vulnerable group	• Increased number of employed local residents with consideration to gender equality and vulnerable group
	Cultural/Lifestyle Change of Indigenous Peoples	• Conduct FBI at the proposed depot area in accordance to the NCIP AO No. 3, 2012. If section of the depot site is within an Ancestral Domain,	• Minimal lifestyle change of IPs

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Residual Effects
		additional measures will be implemented in close coordination with the NCIP and LGUs. • Ensure resolution of indigenous community (if any) in coordination with NCIP and LGU.	
	Change/Conflict on ROW and Impact on Public Access	• Maintain the existing public access as much as possible. However, in case of closures/barriers, disseminate information to the public, barangay and LGUs on the potential impact to the existing public access and mitigation measure through the project activities. Provide diversion route with appropriate health and safety measures. In case of any changes, prompt update on the diverted routes to the concerned communities and LGUs, • Assign traffic guide to provide assistance to the road users.	• Inconvenience to public's access to schools and other services, limited to duration of construction.
	Threat to public health and safety	• Formulation and implementation of IEC Plan to inform the affected LGU and local communities and the general public about 1) the project, project activities, duration, possible project impacts and incorporate their comments and inputs in the design, 2) the potential impact of project activities to air quality, noise, vibration, and climate change and mitigation, and safety aspects like areas that are restricted for the public, and 3) the Grievance Redress Mechanism to handle complaint/s if any. • Plan for construction sites and access route in consideration to health and safety of local communities • Install fencing of the construction site, provision of signage and posters, and guarding of the access point to ensure that the public is prevented from entering unsafe areas.	• Accidents may still occur, but the safety and health guidelines in place will significantly lower the exposure of workers and commuters to occupational and construction hazards, respectively.
	Traffic Congestion	• Conduct Traffic Impact Assessment (TIA) and based on the results of TIA, prepare and implement Traffic Management Plan (TMP), coordinate to the concerned LGUs and transport operator/s and get their inputs and approval • Schedule transport of heavy structures during period when there are fewer vehicles on the road and posting of appropriate traffic signage and warnings. • Disseminate information to the general public, host barangays and LGUs on the potential impact of the project to the existing access and provide mitigating measures.	• Minimal traffic congestion may still occur; • Inconvenience to commuters. The residual impacts will be confined to construction phase only.
OPERATION			
LAND			
Land Use and Classification	Impairment of visual aesthetic	• Maintain tree planting to minimise the visual impact of the project	• Trees planted along the alignment may create a positive visual impact
Geology/ Geomorphology	Inducement of subsidence, Liquefaction, Landslide, Mud/Debris Flow, etc.	• Conduct proper inspection and prompt maintenance checks to every single installed structure and facility and improve/ enhance capacity when possible • Conduct inspection in the event of natural hazard occurrence to assess damage of structures • Regular Coordination with the PHIVOLCS for earthquake and volcanic events to adjust the train schedule as necessary.	• None
Pedology (Soil Quality)	Degradation of soil quality (soil contamination)	• Strict implementation of solid waste management plan and proper disposal by an accredited contractor in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969.	• None
Terrestrial Ecology	• Loss of Habitat • Threat to Existence and/or Loss of	• Minimize the noise, vibration, illumination, and vehicular movement which can disturb significant fauna area (alignment sections in Malolos to Sto.	• Minimal disturbance to flora and fauna near bio-diversity areas

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Residual Effects
	Important Local Species • Hindrance to Wildlife Access	Tomas, which are under Manila Bay Biodiversity Area).	
WATER			
Groundwater and Freshwater Quality	Deterioration of nearby groundwater and surface water due to discharge of untreated wastewater in stations and depot	• Each commuter station and depot will have a sewage treatment plant (STP) and a separate treatment facility for non-sewage waste waters such as from sinks, and washings to meet the applicable effluent standards. Handling of potential contaminants during operation phase will be compliant with RA 6969.	• None
AIR			
Acoustic Noise	Increase in ambient noise level	• Optimize the number of train operation at night time to reduce generated noise • Provision of effective height of noise barriers on each side of the track especially on areas with sensitive receptors such as school, hospital, residential area • Provision of noise control device such as muffler to all stationary sources (i.e. generator set) • Regular inspection and proper maintenance of trains and tracks to reduce operational noise	• Minimal increase in ambient noise levels confined to areas adjacent to alignment
Ground Vibration	Increase in ground vibration level	• Regular inspection, proper maintenance and reconditioning of trains and tracks such as rail grinding, slip-slide detectors and maintenance or replacement of suspension system, brakes and wheels	• Minimal increase in vibration levels
PEOPLE			
People	Generation of estimated 1,400 job positions; opportunities for business	• Coordinate closely with the host LGUs, specifically at the barangay level regarding hiring of regular workers to ensure that the workers being considered are legitimate residents in the area in consideration to gender equality.	• Higher employment rates in the host cities
	Influx of ISFs	• Install fencing and provide guards to prevent the settlement of ISFs along the ROW	• None
	Threat to public health and safety	• Provide security guards in all stations to direct passengers on the safe zone • Provide sanitary facilities or utilities in all stations and depot. • Implement the Occupational Health and Safety Management Plan. • Provide appropriate PPE to all personnel undertaking maintenance work.	• Accidents may still occur, but the safety and health guidelines in place will significantly lower the exposure of workers and commuters to occupational and operational hazards, respectively.
	Traffic Congestion in the areas adjacent to the proposed stations	• Establish a TOD Committee, which compose of the Traffic Management of LGUs, Planning Office, PNR, DPWH, and DOTr • Plan and implement TOD in consideration to the loading and unloading area and the circulation of the traffic as well as the integration of transport facility within the station.	• Minimal traffic build-up may still occur in areas adjacent to the proposed stations
	Reduced travel time for commuters	• Promote benefit of reduced travel time using MCRP mass transit over other modes of transportation	• Increased number of commuters using the MCRP for transportation

Grievance Redress Mechanism

24. The Grievance Redress Mechanism (GRM) is an effective tool for early identification, assessment, and resolution of compliants on projects. The GRM for the proposed MCRP has the following objectives:

- To receive and facilitate the resolution of project 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;
- To measure to the risks and adverse impacts of the project; and
- To 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.

The Grievance Procedure for the proposed MCRP is presented in **Table ES-11.**

Table ES-11 Grievance Procedure for the Proposed MCRP

Steps	By	Actions	
1	Aggrieved Stakeholder	Any aggrieved stakeholder will lodge his/her grievance in writing, verbally or electronically transmitted to the DOTr Railway Office for immediate action.	
2	The Grievance Officer (DOTr Railway Office)	• 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 grievance registry of the DOTr-Record Management System) of the complaint, provide copy and give contact details of where the complaint will be forwarded and who is responsible for acting on complaint. • Review the complaint to determine whether it is project related or not.	
		a) If the complaint is project-related, the DOTr Railway Office will forward the complaint to the HSEO within the day from receipt of complaint.	b) If it is not project-related, the DOTr Railway Office will assist the PAP by referring the complaint to the appropriate agency or LGU who may be able to act on the complaint.
3	Aggrieved Stakeholder		If the aggrieved stakeholder is not satisfied with the decision of the Grievance Officer of DOTr Railway Office that the complaint is not project-related, the aggrieved stakeholder may elevate his/her complaint to the HSEO.
4	The Grievance officer (DOTr Railway Office)		• Receive request from the aggrieved stakeholder to elevate his/her complaint to HSEO of the Contractor • Record the status of the aggrieved stakeholder complaint.
5	1st Level PMO HSEO	• Receives complaint forwarded by the Grievance officer. • Act and decide on the complaint within three (3) working days reckoning from the day it is received from Grievance Officer and inform the decision to the aggrieved stakeholder on the decision accordingly. • Inform the Grievance Officer the action and/or decision on the aggrieved stakeholder's complaint.	
6	The Grievance Officer (DOTr Railway Office)	• Receive and record decision of 1st level decision maker • Inform to the aggrieved stakeholder.	
9	Aggrieved Stakeholder	• Receives action of the 1st level through the Grievance Officer • If satisfied, the complaint is resolved and recorded accordingly. • If not satisfied with the decision of the 1st level or if his/her complaint has not been acted upon within a period of three (3) working days and has not received any response from the 1st level decision maker, the aggrieved stakeholder can forward the complaint, or file an appeal, to the HSEC.	
	Grievance officer (DOTr Railway Office)	• Receive request from the aggrieved stakeholder to elevate his/her complaint to the HSEC • Record the status of the aggrieved stakeholder complaint. • Forward the complaint to the 2nd Level within the day from receipt of complaint.	
7	2nd Level HSEC	• Receives complaint from the Grievance Officer. • Act and decide on the complaint within 10 working days and inform the decision to the aggrieved stakeholder on the decision accordingly. • Inform the Grievance Officer the action and/or decision on the aggrieved stakeholder's complaint.	
8	Grievance Officer (DOTr Railway Office)	• Receive and record decision of HSEC • Inform to the aggrieved stakeholder.	
9	Aggrieved Stakeholder	• Receives action of the 2nd Level through the Grievance Officer • If satisfied, the complaint is resolved and recorded accordingly. • If not satisfied with the decision of the 2nd Level or if his/her complaint has not been acted upon within a period of 10 working day and has not received any response from the 2nd Level, the aggrieved stakeholder can forward the complaint, or file an appeal, to the 3rd Level.	
10	Grievance Officer (DOTr Railway Office)	• Receive request from the aggrieved stakeholder to elevate his/her complaint to the 3rd Level. • Record the status of the aggrieved stakeholder complaint. • Forward the complaint to the 3rd level within the day from receipt of complaint.	

Steps	By	Actions
11	3rd Level MMT / PMO Board	• Receives complaint from the Grievance Officer. • Act and decide on the complaint within 15 working days and inform the decision to the aggrieved stakeholder on the decision accordingly. • Inform the Grievance Officer the action and/or decision on the aggrieved stakeholder's complaint.
12	Grievance Officer (DOTr Railway Office)	• Receive and record decision of the 3rd Level • Inform to the aggrieved stakeholder.
13	Aggrieved Stakeholder	• Receives action of the 3rd Level through the Grievance Officer • If satisfied, the complaint is resolved and recorded accordingly. • If not satisfied with the decision of the MMT or if his/her complaint has not been acted upon within a period of 15 working day and has not received any response from the 3rd Level, the aggrieved stakeholder can forward the complaint, or file an appeal, to the DENR
14	4th Level DENR	• Receives complaint from aggrieved stakeholder. • Once the complaint is filed in the DENR, technical conference will follow.

1. PROJECT DESCRIPTION

25. The Department of Transportation (DOTr) is the executive department of the Philippine Government responsible for the maintenance and expansion of viable, efficient, and dependable transportation systems as effective instruments for national recovery and economic progress through the country's land, air and sea transportation infrastructures.

26. President Duterte's administration released a 10-point Socio-economic Agenda and among the reforms that will drive this agenda is the acceleration of infrastructure and the development of industries that will yield robust growth across the archipelago, create jobs, and uplift the lives of Filipinos. Infrastructure is among the top priorities of this administration. Public spending on infrastructure projects could reach 8–9 Trillion Pesos from 2017–2022.

27. The Build!Build!Build! Program is the administration's comprehensive infrastructure development program launched in April 2017. The program identified 70 infrastructure flagship projects or high impact projects. Of these projects, 19 projects are located in Mega Manila. Besides the flagship projects, four (4) projects were also listed as key projects.

28. The projects for Mega Manila are composed of expressway, urban road, railway, road-based public transport, and traffic management. Completion of most of the projects is within or by end of current administration, i.e. by 2022.

29. DOTr's thrust is to guide the development of new urban centers and to meet large residential demands, a commuter railway service to connect Metro Manila with its adjacent northern and southern suburban areas is deemed to be an important mass transit backbone for Metro Manila as well as for the growth corridor of the Greater Capital Region (GCR), comprising of Region III, National Capital Region (NCR) and Region IV-A.

30. The Japanese International Cooperation Agency (JICA) and DOTr have agreed to the conduct of Detailed Design Study (including supplementary F/S) of the PNR Clark Phase 2 (Malolos-Clark Railway) Project (MCRP) and the PNR South Commuter (North South Railway Project (NSRP)) Project. The projects will be assisted by a grant within the framework of JICA and will be co-financed by Asian Development Bank (ADB).

31. The target of this study is the MCRP line extending the North South Commuter Railway (NSCR) line (Tutuban to Malolos) to the north. The NSCR Detailed Design (DD) study has already been accomplished and now under construction.

1.1 PROJECT LOCATION AND AREA

1.1.1 Description of the Project Area

32. The proposed MCRP alignment will traverse ten (10) municipalities/cities of Malolos and Calumpit in Bulacan; Apalit, Minalin, Sto. Tomas, San Fernando, Angeles, and Mabalacat in Pampanga; and Bamban and Capas in Tarlac.

33. From Malolos to Clark, DOTr will utilize the existing Right-of-Way (ROW) of the Philippine National Railways (PNR), a government-owned railway company in the Philippines under the DOTr. This area is intended for railway infrastructure and has a total length of 51km. From Clark to Capas, DOTr will execute the power of eminent domain of the government for the use of the private lands in Bamban and the existing arterial road of Bases Conservation and Development Authority (BCDA) in Capas. This segment will have a total length of 18.2km. Moreover, DOTr will utilize the BCDA properties within the Clark Special Ecomonic Zone

(CSEZ) for the Clark to CIA segment a total length of 3.3km. **Annex 1-1** presents the written confirmation from BCDA for the use of its properties for the proposed MCRP.

34. The proposed MCRP Depot will be located in a 0.4km^2 (40ha) lot area along Sacobia River in Mabalacat, while the location of the proposed MCRP stations are presented in **Table 1.1.1**. The location map of the proposed MCRP is shown in **Figure 1.1.1**.

Table 1.1.1 Station Location

Stations		Location	Geographical Coordinates	
			North Latitude	East Longitude
1	Calumpit	Calumpit, Bulacan	14°54'45.68"N	120°45'57.57"E
2	Apalit	Apalit, Pampanga	14°56'39.22"N	120°44'59.05"E
3	San Fernando	San Fernando, Pampanga	15° 1'40.49"N	120°41'9.24"E
4	Angeles	Angeles, Pampanga	15° 8'5.94"N	120°35'56.72"E
5	Clark	Mabalacat, Pampanga	15°10'34.33"N	120°34'52.74"E
6	CIA	Mabalacat, Pampanga	15°12'3.65"N	120°33'26.91"E
7	NCC	Capas, Tarlac	15°20'5.33"N	120°31'34.84"E

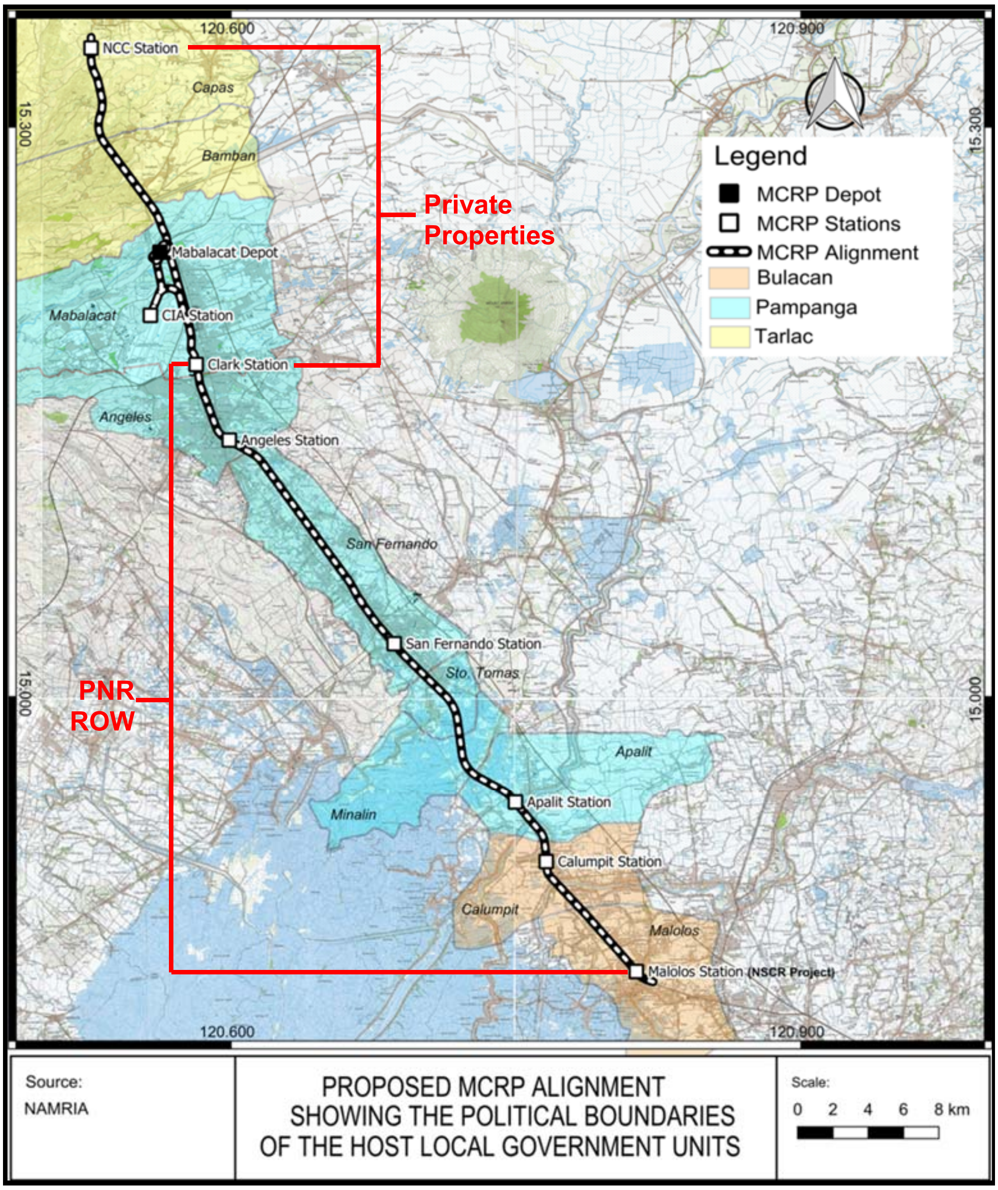


Figure 1.1.1 Project Alignment Showing LGUs' Political Boundaries

1.1.2 Impact Areas

35. The direct impact areas (DIA) cover the existing PNR ROW with an approximately width of 30m and total length of 72.5km. Additionally, the DIA at the MCRP Stations will be extended to a total width of 60m. In terms of socio economic benefits, the DIA areas include the host barangays, and cities/municipalities of Bulacan, Pampanga, and Tarlac, which are the project beneficiaries for employment, business opportunities, taxes, and benefits from decongestion of road from vehicular traffic as well as expansion of economic opportunities in the Region.

36. The indirect impact areas (IIA) will cover the nearby LGUs outside the Provinces of Bulacan, Pampanga, and Tarlac who will benefit from the rapid economic growth in the region and the entire country. Stable and reliable means of transportation can contribute further to the economic stability of the country.

37. The direct and indirect impact barangays of the proposed MCRP are presented in **Table 1.1.2** and in **Figure 1.1.2** to **Figure 1.1.11**.

Table 1.1.2 Direct and Indirect Impact Barangays of the Proposed MCRP

LGU	Host/Direct Impact Barangays	Indirect Impact Barangays
Malolos	Bulihan and Longos	Anilao, Atlag, Babatnin, Bagna, Bagong Bayan, Balayong, Balite, Bangkal, Barihan, Bungahan, Dakila, Guinhawa, Caingin, Calero, Caliligawan, Canalate, Caniogan, Catmon, Ligas, Liyang, Look 1st, Look 2nd, Lugam, Mabolo, Mambog, Masile, Matimbo, Mojon, Namayan, Niugan, Pamarawan, Panasahan, Pinagbakahan, San Agustin, San Gabriel, San Juan, San Pablo, San Vicente (Pob.), Santiago, Santisima Trinidad, Santo Cristo, Santo Niño (Pob.), Santo Rosario (Pob.), Santol, Sumapang Bata, Sumapang Matanda, Taal, Tikay, Cofradia.
Calumpit	Pio Cruzcoza, San Marcos, Calumpang, Iba Este, Palimbang, Iba O'Este, Balungao, and Gatbuca	Balite, Buguion, Bulusan, Calizon, Caniogan, Corazon, Frances, Gugo, Longos, Meysulao, Meyto, Panducot, Poblacion, Pungo, San Jose, San Miguel, Santa Lucia, Santo Niño, Sapang Bayan, and Sucol.
Apalit	Capalangan, Sulipan, and San Vicente	Balucuc, Calantipe, Cansinala, Colgante, Paligui, Sampaloc, San Juan, Sucad, and Tabuyuc.
Minalin	Lourdes, San Isidro, Sta. Maria and San Pedro	Bulac, Dawe, Maniango, San Francisco de Asisi, San Nicolas (Poblacion), Santa Rita, Santo Domingo, Santo Rosario and Saplad.
Sto. Tomas	Poblacion, San Matias, Sapa (Sto. Nino), and Moras dela Paz	San Bartolome, San Vicente, and Sto.Rosario
San Fernando	Baliti, Dolores, Lourdes, Maimpis, Malpitic, Pulung Bulu, Quebiawan, San Agustin, San Nicolas, San Pedro Cutud, Sta. Lucia, Sto. Niño, Sindalan, Calutcut and Panipuan	Alasas, Bulaon, Dela Paz Norte, Dela Paz Sur, Del Carmen, Del Pilar, Del Rosario, Juliana, Lara, Magliman, Malino, Pandaras, Santo Rosario (Pob.), Saguin, San Felipe, San Isidro, San Jose, San Juan, Santa Teresita, and Telabastagan
Angeles	Agapito del Rosario, Balibago, Claro M. Recto, Pulungbulu, Lourdes Sur, Lourdes Sur East, Malabañas, Sta. Teresita, Santo Cristo, Tabun	Anunas, Capaya, Cuayan, Cutcut, Cutud, Lourdes North West, Margot, Mining, Pampang, Pandan, Pulung Maragul, Pulung Cacutud, Salapungan, San Jose, San Nicolas, Santa Trinidad, Santo Domingo, Santo Rosario (Pob.), Sapalibutad, Sapangbato, Virgen Delos Remedios, Amsic, and Ninoy Aquino (Marisol).
Mabalacat	San Joaquin, Lakandula, Dolores, Tabun, Dau, and Poblacion	Atlu Bola, Bical, Bundagul, Cacutud, Camachiles, Dapdap, Dau, Duquit, Mabiga, Mamatitang, Mangalit, Mawaque, Paralayunan, San Francisco, Santa Ines, Santa Maria, Santo Rosario, Sapang Balen, Sapang Biabas, Calumpang, Macapagal Village, and Marcos Village
Bamban	Santo Niño and San Vicente	Anupul, Banaba, Bangcu, Culubasa, Dela Cruz, La Paz, Lourdes, Malonzo, Virgen Delos Remedios, San Nicolas, San Pedro, San Rafael, and San Roque
Capas	Aranguren, Cristo Rey, Cutcut 2nd, and Maruglu	Bueno, Cubcuc (Pob), Cutcut 1st, Dolores, Estrada, Lawy, Manga, Manlapig, O'Donnell, Santa Lucia, Santa Rita, Santa Domingo 1st, Santa Domingo 2nd, Santa Rosario, Talaga, and Santa Juliana.

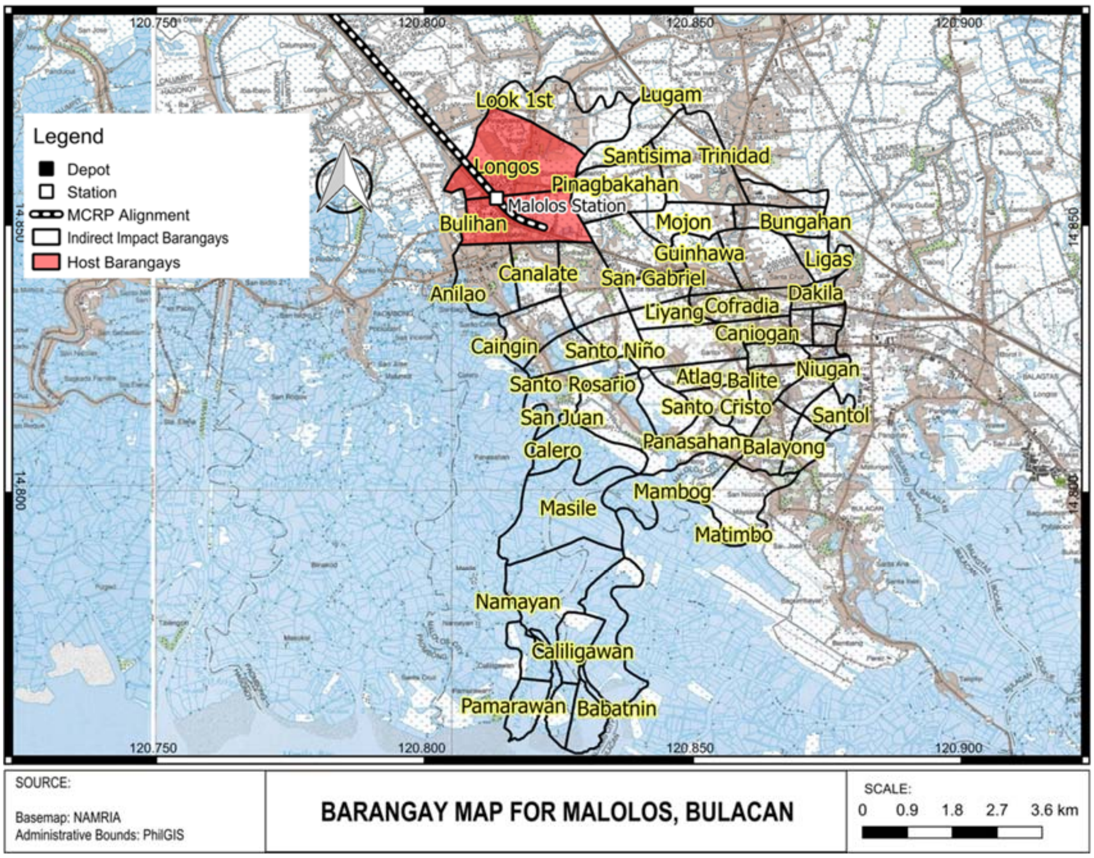


Figure 1.1.2. Direct and Indirect Impact Barangays in Malolos

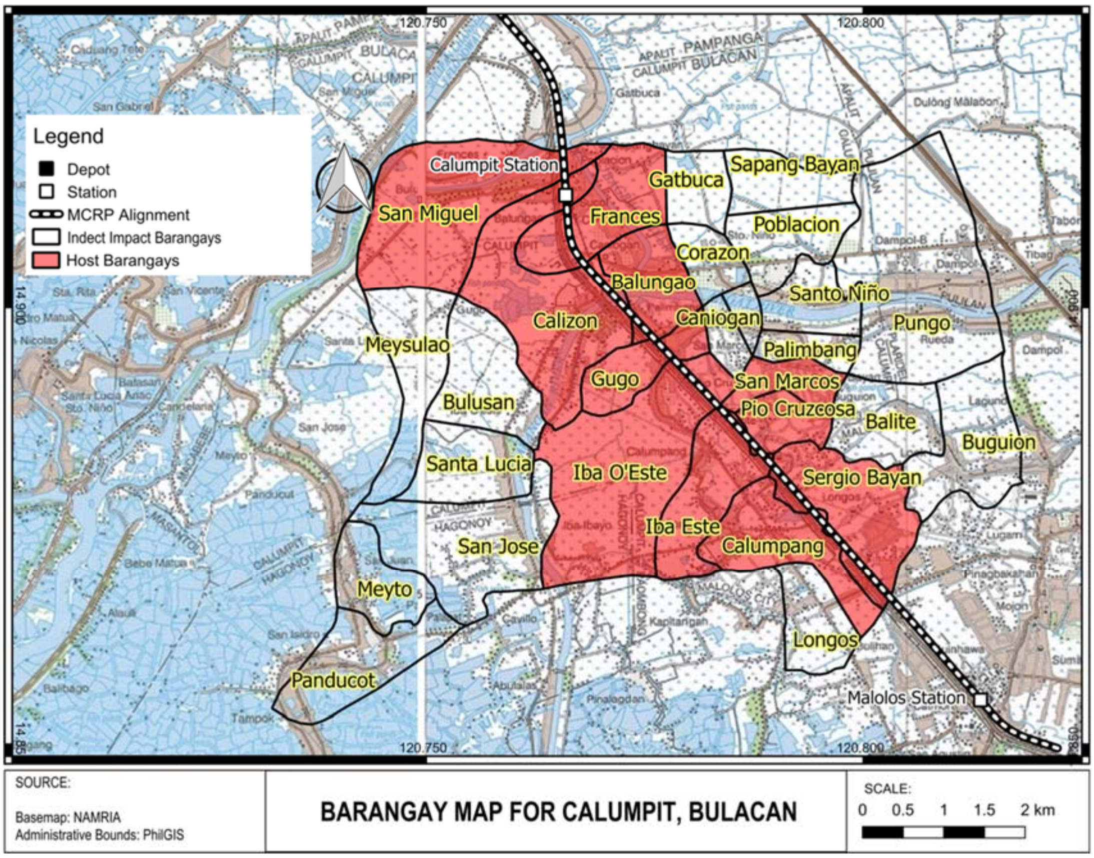


Figure 1.1.3 Direct and Indirect Impact Barangays in Calumpit

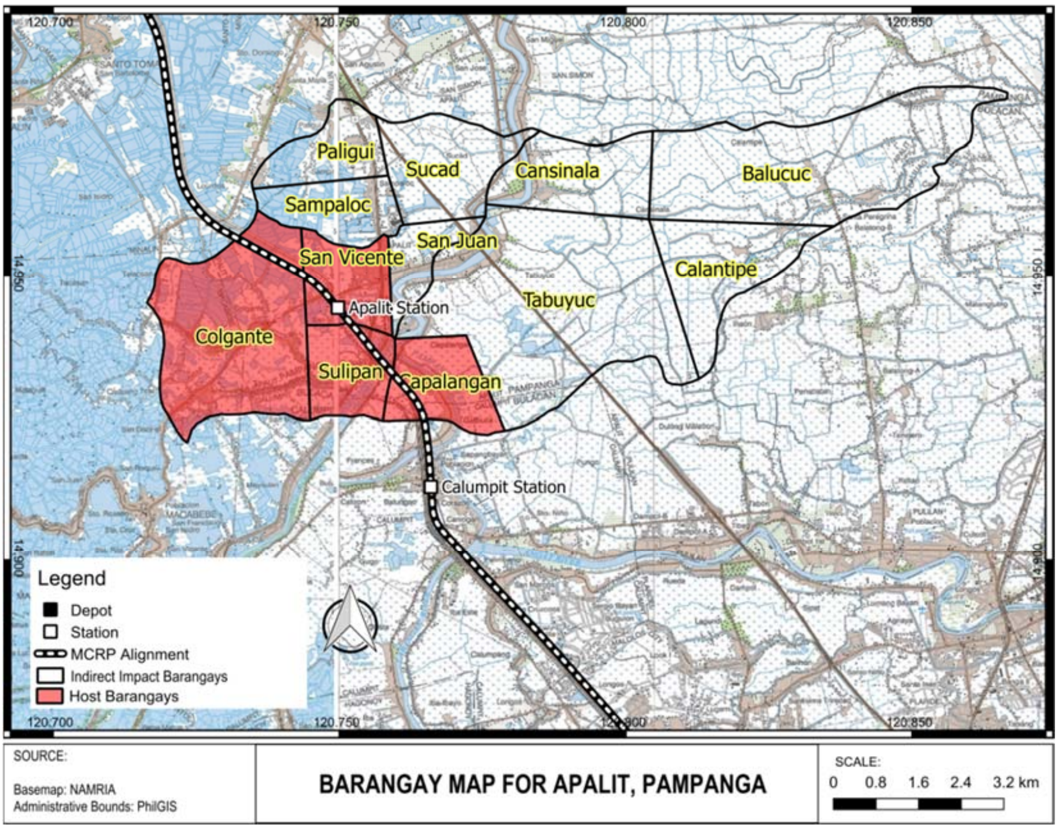


Figure 1.1.4 Direct and Indirect Impact Barangays in Apalit

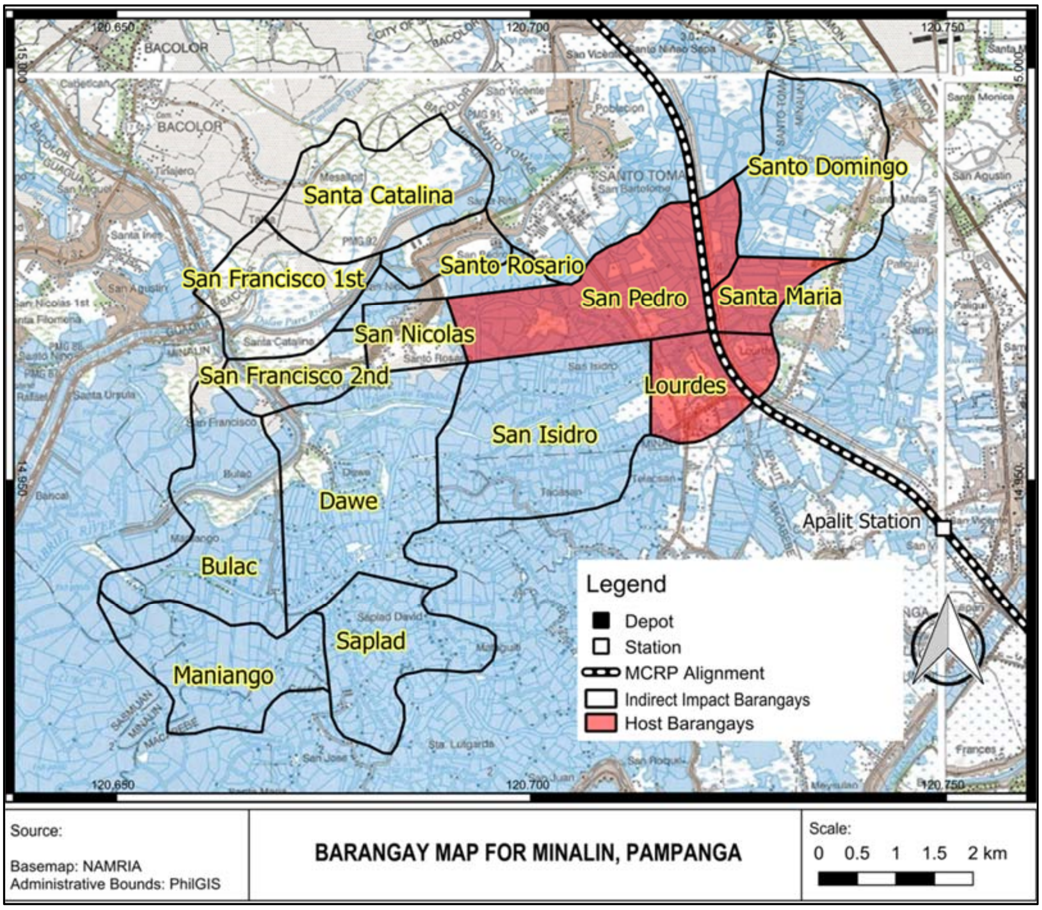


Figure 1.1.5 Direct and Indirect Impact Barangays in Minalin

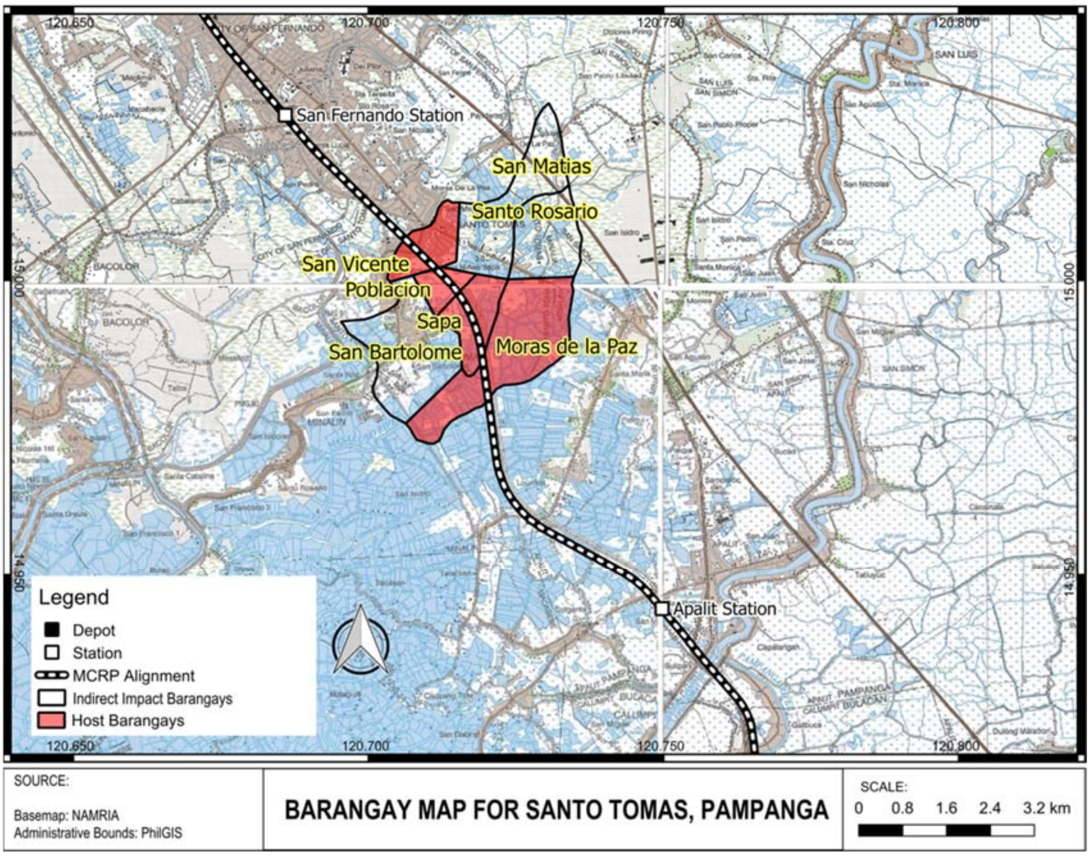


Figure 1.1.6 Direct and Indirect Impact Barangays in Sto. Tomas

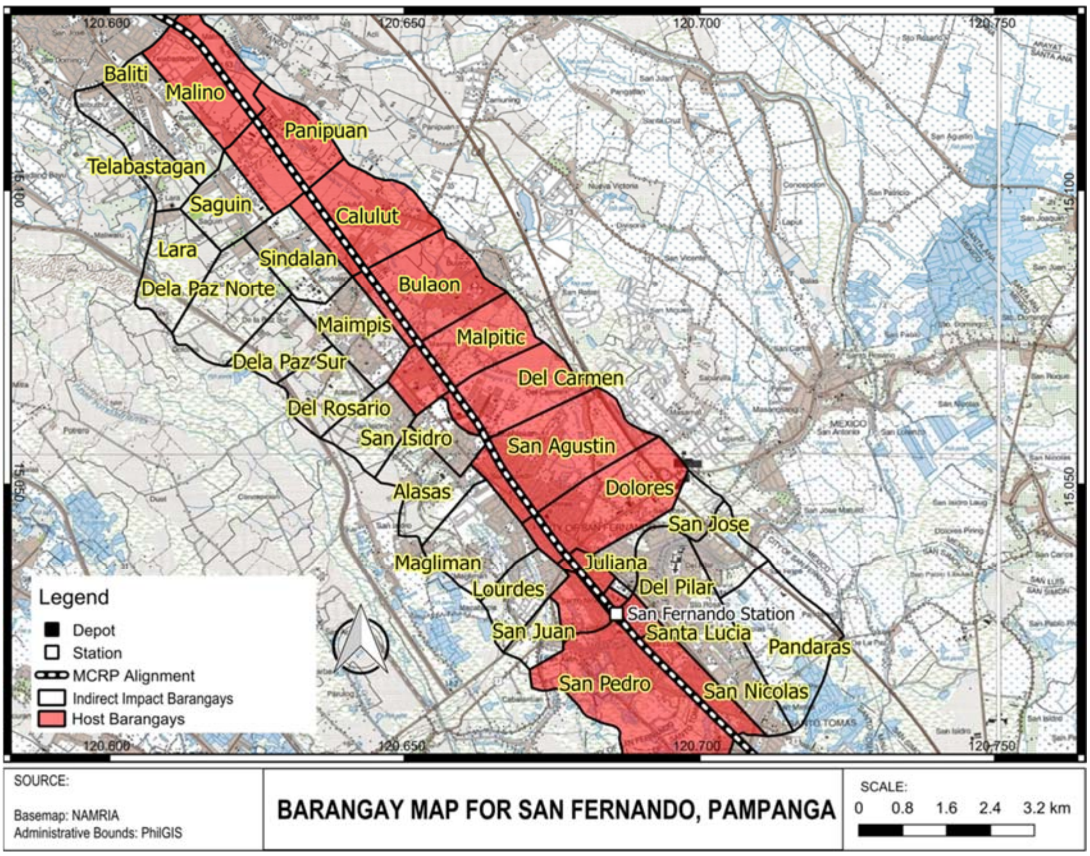


Figure 1.1.7 Direct and Indirect Impact Barangays in San Fernando

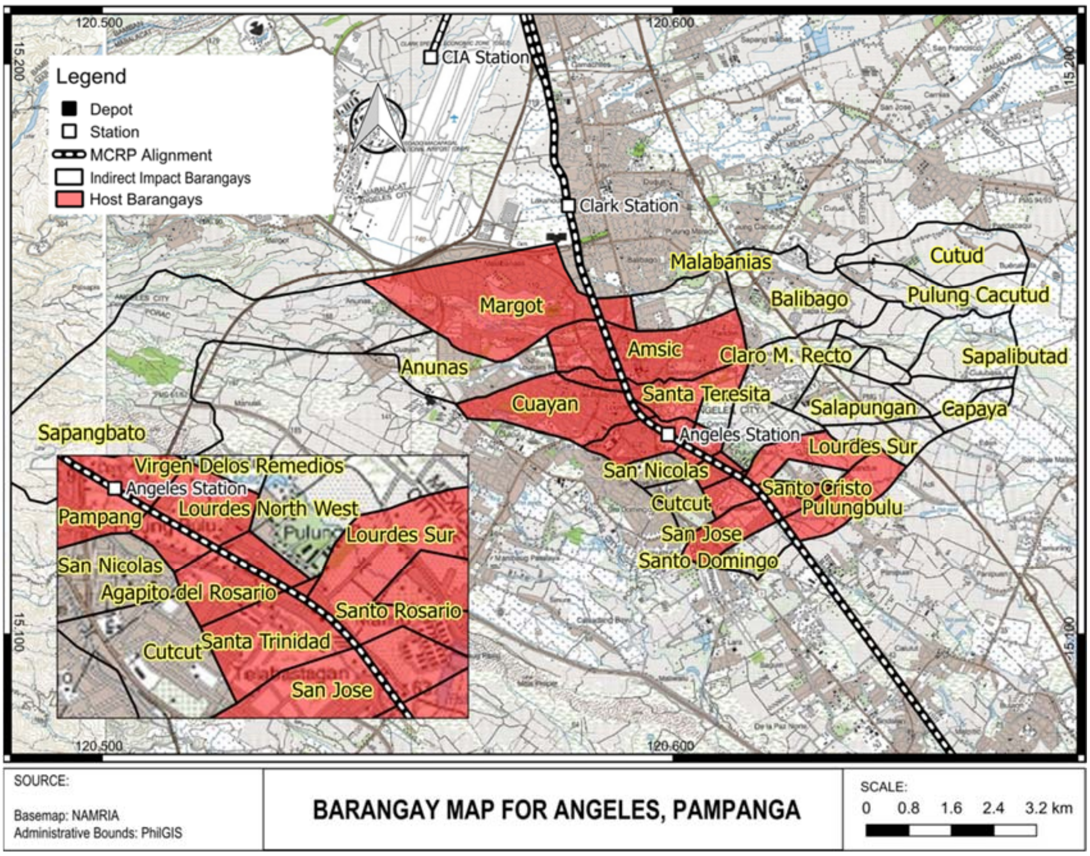


Figure 1.1.8 Direct and Indirect Impact Barangays in Angeles

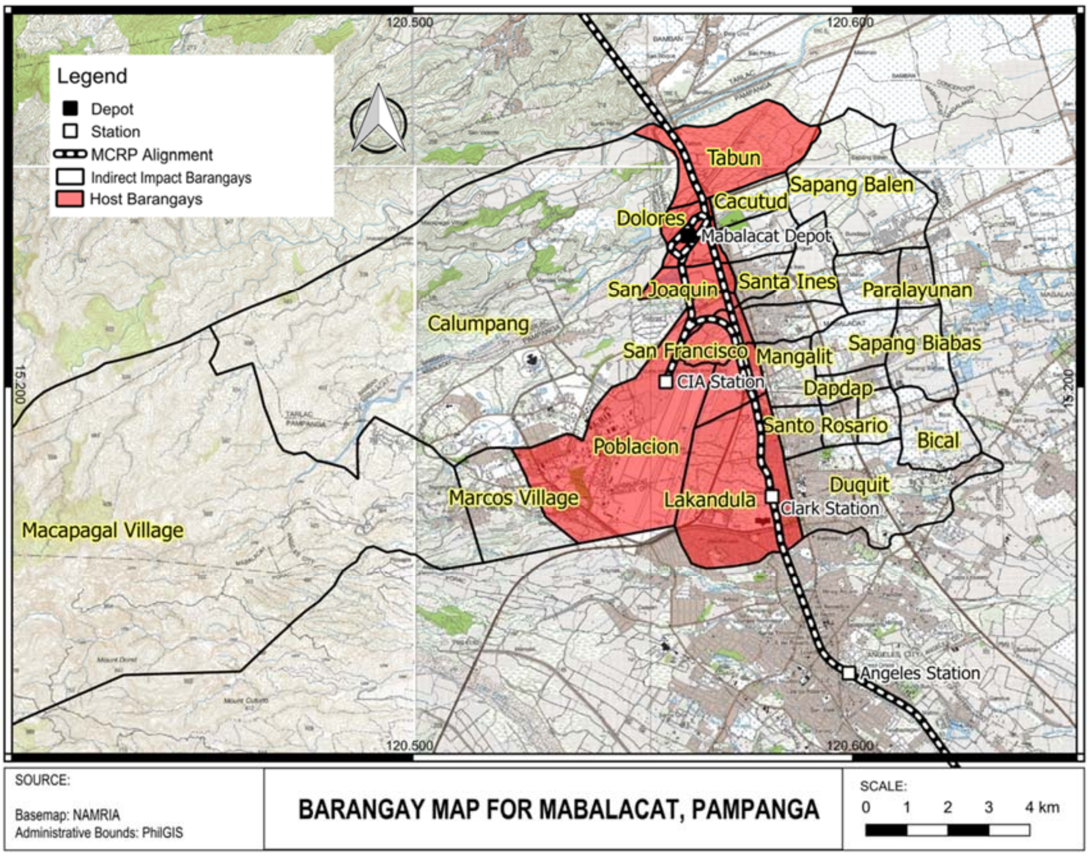


Figure 1.1.9 Direct and Indirect Impact Barangays in Mabalacat

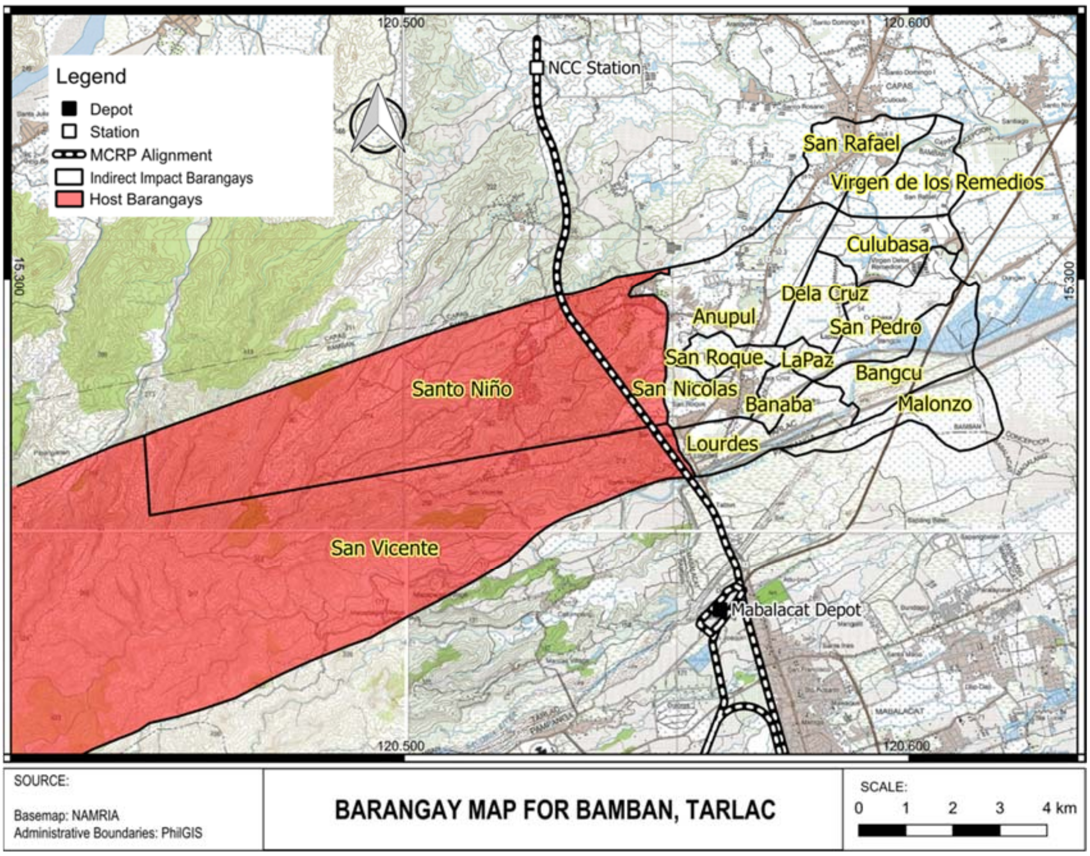


Figure 1.1.10 Direct and Indirect Impact Barangays in Bamban

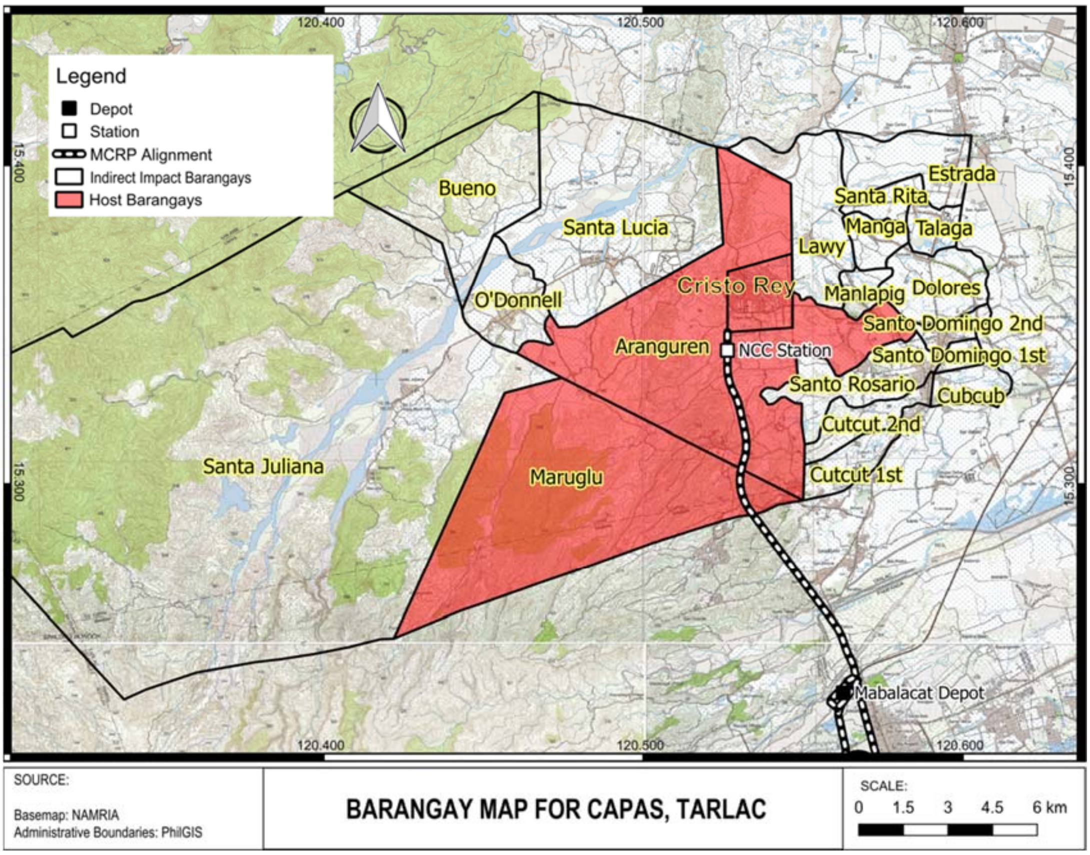


Figure 1.1.11 Direct and Indirect Impact Barangays in Capas

1.2 PROJECT RATIONALE

38. The population of Metro Manila in the Philippines increased by 1.5 times from 8.0 million in 1990 to 12.0 million in 2010. With a population density of 20,000 per km², NCR is home to about 13% of the population of the Philippines and the main economic centre accounting for 38% of the country's gross domestic product (GDP).

39. Severe traffic congestion and environmental degradation characterize Metro Manila particularly at city centers where high density development continues. Urban sprawl has spilled over onto surrounding northern and southern provinces which are within daily commuting distance from Metro Manila. With increasing vehicle ownership, congestion is expected to worsen, further increasing travel times of commuters.

40. Urban rail services including Metro Rail Transit (MRT), Light Rail Transit (LRT) and commuter rail offer a more efficient alternative to road-based transport, however, the existing network needs to be significantly expanded in reach and capacity in order to meet the increase daily passenger transit demand. A mass transit service connecting Metro Manila with its adjacent areas is currently limited and as such, this presents a significant bottleneck to the further development of Metro Manila and its adjacent northern and southern suburban areas.

41. For this reason, the expansion of the existing mass transportation system has been identified by the Government as one of its highest priorities. Based on the Metro Manila Urban Transportation Integrated Study (MMUTIS) formulated by the Philippine Government in 1996, with the technical and financial assistance from JICA, an Urban Development Plan and Transportation Network Development Plan were established with 2015 as the target year.

42. Today, Manila is serviced by LRT1, LRT2, and MRT3, total length of 51.2 km of railway services. However, there is still a large demand for mass public transport to meet the transit need of the fast growing and highly dense Metropolis. While there is a rail commuter service by the PNR connecting the capital to the southern cities as far as Biñan, Laguna, there is no such service to the north of Metro Manila. Moreover, areas as far as Malolos to the north are rapidly developing into residential areas without the corresponding provision in public transport provision.

43. To guide the development of new urban centers and to meet large residential demands, a commuter railway service to connect Metro Manila with its adjacent northern and southern suburban areas is deemed to be an important mass transit backbone for Metro Manila as well as for the growth corridor of the GCR, comprising of Region III, Metro Manila and Region IV-A.

1.3 PROJECT ALTERNATIVES

1.3.1 ROW Alternatives Options

1.3.1.1 Alternatives for Malolos to CIA

(1) Alternatives

44. DOTr considered two (2) route options for the proposed MCRP: (1) PNR ROW; and (2) NLEX ROW (**Figure 1.3.1**) under the Feasibility Study on Clark-Manila Railway Project in July 2017.

1) PNR ROW Option

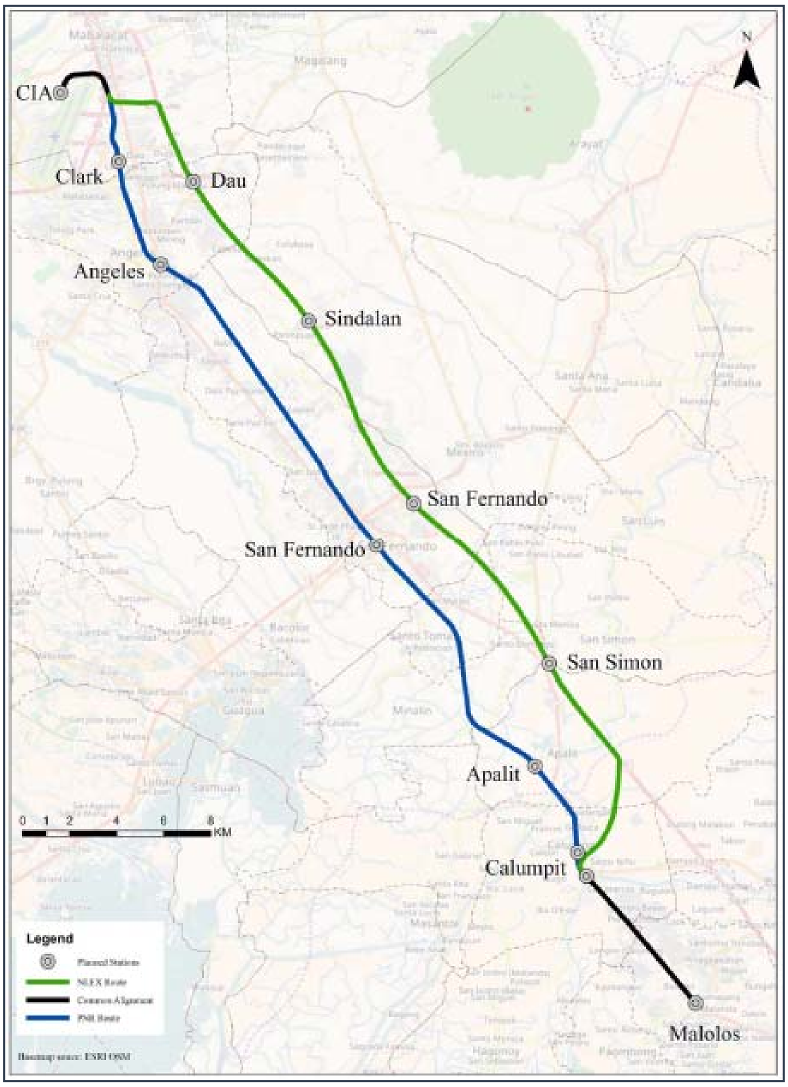
45. The PNR ROW has a total length of 51 km from Malolos to Clark and the alignment is basically located in agricultural areas and developed areas. The sections resting on agricultural

areas are basically vacant while those sections located along developed areas will be mainly secured from the Clark Development Corporation (CDC).

2) NLEX ROW Option

46. The NLEX ROW with a total length of 52.2 km starts at 5.8 km before San Simon Interchange after coming out from the PNR alignment in the town center of Calumpit, Bulacan. The NLEX ROW route will run alongside the boundary of the NLEX ROW northwards. It will then traverse Apalit Interchange, San Fernando Interchange, Sindalan Interchange, and Dau Interchange prior to veering west towards Clark Special Economic Zone (CSEZ). This will be running along the boundary and parallel to the CIA runway.

47. DOTr will utilize the existing PNR ROW from Malolos NSCR Station to Angeles and Clark, including Mabalacat. The PNR ROW is recommended with major positive points such as lower costs with less construction delay factors (such as affected houses, land acquisition, and affected trees) as compared to the NLEX ROW.



Source: Feasibility Study on Clark-Manila Railway Project, July 2017

Figure 1.3.1 Route Options

(2) Comparison of Alternatives

1) Social and Environmental Impact

48. Some sections of the railway alignment may require more than the existing PNR ROW due to large structures. On the other hand, the central section of the NLEX ROW consists of paved travel ways, medians, and paved shoulders. The outer sections of the paved NLEX lanes are usually covered with grasses and/or planted with trees. Moreover, most of the trees are fully grown and close to the ROW boundaries at both west and east sides. While there are spaces on both sides of the carriageway, the western side is constrained by the presence of high voltage power lines and cables. The proposed MCRP could run inside the boundary of the expressway ROW. However, only a 7.5 m ROW next to the existing paved lanes could be available for the NLEX route with 917 trees lined up along the entire alignment, considering the existing NLEX structures. This would necessitate additional lands adjacent to the expressway ROW.

2) Legal Considerations

49. The PNR ROW is secured government property of the PNR, which is under the DOTr. The area is intended for railway infrastructure. Thus, using the property for the proposed MCRP will not encounter any significant legal issue.

50. On the other hand, the NLEX ROW though owned by the Philippine Government, its exclusive and unrestricted right to use is granted to the Manila North Tollways Corporation (MNTC) through the Supplemental Toll Operating Agreement (STOA). This is for the entire duration of the concession period from 2000 to 2037. The ROW that will be used for the proposed MCRP has to be approved by both the Government and MNTC. This may cause a breach of the contract leading to the termination of the STOA and eventually may lead to a long and cumbersome legal proceedings.

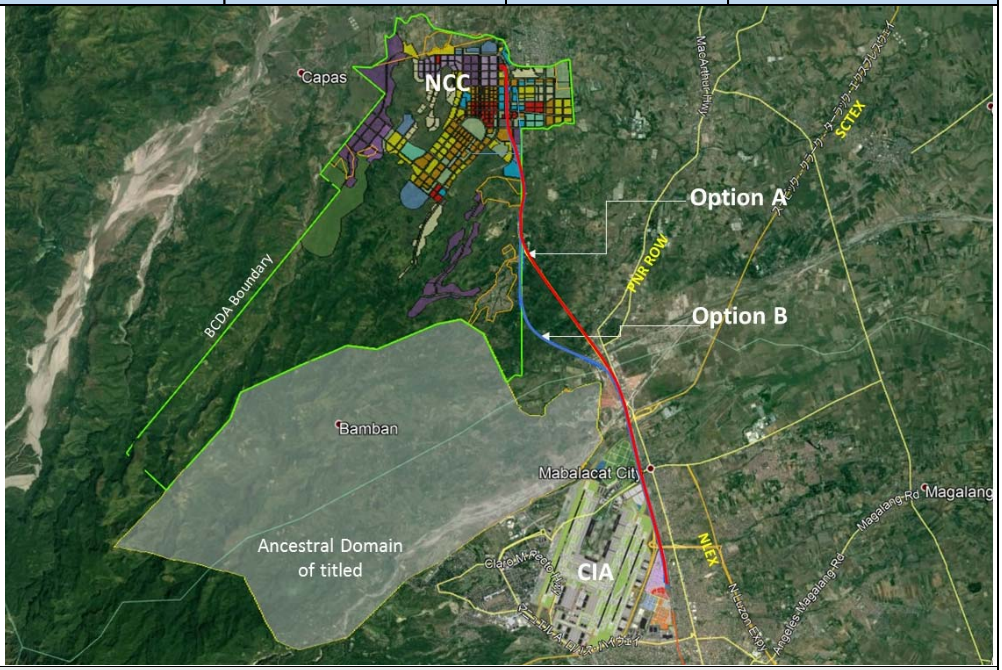
3) Costs

51. The PNR route will entail 150.31 Billion Pesos (US$ 3.01 Billion) for compensation and construction costs while for the NLEX route, the project cost was estimated at 181.31 Billion Pesos (US$ 3.63 Billion).

1.3.1.2 Alternatives for CIA to NCC

52. Two (2) ROW alternatives were considered for CIA to NCC and Clark to CIA. Option A has a longer distance and uses the existing arterial road of Bases Conservation and Development Authority (BCDA). On the other hand, Option B will maximize the BCDA property and has a shorter distance but will require more tunnels. Based on the letter provided by the NCIP dated April 24, 2018, both options will not traverse or overlap the Ancestral Domain areas in Bamban (**Annex 1-2**). However, cosidering the cost for the land acquisition and tunneling, Option A was chosen as the better route from CIA to NCC. The result of alternative analysis is shown in **Table 1.3.1.**

Table 1.3.1 Comparison of ROW Alternative for CIA-NCC Route

	Option A	Option B
Alternative options		
Social Environment		
Land Acquisition	Slightly more new land acquisition compared to Option B	Minimum new land acquisition
Affected Households	Very few	Very few
Historical/Cultural Heritage	No historical/cultural heritage along the alignment	No historical/cultural heritage along the alignment
Indigenous People/ Ethnic Minorities	Does not pass through Ancestral Domain area	Does not pass through Ancestral Domain area
Natural Environment		
Protected Area	No Protected Area along the alignment	No Protected Area along the alignment
Biodiversity	Passes through Sacobia River which was affected by the eruption of Mt Pinatubo	Passes through Sacobia River which was affected by the eruption of Mt Pinatubo
Pollution Prevention		
Noise and Vibration (Outside train)	Tunnel blasting might cause noise and vibration pollution which can be mitigated	Tunnel blasting might cause noise and vibration pollution which might be mitigated
Air Pollution	Tunnel blasting might cause air pollution which can be mitigated.	Tunnel blasting might cause air pollution which can be mitigated
Water Pollution	Few impact	Few impact
Others		
Construction Period	The tunnel length will be shorter than Option B.	The tunnel length longer than Option B and will need a longer period of time for construction.
Construction Cost	Construction cost is lesser than Option B	Construction cost is higher than Option A
Total Evaluation	Technically and financially suitable and preferred alignment.	Pollution will be generated longer period.

Source: JICA Study Team

1.3.2 Structure Alternative Options

53. Malolos-Clark section will pass through residential areas and has a lot of road crossings with arterial roads. There are also flood prone areas. **Table 1.3.2** shows Elevated Structures Option and Reinforce Soil Wall Structure Option for Malolos-NCC section (excluding Clark-CIA section). **Table 1.3.3** shows the Underground Option for the Clark-CIA section.

Table 1.3.2 Comparison of Structural Type of Structures MCRP (Malolos-NCC)

	Elevated Structure Option	Reinforce Soil Wall Structure Option
Social Environment		
Land Acquisition	Narrow ROW will be required	Wider ROW will be required than the Elevated Structure for the amelioration of the soil

	Elevated Structure Option	Reinforce Soil Wall Structure Option
Affected Households	Resettlement of PAPs and ISFs within the ROW is necessary	Resettlement of PAPs and ISFs within the ROW is necessary
ROW	The necessary ROW between stations is 20-30m, and 60m at the station	The necessary ROW between stations is 20-30m, and 60m at the station
Dividision of local community	Few impact of community division	Very large impact of community division
Natural Environment		
Protected Area	Lesser impact than Reinforce Soil Wall Structure Option is expected	A large impact is expected
Biodiversity	Lesser impact than Reinforce Soil Wall Structure Option is expected	A large impact is expected
Flooding Risks	As it is an elevated structure, the tracks will not be submerged in case of flooding	As the embankment will act as a dam, additional drainage will be necessary to minimize flooding
Pollution Prevention		
Noise (Outside train)	There will be noise along the railway, but the impact can be mitigated by putting up sound insulating walls	There will be noise along the railway, but the impact can be mitigated by putting up sound insulating walls
Air Pollution	The operation of construction machinery and vehicles during construction is expected to generate air pollution	There will be many vehicles loading embankment material during construction and air pollution is expected
Water Pollution	Few impact	Few impact
Ground Subsidence	No ground subsidence	There is risk of land subsidence in case of soft ground
Engineering		
Construction Time	Long	Long as soil improvement is necessary
Construction Cost	Cheaper than the underground structure	Same as elevated structure as soil improvement is necessary
Operation /Maintenance	Maintenance time and cost are lesser than the underground structure	Maintenance time and cost are the lower, but in case of ground subsidence or condition change, reparation is very difficult
Disaster Prevention	Relatively safe and measures are easy compared to underground structure	Relatively safe and measures are easy compared to elevated structure
Earthquake	Structures are designed in consideration of earthquakes	Structures are designed in consideration of earthquakes
View from the Windows	Good	Good
Landscape	Elevated structure feels more liberated than reinforce soil wall structure, but the design needs to consider the landscape	Reinforce wall structure feels more obstructed than elevated structure, the design needs to consider the landscape
Physical Conditions	Few impact to the road	Few impact to the road
Evaluation	After overall evaluation, it is the most suitable structure	It has a big impact on roads and there are fewer merits compared to elevated structure

Source: JICA Study Team

Table 1.3.3 Comparison of Structural Type of Structures MCRP (Clark-CIA)

	Elevated Structure Option (Same as Table 1.3.2)	Underground Option
Social Environment		
Land Acquisition	Narrow ROW will be required	Wider ROW will be required
Affected Households	Resettlement of PAPs and ISFs within the ROW is necessary	No resettlement needed for the land above the tunnel
ROW	The necessary ROW between stations is 20-30m, and 60m at station	The necessary ROW between stations is 20-30m, and 60m at station
Division of local community	Few impact of community division	No impact of community division
Natural Environment		
Protected Area	Lesser impact than Reinforce Soil Wall Structure Option is expected	Tunnel structure have very few impact on the ground
Biodiversity	Lesser impact than Reinforce Soil Wall Structure Option is expected	Tunnel structure have very few impact on the ground
Flooding Risks	As it is an elevated structure, the tracks will not be submerged in case of flooding	Need to take measures to prevent submersion in the tunnel in case of flooding
Pollution Prevention		
Noise (Outside train)	There will be noise along the railway, but the impact can be mitigated by putting up sound insulating walls	There will be no noise along the railway
Air Pollution	The operation of construction machinery and vehicles during construction is expected to generate air pollution	During construction, transportation of excavated soil by vehicle is expected to generate air pollution
Water Pollution	Few impact	Possible impact on underground water due to

	Elevated Structure Option (Same as Table 1.3.2)	Underground Option
		construction
Ground Subsidence	No ground subsidence	Low risk of flooding because of underground structure
Construction Time	Long	Longest
Engineering		
Construction Cost	Cheaper than underground structure	Very expensive
Operation /Maintenance	Maintenance time and cost are lesser than underground structure	Maintenance time and cost are higher
Disaster Prevention	Relatively safe and measures are easy compared to underground structure	If fire occurs in the tunnel, it will become a big disaster
Earthquake	Structures are designed in consideration of earthquakes	Structures are designed in consideration of earthquakes
View from the Windows	Good	Bad
Landscape	Elevated structure feels more liberated than reinforce soil wall structure, but the design needs to considerate the landscape	No impact on landscape because of underground structure
Physical Conditions	Few impact to the road	No impact on roads
Evaluation	Not as convenient, but technically and financially the better option. Subject to CAAC Aerodrome Height Restrictions.	Very convenient but very expensive and has a long construction period

Source: JICA Study Team

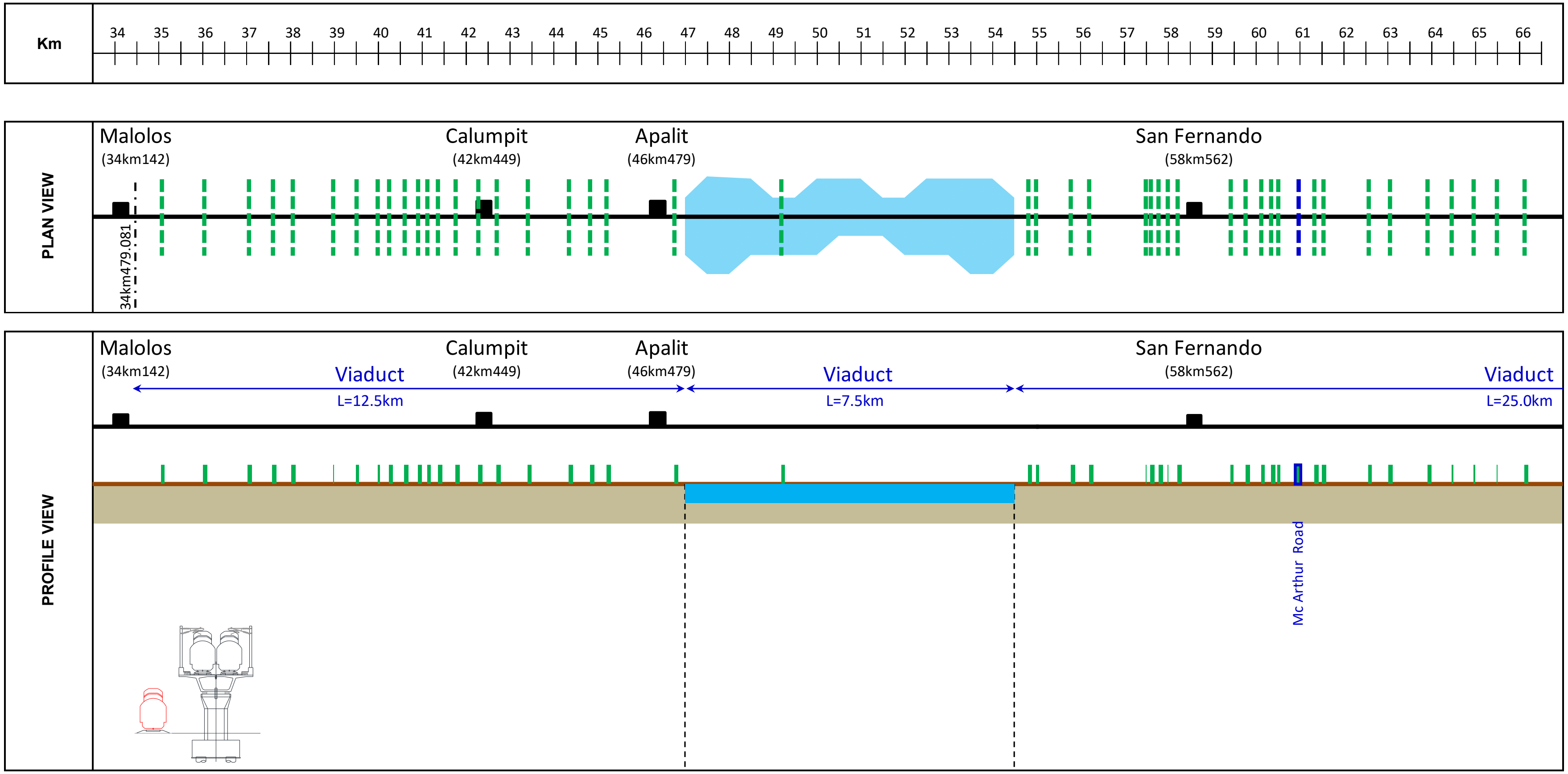


Figure 1.3.2 Draft Proposed Vertical Structure (1/2)

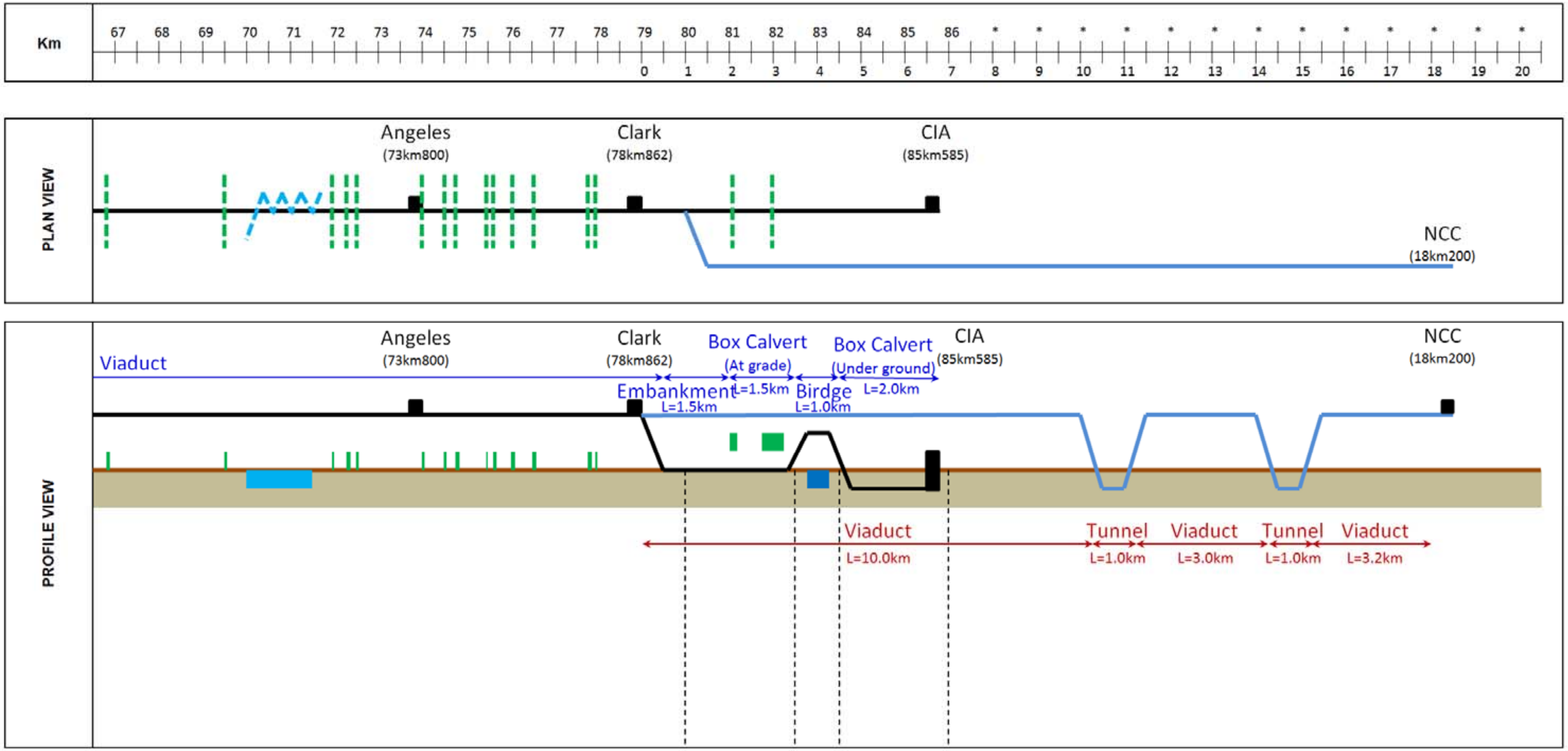


Figure 1.3.3 Draft Proposed Vertical Structure (2/2)

1.3.3 Depot Alternative Options

54. The required area of the depot is approximately 40 to 45 hectares including the space for the training center for railway personnel. Two (2) sites were considered for the Depot, Option 1: Along Sacobia River near CIA with an estimated area of more than 0.4 km^2 (40 hectares); and Option 2: Northwest of Xevera Subdivision with an estimated area of 0.42 km^2 (42 hectares). Based on the assessment presented in **Table 1.3.4**, Option 1 was chosen as the better location of the depot. However, futher investigation will be conducted for the site of the proposed Mabacat Depot due to its close proximity to CADT 025-A. DOTr is currently coordinating with the NCIP for the conduct of field-based investigation (FBI) to determine whether or not the location of the proposed Mabalacat Depot overlaps with, or affects an Ancestral Domain area.

Table 1.3.4 Alternative Comparison of Depot Site

	Option 1 Along Sacobia River near CIA	Option 2 Northwest of Xevera Subdivision
Picture		
Social Environment		
Land use	Unused 40 ha land owned by BCDA	Approx. 42 ha agricultural land (Rice paddy)
Land Acquisition	No need for land acquisition	Need new land acquisition
Resettlement	Resettlement of 122 ISF	Risk of loss of income for farmers
Natural Environment		
Protected Area	No protected area around the Project site	No protected area around the Project site
Land Alteration	Loss of upland and forest (approx. 30 ha)	Loss of agricultural land (approx. 42 ha)
Pollution		
Noise and Vibrations	There is a risk of noise and vibration impact on residential area	Small impact of noise and vibration as there is no residential area nearby
Water	Risk of water pollution of Sacobia river due to mud water discharged during construction	Risk of water pollution of Sacobia river due to mud water discharged during construction
Engineering		
Construction	Short railroad siding, favorable cost wise	Long railroad siding, not favorable cost wise
Operation	Near CIA, convenient for commuting CIA	Far from CIA and less convenient for commuting
Access	Limited land, difficult to provide access for both northbound and southbound line	Free land, possible to provide access to both northbound and southbound line
Evaluation	As there is no need of land acquisition, the site is outside the Ancestral Domain, the land is fit to be used as depot site and suitable option	There are no houses to be affected by noise and vibrations, but because of new land acquisition, cost and less convenience, the total evaluation is low

Source: JICA Study Team

1.3.4 Technology Option

55. The DOTr will utilize an Electric Multiple Unit (EMU) Train for the Project. An EMU is consist of self-propelled carriages that uses electricity as the motive power. An EMU requires no separate locomotive, as electric traction motors are incorporated within one or a number of the carriages. An EMU is usually formed of two or more semi-permanently coupled carriages, but electrically powered single-unit railcars are also generally classified as EMUs.

56. EMUs are popular on commuter and suburban rail networks around the world due to their fast acceleration and pollution-free operation. Being quieter than Diesel Multiple Units (DMU) and locomotive-drawn trains, EMUs can operate later at night and more frequently without

disturbing nearby residents. In addition, tunnel design for EMU trains is simpler as no provision is needed for exhausting fumes, although retrofitting existing limited-clearance tunnels to accommodate the extra equipment needed to transmit power to the train can be difficult.

1.3.5 No Project Option

57. Public transportation access from the suburbs to Metro Manila is not sufficient, and it is a bottleneck for further development towards the northern and southern direction. The northern part of the metropolis up to CIA has no operating rail traffic, and residential areas are expanding without sufficient public transportation. In the southern part, very few non-electrical PNR trains are operating up to Calamba in the Province of Laguna. Urgent measures are needed to ensure public transportation linking the northern and southern parts to the metropolis.

58. Therefore, if MCRP which is the railway system linking the northern part of the metropole to Metro Manila stays undeveloped, sustainable growth of local industry will be hampered and the environment of the area will deteriorate further by the traffic congestion and air pollution. Therefore, not pursuing the Project is not an option.

1.4 PROJECT COMPONENTS

59. This section presents the main components, support facilities, pollution control devices, and temporary facilities for the MCRP.

1.4.1 Railway Characteristics

60. In MCRP, both local trains and airport access trains come from Metro Manila and head to CIA. The proposed maximum speed of the airport access train is 160 km/h in contrast to 120 km/h of local trains. Thus, for the high-speed operation of the airport access train, MCRP will have the capability to achieve the higher speed than NSCR Project, which is under preparation for the construction.

61. In addition, there is a large speed difference between the airport access train and the local train. Thus, facilities for a train to pass another train will be equipped enough. Otherwise, the train headway would not be short.

62. As for the topographic features, the elevation is relatively flat from Malolos to San Fernando, and then, it gets gradually higher towards Clark. Nevertheless, this section can adopt the viaduct structure in general, will be adopted in this segment, since there is no sharp gradient obstructing the railway operation. However, the area from Clark northwards towards NCC has hilly terrain. Thus, this segment, it might have the tunnel section depending on the selection of route.

1.4.2 Main Components

63. The main components of MCRP includes: 1) Main railway line, 2) Stations, 3) Maintenance Depot, 4) E & M System, and 5) Rolling Stock. Details of each main component are as follows:

(1) Main Railway Line

64. The MCRP alignment is 51 km long from Malolos to Clark and around 72.5 km up to NCC. The track will consist of PC Sleeper and Ballast (Crushed stone). The required ROW width of the railway track is set at 30 m all along the alignment (width of viaduct is 10.3 m).

(2) Structure Type

65. The proposed vertical alignment is taken at ground level as much as possible, when the vertical clearance is satisfied, otherwise the vertical alignment is designed elevated. The elevated section (viaduct) is planned at urban area for over 62.7 km, whereas the grade/embankment section is planned for 4.8 km. Possible underground is 5km from Clark Station to CIA and from CIA to NCC. **Figure 1.4.1** to **Figure 1.4.3** show the cross section of a typical viaduct, embankment, and at grade respectively.

1) Viaduct

66. PC segmental box girder has been planned with 40m span as the optimal span based on ground condition study. The policy of the optimal span will be considered according to the ground conditions and construction assumption based on the previous plan.

Figure 1.4.1 PC segmental box girder

2) Embankment

67. Embankment will be adopted where it would not impact the regional split. Namely, the embankment will be planned in the suburbs areas and farmlands. The Embankment Profile Plan is better to set a lower alignment and allow for economical efficiency.

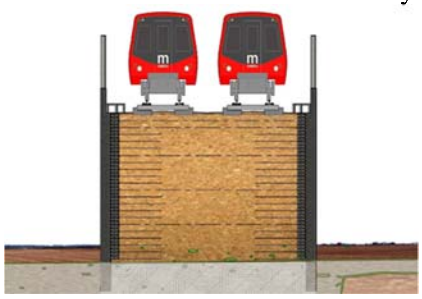


Figure 1.4.2 Cross-section of typical Embankment

3) At Grade

68. At grade will be adopted where it would not impact to the regional split. The at grade section will be planned in the suburbs areas and farmlands where elevating the railway is not necessary for economical efficiency.

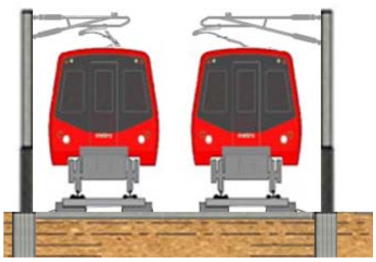


Figure 1.4.3 Cross-section of typical At Grade

(3) Stations

69. There will be seven (7) stations along the MCRP alignment. All stations will be elevated and will have a ROW width of 60 m (including the tracks). Basically, the station layout has two (2) separate platforms, serving two (2) tracks except the station with a single platform at the center.

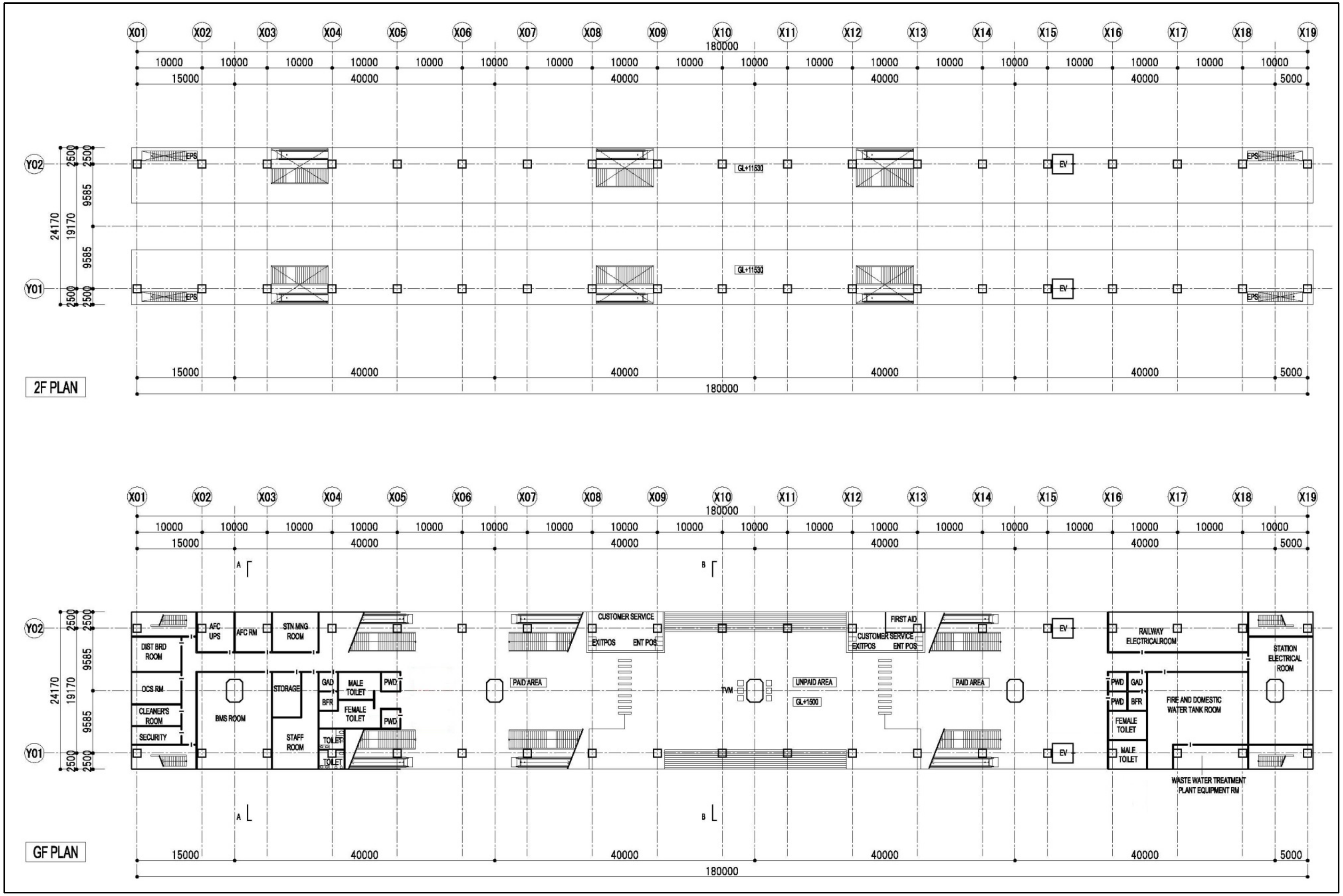
70. The stations will also adopt universal design, which will incorporate the Barrier-Free Guidelines for elderly, children, and persons with disabilities by both Philippines and Japan. The proposed measure is to provide elevator and escalators, in addition to stairs for vertical movement of passengers from streets to stations' platforms. **Figure 1.4.4** shows the cross section of the alignment at the station and the sample design of the station.

71. The estimated required space and major dimensions the stations are shown in **Table 1.4.1**. Final specifications will be determined in the DD phase.

Table 1.4.1 Draft Specification of Proposed Station

Items	Description
Total required width for station	approx. 23 m for single platform, approx. 40 m for two platforms
Platform Length	220 meters (platform length for 8 car train)
Platform width	8 m
Structure Type:	2 to 4 storeys
Other facilities of the stations	a) Stairs, Elevators and Escalators b) Restrooms/toilets c) Automatic Fare Control systems consisting of Ticket Vending Machines, Automatic Gates, Automatic Fare Adjustment Machines, Data Collecting Machines and office booking machines d) Information Counter and e) Emergency exits.

Figure 1.4.4 Sample Design of the Station



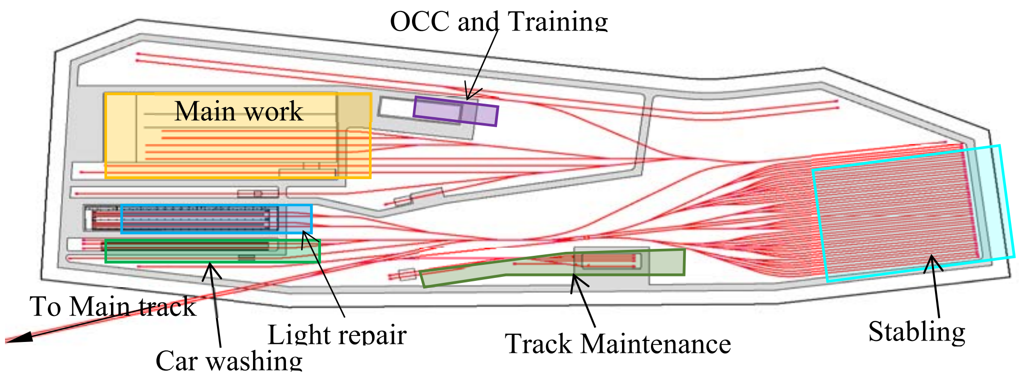
Source: JICA Design Team

Figure 1.4.5 Typical Layout of the Station

(4) Maintenance Depot

72. The depot will be located in an area along Sacobia near CIA. The lot area is approximately 40 hectares. The depot will serve as an area for stabling, maintenance, inspection, and train repair. Also, the depot will function mainly as a central command office which conducts the operation control of the main line and the integrated management of electricity, facilities for the crew, and the maintenance base for track, power supply system, signaling, communication systems, and civil and architectural facilities. **Figure 1.4.6** shows the layout of the depot site.

- Operation control center
- Maintenance and workshop buildings
- Access tracks
- Train storage tracks
- Workshop for heavy rolling stock maintenance
- Light repair shop
- Catenary and track maintenance shops
- Unscheduled Repair Shop
- Wheel Re-profiling Shop
- Car washing track
- Test track
- Sub Stations
- Sewage treatment plant, Storm water reservoir, Emergency facility
- Access Road inside depot, car parking, light, fence etc.



Source: JICA Study Team

Figure 1.4.6 Layout of the Depot Facility

(5) E & M System

73. E & M System refers to the electrical, mechanical, communication and automation, water services, fire detection and protection systems. This includes but not limited to the following:

Table 1.4.2 Proposed E & M System (Draft)

Item	Description
Train Operation	Limited express train, express train and commuter train
Railway operator	Single operator
Rolling Stock	DC EMU (As describe in (6))
Propulsion system	Self-cooling and four (4) traction motors control system, IGBT or Hybrid-SiC device, Apply to High-efficiency totally enclosed traction motor, possible of continuous round-trip, tow or rescue the failed train which has the same weight
Brake system	Service brake, emergency brake and security brake
Signal System	Communication Based Train Control (CBTC)
Train Management System	2 independent systems, a network of 100 Mbps

Item	Description
Communication system	Backbone system, Radio system, Voice and Data system, Closed Circuit television system, Passenger information Display system, Public Address System, time server and master clock system, meteorological and seismic monitoring system, railway facility monitoring system
Power Supply	DC 1500V centenary system, substations are set every 3-5 km, power supplied by MERALCO
Maintenance	Departure inspection, light maintenance, heavy maintenance, other maintenance
Others	Automatic Fare Collection System

(6) Rolling Stock

74. The DOTr will utilize an EMU Train for the proposed MCRP. Therefore, the power supply system rolling stock is required for train operating electric power.

75. DOTr plans to operate three (3) types of train services in this project, namely, 1) Commuter train, 2) Express Commuter train, and 3) Airport Limited Express train, which can connect CIA and the center of Manila within 1-hour.

76. Commuter train will have a total of 17 rolling stock (136 cars) with a capacity of 2,200 passengers (seating + standing) per train set. The train's maximum speed is 120 km/hr and will be fully air-conditioned. Whereas, the Limited Express will have a total of 13 rolling stock (104 cars) with a capacity of 400 passenger (seated) per train set, with maximum train speed of 160 km/hr and fully air-conditioned.

Figure 1.4.7 Sample of an EMU Train

1.4.3 Support Facilities

(1) Substation Facilities

77. Substations will be equipped with supporting facilities of receiving facilities, and transformers and rectifiers and facilities for supplying power to the railway system.

(2) Drainage Facilities

78. Drainage facilities will be installed to ensure that the Project structures (viaduct, embankment, at grade track) will minimize the adverse impacts by safely converting runoff from the rail to the identified discharge points and introduce applicable improvement to rivers affected by the alignment. In other words, it is to ensure that the project will not impede any drainage channels and contribute to any flooding. Drainage system of station is considered a minor system while the drainage system of Depot is considered a major system.

79. Revetments or river bank protection and river bed protection will be provided at rivers and stream crossing wherever necessary. Bridge abutments and bridge pier foundation may also be provided with protection if warranted.

(3) Administration and Operation Centre

80. Administration building will be built, which will house the control rooms, office, security/first aid, kitchen/dining, toilet/locker, workshop and consumables.

(4) Training Centre

81. DOTr considers to establish Philippine Railway Institute (PRI) as a governmental body attached to DOTr for promoting and executing a capacity building institution on railway matters. Driver's licenses and engineer's certifications will be issued by PRI. PRI will also prepare the materials and knowledge base for training in each railway organization.

1.4.4 Pollution Control Devices

(1) Air Pollution Control Facilities

82. The air pollution and noise levels which will be generated during construction of the MCR Project are temporary in nature. Nonetheless these will be appropriately mitigated. To minimize dust suspension, the following measures will be implemented:

- Minimize alteration of topography and removal of vegetation to minimise earthworks;
- Regular cleaning and clearing of construction access /sites of spoils and debris from construction equipment and vehicles and wetting of ground soil when necessary;
- Store excavated materials at designated disposal area. Construction materials and trucks loaded with spoils will be covered;
- Undertake daily cleaning of paved routes around the pier construction sites;
- Control vehicle movement maintaining the speed limit within the construction site to <10kph;
- Plant vegetation on bare ground as early as possible and create vegetated buffer zone where possible.
- Regular preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standards. Wherever possible, use electrically-powered equipment;
- Minimize vehicle transport by maximizing the use of site-generated materials.
- Air quality will be monitored at identified baseline sampling points including nearby sensitive receptors (residential, school and hospital areas) and ecologically significant area/s (if any) likely to be affected by the operation of construction machines and evaluate effectiveness of the air pollution reduction measures provided.

83. To mitigate the potential impacts of noise, the following measures will be implemented:

- Plan construction activities in consideration of time and scale of construction to optimize the use of construction equipment, machineries, and vehicles to minimize nuisance noise. Schedule high noise generating activities during daytime to reduce disturbance to nearby communities;
- Provision of temporary noise barriers such as acoustic curtains;
- Provision of noise control devices such as mufflers and noise suppressors for all construction equipment and machineries to help minimize the generation of noise. Use of electric instead of diesel powered equipment and hydraulic tools instead of pneumatic tools;
- Regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard;
- Minimize vehicle transport by maximizing the use and recycling of materials generated on-site;

- Provision of training on noise mitigation and provide appropriate personal protective equipment (PPE), e.g. earmuffs to construction workers; and
- Monitor noise levels at identified sampling point including nearby sensitive receptors (residential, school and hospital areas) including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provide.

84. During operation the proposed MCRP is not expected to generate air pollution. Noise from the operation of the EMUs is expected to be within standard limits. The use of long rails and ballast-less track with elastic and absorbent sleeper supports will minimize the noise generation from train operation. However, at the stations, buffer structures will be provided to reduce noise levels particularly in noise sensitive receptor areas. All generator sets will be provided with enclosures and mufflers.

(2) Water Pollution Control System

85. Wastewater from the administration and Depot Facilities will be treated in a Sewage Treatment Plant (STP) prior to discharge into receiving body of water. Effluent from STP will be monitored to ensure that its quality meets the DENR standards.

(3) Solid Waste Management System

86. Waste material generated will be classified as hazardous and non-hazardous wastes. Separate receptacles and storage areas will be established for each type of waste identified at the Project site. Non-hazardous solid waste will be classified as compostable, re-usable, recyclable, and residual. These will then be properly disposed of, based on their classification. DOTr will comply with disposal regulations as stipulated in the Ecological Solid Waste Management Act of 2000 or Republic Act 9003. Hazardous waste will be classified based on Republic Act 6969 or the Toxic Substances and Nuclear Wastes Control Act 1909. It will be handled, stored and transported according to Philippine standards and treated through DENR-accredited hazardous waste treaters. The following are the solid wastes generated from the proposed Project:

- Household waste consisting of compostable waste materials from food and recyclable or residual materials such as plastics, wrappers, crates or boxes for food supply of workers and/or employees;
- Debris and other materials removed from construction activities such as spoils or excavated materials;
- Industrial solid wastes, such as damaged vehicle and equipment parts, etc.;
- Hazardous wastes such as fuel/lube oil sludge, and bulbs.

1.4.5 Temporary Facilities

87. A temporary construction yard of approximately 48,000 m^2 will be located with the ROW. The temporary facilities that will be installed within the temporary construction yard will consist of the following, 1) Office (Contractor and Engineer), 2) Laboratory, 3) Labor Quarter (1,000 workers), 4) Warehouse, 5) Rebar, Form Fabrication Yard, 6) Batching Plant and 7) Segment Fabrication Yard. Separate ECCs will be secured by the Contractor for the Rebar, Form Fabrication Yard, Batching Plant and Segment Fabrication Yard.

1.4.6 Utility Requirements

88. Utility requirements during construction phase includes fuel, power supply, and water supply and construction access. Discussion of detailed information for the construction and operation phases is discussed below. During operation, fuel requirement for this phase involves the use of heavy equipment, transport and service vehicles.

1.4.6.1 Fuel Requirement

(1) During Construction

89. Fuel requirement during construction is estimated at 256,100 liters per year for the use of heavy equipment, transport and service vehicles.

(2) During Operation

90. Fuel requirement during operation is estimated at 20,000 liter/year for the use of back-up generators at stations during power interruption and for the service vehicles.

1.4.6.2 Power Supply

(1) During Construction

91. Power supply of 60,683,805 kWh/year will be sourced either by tapping at the nearest electricity source or through a generator set. Contractor will be required to submit an environmental and safety management plan for the use of generator sets.

(2) During Operation

92. The estimated power requirement during the operation phase is 420,118,650 kWh/yr. To ensure high reliability of power supply during the operation, adequate redundancies in the transmission and distribution will be incorporated in the detail design stage. Power supply will be sourced out from MERALCO.

1.4.6.3 Water Supply

(1) During Construction

93. Water for construction of the Project will be taken from the nearest water source/ provider. In the absence of such water provider, water will be sourced from the groundwater after obtaining necessary permit from the NWRB or by sourcing it out and delivery via water tank trucks (if one of the possible water supply option).

(2) During Operation

94. Water supply during operational phase will be sourced from the local water districts. Water usage will be minimal and limited to domestic use only (e.g. for usage in and maintenance of comfort rooms, etc.).

1.4.6.4 Construction Materials

95. The construction materials such as sand, steel, cement, etc. will be sourced locally. On the other hand, the railway tracks, the tension membrane for roofing and rolling stocks will be sourced outside the Philippines.

1.4.6.5 Construction Access

96. All construction roads including roads which run through urban areas and narrow areas must be always maintained in good conditions. Especially water puddles brittle the roads and affect the transport of equipment and materials. Thus, a drainage system must be carefully designed. At the planning stage, it is important to design durable roads which won’t be damaged during the dry and rainy seasons.

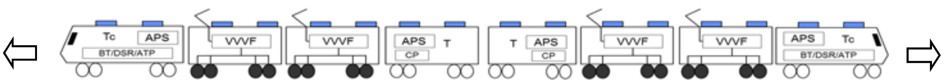
97. More than half of the construction sites are in urban areas, the access to the site will be through the public roads. Therefore, attention should be paid to general vehicles. Also consideration for the 3rd parties, such as assigning security guards, providing vehicle washing facilities at entrances and exits to the site, etc. are necessary.

98. One railway track which runs in the construction site has to be secured for the operation all the time. This constrains the transporting of materials and machinery to the site. The thorough study will be needed on this matter.

1.5 PROCESS/TECHNOLOGY

99. Technologies to be adopted for Commuter/Express Commuter and Airport Limited Express are described in below **Table 1.5.1** and **Table 1.5.2**.

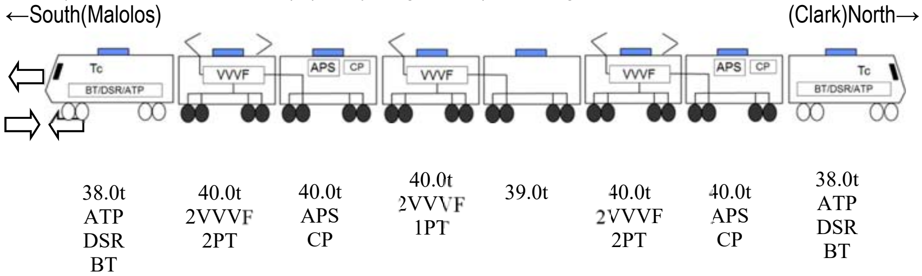
Table 1.5.1 Specification and Performance of Commuter Train (Draft)

No	Item	Specification, Performance
1	Basic	Commuter Train DC1,500V (Light weight stainless steel or Aluminium) Tc: Trailer Car with driver's cab M: Motor car T: Trailer car
2	Basic Configuration	In case of 4M4T (Tc+M+M+T+T+M+M+Tc) (Empty weight 264T) following is for reference ←South(Malolos) (Clark)North→  Legend ● :Motor Axle ○ :Trailer Axle :Tight lock coupler ATP: Automatic Train Protection, DSR: Digital Space Radio, VVVF: VVVF inverter CP: Compressor APS: Auxiliary power Supply PT: Pantograph, BT: Battery : Air Conditioner
3	Performance	Acceleration (Design):3.3km/h/s Deceleration (Design):4.2km/h/s (Max service brake, Instantaneous deceleration) 4.7 km/h/s (Emergency brake, Instantaneous deceleration) Design operation Max speed: 120km/h
4	Gauge	1,435mm (standard gauge)
5	Electric system	DC1,500V overhead catenary
6	Capacity	Leading car : 266(45), Intermediate car: 285(54) ( ):seat number calculated by 7person/m^2
7	Body	MAX:19,500mm (Length)×2,950 mm (Width)×3,655 mm (Height) MAX Height 4,150mm, when pantograph is folded, 1,130～1,150 mm(Height of floor) Straight structure without hem aperture Driver unit: right side
8	Bogie	Bolster less type, Max axle weight:16t
9	Coupler	Leading car: tight lock coupler Intermediate car: semi-permanent coupler. Connectable with NSCR train without adapter
10	Current Collection	Single arm type 4 pantographs/1 train-set (No high voltage train line)
11	Traction Motor	3-phased totally enclosed high efficiency induction motor 4 unit / M car Non- disassembly bearing exchange type
12	Driving device	Parallel cardan

No	Item	Specification, Performance
13	Propulsion system	VVVF inverter (Self cooling) 1C4M×4sets/train-set. The device for VVVF inverter will be applied IGBT or Hybrid-SiC due to more energy saving.
14	Brake system	Electric command linked to ATP, combined type of electric and pneumatic, Security brake. Regenerative priority (Entire control, Rainy mode control) Parking brake (leading car), Slide control (Trailer car)
15	Compressor	With air drier 2 or 3 units/train-set Main power: 3-phase 440V・60Hz
16	Auxiliary Power Supply	SIV: 3-phase inverter with IGBT(self-cooling) 4 units/train-set DC1500V→3-phase 440V・60Hz, single-phase AC220V・60Hz, DC100V
17	Battery	Sintered alkaline storage battery: DC100V 2 units/train-set
18	Door system	Electric (with adjacent door control backup function and door scissors control) or Pneumatic (with weakened function)
19	Lighting system	Crew cab, Saloon, Headlight, Tail light, Door Emergency car side light: LED type
20	Fun	Line flow fun
21	Air conditioner	ON/OFF type 3-phase 440V・60Hz Distribution mounting of 2 units /a car
22	Heater	Not mounted
23	PA system	Passenger broadcast: automatic volume control function with a variance amplification, automatic broadcast and outside speaker Broadcast simultaneously by the crew operating unit (Inside and outside) Intercom between crew cab, Interactive emergency communication equipment (with conversation function with the OCC and a broadcast function from the OCC)
24	Space Radio	Digital space radio with redundancy
25	ATP	CBTC
26	Destination Display	Collective setting by TMS monitor, front and side display (with collar LED)
27	CCTV	Saloon security camera (4 units /a car) Aggregated each car HUB, displayed in TMS monitor and stored in memory in the cab via Ethernet
28	Saloon Display	LCD type (17 inch wide) 8 units/car various guidance display
29	Train Management System (TMS)	Control transmission for powering and service brake command, Monitor transmission for destination, guidance, and air conditioner demand etc. Trouble monitoring and memory with support guidance, inspection function on the train, On-board driving information system (24hour each device condition memorized) Display function for pressure gage, ammeter, powering and braking conditions etc. Ethernet type・Control demand : duplex and loop system(redundancy)
30	Barrier Free	Identification band (cleat) on the floor just before the door Indicator light and chime (inside and outside) at opening and closing doors Wheel chair (free) space

Source: JICA Study Team

Table 1.5.2 Specification and Performance of Limited Express Train (Draft)

No	Item	Specification, Performance
1	Basic	Limited Express Train DC1,500V (Light weight stainless steel or Aluminium) Tc: Trailer Car with driver's cab M: Motor car
2	Basic Configuration	6M2T (Tc+M+M+M+M+M+M+Tc) (Empty weight 315t) following is for reference ←South(Malolos) (Clark)North→  Legend ●:Motor Axle ○:Trailer Axle :Tight lock coupler ATP: Automatic Train Protection, DSR: Digital Space Radio, VVVF: VVVF inverter, CP: Compressor, APS: Auxiliary power Supply, PT: Pantograph, BT: Battery, : Air Conditioner

No	Item	Specification, Performance
3	Performance	Acceleration (Design, starting):3.0km/h/s Deceleration(Design):4.2km/h/s (Max service brake, Instantaneous deceleration) 4.7 km/h/s (Emergency brake, Instantaneous deceleration) Design operation Max speed:160km/h
4	Gauge	1,435mm (standard gauge)
5	Electric system	DC1,500V overhead catenary
6	Capacity	About 400(seats)
7	Body	MAX: 19,500 mm (Length) ×2,950 mm (Width) ×3,655 mm (Height) Reading car length may be longer. MAX Height 4,150mm, when pantograph is folded, 1,130～1,150 mm (Height of floor) Under consideration
8	Bogie	Bolster less type, Max axle weight:16t
9	Coupler	Leading car: tight lock coupler Intermediate car: semi-permanent coupler Connectable with NSCR train without adapter
10	Current Collection	Single arm type
11	Traction Motor	3-phased totally enclosed high efficiency induction motor 4 unit / M car Non- disassembly bearing exchange type
12	Driving device	Parallel cardan
13	Propulsion system	VVVF inverter (Self cooling) 1C4M×6sets/train-set The device for VVVF inverter will be applied IGBT or Hybrid-SiC due to more energy saving.
14	Brake system	Electric command linked to ATP, combined type of electric and pneumatic, Security brake. Regenerative priority (Entire control, Rainy mode control) Parking brake (leading car), Slide control
15	Compressor	With air drier 2 or 3 units/train-set Main power: 3-phase 440V・60Hz
16	Auxiliary Power Supply	SIV: 3-phase inverter with IGBT(self-cooling) 4 units/train-set DC1,500V→3-phase 440V・60Hz, single-phase AC220V・60Hz, DC100V
17	Battery	Sintered alkaline storage battery: DC100V 2 units/train-set
18	Door system	Electric (With adjacent door control backup function and door scissors control) or Pneumatic (With weakened function), Airtight protecting mechanism
19	Lighting system	Crew cab, Saloon, Headlight, Tail light, Door・Emergency car side light: LED type
20	Fun	Under consideration
21	Air conditioner	ON/OFF type 3-phase 440V・60Hz Under consideration (including ventilation function)
22	Heater	Not mounted
23	PA system	Passenger broadcast: automatic volume control function with a variance amplification, automatic broadcast and outside speaker Broadcast simultaneously by the crew operating unit (Inside and outside) Intercom between crew cab, Interactive emergency communication equipment (with conversation function with the OCC and a broadcast function from the OCC)
24	Space Radio	Digital space radio with redundancy
25	ATP	CBTC
26	Destination Display	Collective setting by TMS monitor, front and side display (with collar LED)
27	CCTV	Saloon security camera Aggregated each car HUB, displayed in TMS monitor and stored in memory in the cab via Ethernet
28	Saloon Display	Under consideration
29	Train Management System (TMS)	Control transmission for powering and service brake command, Monitor transmission for destination, guidance, and air conditioner demand etc. Trouble monitoring and memory with support guidance, inspection function on the train, On-board driving information system (24hour each device condition memorized) Display function for pressure gage, ammeter, powering and braking conditions etc. Ethernet type・Control demand: duplex and loop system(redundancy)
30	Barrier Free	Identification band (cleat) on the floor just before the door Indicator light and chime (inside and outside) at opening and closing doors Wheel chair space
31	Toilet	1 or 2, One of them is a wheelchair accessible type Under consideration
32	Others	Under consideration about Wi-Fi, power supply and USB, etc.

Source: JICA Study Team

1.6 PROJECT SIZE

100. The proposed MCRP is a linear infrastructure with a total width of 30m (except in stations) and a total length of 72.5 km from Malolos to NCC in Capas. Of which 51 km from Malolos to Clark is mostly PNR ROW aside from the Clark – CIA. The depot has an area of approximately 0.4km^2 (40ha). The proposed MCRP has seven (7) stations and each station has a maximum area of approximately 0.0132km^2 (1.32ha) with a width of 60m and a length of 180-220m. The distances between the stations are presented in **Table 1.6.1.**

Table 1.6.1 Distances between the Proposed MCRP Stations

Station		Distance (km)
	Malolos (NSCR Project)	
		7.7
1	Calumpit	
		4
2	Apalit	
		12
3	San Fernando	
		15.3
4	Angeles	
		5
5	Clark	
		7
6	CIA	
		18.2
7	NCC	
	Total	72.5

1.7 DEVELOPMENT PLAN, DESCRIPTION OF PROJECT PHASES AND CORRESPONDING TIMEFRAMES

1.7.1 Project Phases

101. This section describes the various activities to be undertaken during the Pre-Construction, Construction, and Operational Phases of the Project.

(1) Pre-Construction Phase

- DD and surveys (e.g. Geotechnical Investigation, FBI, TIA, etc.)
- Preparation of relevant plans and programs
  - Construction Plan
  - Drainage Plan
  - Traffic Management Plan (TMP)
  - Solid and Hazardous Wastes Management Plan
  - Soil Management Plan
  - Emergency Preparedness and Response Plan
  - Occupational Health and Safety Plan
  - Energy and Water Conservation Program
- Planning and Utility Diversion specially in open cut areas and viaduct sections if there are utility line. Overhead high voltage cables, telephone and communication cables exist inside and near the proposed MCRP area. These cables need to be treated during construction planning stage especially high voltage cables. Those cables which will obstruct the construction must be relocated. Sufficient time will be allocated for the relocation since it requires consultation with relevant utility agencies. Exact locations of underground water pipes will be checked as well by gathering information and carrying out trial excavations etc.

- Land acquisition for the depot area and project ROW
- Resettlement of Project affected people
- Bidding and selection of contractor
- Acquisition of Permits (e.g. Tree Cutting Permit, Building Permit, etc.)
- Procurement of construction materials, Rolling Stock and E&M
- Implementation of environment mitigation measures of pre-construction activities.

(2) Construction Phase

- Preparation of construction site which include clearing of existing vegetation, removal, of existing structures along the MCRP alignment and earth moving activities
- Implementation Protection and conservation measures for the old PNR structures
- Transport of materials
- Construction of temporary facilities, depot, viaduct, embankment and at grade structures and station
- Manufacturing of girder for elevated section
- Implementation of environment mitigation measures, monitoring of construction activities.
- Implementation of Traffic Management Plan

(3) Post Construction Phase

- Demolition of all temporary structures/ facilities
- Decommissioning and removal of construction machinery and equipment from the site
- Clean-up and restoration/rehabilitation activities
- Selection of Operator

(4) Operation Phase

- Test run of the MCRP trains
- Maintenance work of passenger facilities such as the station
- Maintenance of rolling stock
- Maintenance of E&M System including power supply system, Automatic ticketing system
- Implement the EMP and EMoP
- Commercial operation (optional)

(5) Abandonment Phase

102. In the unlikely event that the operation of the proposed MCRP is no longer deemed feasible to operate and maintain, a decommissioning or abandonment plan will be prepared by the proponent. The abandonment plan will specify the proposed studies to be conducted (e.g., site assessment) and what equipment can be recovered, relocated, or sold, and the area will be developed based on the next industrial use of the site. If soil contamination is present, the subject area will be decontaminated through the appropriate measures. The green buffer zone will have to be retained.

1.7.2 Project Schedule

103. The schedule of MCRP is presented in
104.
105.
106. **Table 1.7.1**. The construction will commence upon securing all the needed regulatory requirements.

Table 1.7.1 Proposed Timeline of MCR

Project Phase	2018				2019				2020				2021				2022			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Pre-construction																				
Construction																				
Trial Run																				
Operation																				

Source: JICA Design Team

1.8 MANPOWER

107. The manpower requirement during pre-construction and construction phases of the proposed MCRP will be approximately 12,200 laborers, both skilled and non-skilled. During the operation, it is estimated that the MCRP will provide employment to more or less 1,400 employees for the operations and maintenance of the stations and maintenance of the trains at the depot.

Table 1.8.1 Manpower Requirement for the Proposed MCRP

	Civil	E&M	Rolling Stock	Total	Mode of Hiring
Pre-construction	100	60	40	200	Direct Hire
Construction	10,000	1,500	500	12,000	Through Contractors
Operation		1,400		1400	Direct Hire

108. A percentage of the technical personnel will be provided by Japanese consultants, since Japanese technology will most likely be employed for the MCRP. Most of the technical personnel will be hired by the Japanese consulting company, while for the construction works, manpower will be hired through the local construction company. All manpower requirements during pre-construction and operation phases will be hired directly by the DOTr. Hiring of workers through agencies are discouraged.

109. In compliance to RA 6685, DOTr will hire at least 50% of unskilled workers and 30% of the skilled labor requirement from the unemployed bonafide and actual residents of Bulacan, Pampanga and Tarlac with priority on the host barangays).

110. DOTr is committed to provide equal opportunities for employment of everyone, in compliance with the Labor Codes of the Philippines, Republic Act No. 10911 known as the Anti-Age Discrimination in Employment Act, and RA 7277 known as the Magna Carta for Disabled Person. DOTr will provide equal opportunities for employment of men and women, on the basis of their abilities, knowledge, skills and qualifications rather than on age or disability.

111. Where possible, provisions to encourage women's participation in labor-based work during the construction, including female hiring to comprise 20% of the total workforce in skilled and unskilled position will be included in the TORs and contracts of local contractors. Provisions to ensure equal payment for equal work between male and female workers, and for payment of benefits for women to be given directly to them will also be included in the TORs and contracts

112. It shall be policy of the DOTr that no person shall be denied access to opportunities for suitable employment on the basis of disability or age and that disabled employee shall be subject to the same terms and conditions of employment and the same compensation, privileges, benefits, fringe benefits, incentives or allowances as a qualified able-bodied person.

113. To ensure that no person will be discriminated or refused employment opportunity on the basis of his/her disability or age, respective Public Employment Service Office (PESO) of each LGU shall develop and administer testing and evaluation instruments for effective job selection, and training. For disabled persons, the contractor may consider engaging in Sheltered Employment. Sheltered Employment as defined in RA 7277 is the provision of productive work for disabled persons through workshop, providing special facilities, income producing projects or homework schemes with a view to give them the opportunity to earn a living thus enabling them to acquire a working capacity required in open industry. In the placement of disabled persons in sheltered employment, the contractor will accord due regard to the individual qualities, vocational goals and inclinations to ensure a good working atmosphere and efficient production.

114. To encourage the participation of the contractor in promoting the welfare of disabled persons and to ensure gainful employment for qualified disabled persons, DOTr will assist the contractor in availing the following incentives as provided for in RA 7277:

a. Private entities that employ disabled persons who meet the required skills or qualifications, either as regular employee, apprentice or learner, shall be entitled to an additional deduction, from their gross income, equivalent to twenty-five percent (25%) of the total amount paid as salaries and wages to disabled persons: Provided, however, that such entities present proof as certified by the Department of Labor and Employment that disabled person are under their employ. Provided, further, that the disabled employee is accredited with the Department of Labor and Employment and the Department of Health as to his disability, skills and qualifications.

b. Private entities that improved or modify their physical facilities in order to provide reasonable accommodation for disabled persons shall also be entitled to an additional deduction from their net taxable income, equivalent to fifty percent (50%) of the direct costs of the improvements or modifications. Note that this provision does not apply to improvements or modifications of facilities required under Batas Pambansa Bilang 344.

115. The policy on hiring including the treatment of statutory benefits of the workers will be stipulated in the TORs and contracts with the local contractors to ensure compliance

1.9 INDICATIVE PROJECT INVESTMENT COST

116. The total capital cost of the proposed MCRP is estimated at Two Hundred Eighty Five Billion Five Hundred Eighty Nine Million Pesos (PhP 285,589,000,000.00) @ PhP 1 ≈ JPY 2.11 conversion rate.

2. LEGAL AND INSTITUTIONAL FRAMEWORK ON EIA

2.1 EIA RELATED LAWS AND REGULATIONS

117. Any private or public projects or activities which are likely to have foreseen adverse effects on the natural and social environment are subject to the Philippine Environmental Impact Statement System (PEISS). Among some of the most important laws and guidelines related PEISS are shown in **Table 2.1.1**.

Table 2.1.1 Important Laws and Manuals of PEISS

Laws and manuals	Stipulation
Presidential Decree No. 1152 (1977)	Philippines' Environmental Code. Comprehensive environmental management with mitigation measures were addressed and concept of the environmental impact assessment was introduced for the first time.
Presidential Decree No. 1586 (1978)	PEISS was established to conduct EIA study for the environmentally critical projects and the projects in the environmentally critical areas.
Presidential Proclamation No. 2146 (1981) and No. 803 (1996)	Proclaiming Environmentally Critical Areas and types of projects as Environmentally Critical Projects and within the scope of PEISS establish under PD No. 1586.
DENR Administrative Order No. 30 Series of 2003 (DAO 03-30)	Providing the implementing rules and regulations for the Philippine Environmental Impact Statement (EIS) System of PD No. 1586.
DENR Administrative Order No. 2017 15	Guidelines on Public Participation under the Philippine Environment Impact Statement System
EMB Memorandum Circular 2007-002	Revised Procedural Manual for DAO 03-30
DENR Memorandum Circular 2010-14	Standardization of Requirement and Enhancement of Public Participation in the Streamlined Implementation of the PEISS
EMB Memorandum Circular 2010-002	Clarification to DENR Memorandum Circular No. 2010-14 and Other EIS System Policy Issuances
EMB Memorandum Circular 2010-004	Guideline for Use of Screening and Environmentally Critical Area (ECA) Mapping Systems
EMB Memorandum Circular 2011-005	Incorporating Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) concerns in the PEISS
EMB Memorandum Circular 2014-005	Guidelines of Coverage Screening and Standardized Requirement under the PEISS amending relevant portions of EMB MC 2007-002

Source: JICA Study Team

2.2 RESPONSIBLE GOVERNMENT AUTHORITIES

118. The DENR is the government entity responsible for the environmental administration. The EMB-DENR is responsible for the issuance of decision-making documents such as ECC and Certificate of Non-Coverage (CNC) for PEISS. EMB Regional Offices in respective regions are primarily responsible for the consultation and supervision of development projects.

2.3 ENVIRONMENTAL IMPACT ASSESSMENT SYSTEM OF JICA AND ADB

2.3.1 JICA Guidelines for Social and Environmental Considerations

119. As a matter of policy, the JICA, as an implementing agency for Japanese Official Development Assistance (ODA) adheres to the need to conduct environmental and social considerations for all forms of assistance; from technical cooperation to loan aid and grant aid projects. To complement this, JICA recognizes seven important Principles; a) that projects must address a wide range of environmental and social impacts, b) measures for environmental and social considerations must be implemented from project conceptualization to monitoring, c) ensure accountability when implementing cooperation projects, d) ensure stakeholder participation in decision-making processes, e) appropriate disclosure of information, f) enhance organizational capacity of proponents, and g) promptness in project implementation. Their Guidelines for Social and Environmental Considerations (April 2010) were developed as far back as 2002 and have evolved over time with the latest version revised and published in 2010. Projects are screened,

scoped and after proper information disclosure are categorized (Category A, B, C, and F1) based on, among others, the project scale, nature and degree of impact on the natural and social environment, the site or location, and the mitigation measures required. For this purpose, the railway projects are categorized as Category A.

120. JICA confirms compliance to the principles and procedures as contained in the Guidelines by a thorough review of the environmental reports and ensure that all project impacts on the natural and social environment are identified and proper mitigating measures are discussed. Further, JICA confirms that projects should conform to the environmental laws and standards of host countries or such other international financial organizations (such as the World Bank's Safeguard Policies) when appropriate. An independent Advisory Committee for Environmental and Social Considerations was established by JICA to provide expert advice in preparatory surveys, environmental review, and monitoring of projects under consideration. If appropriate environmental and social considerations are not undertaken or substantial compliance to established environmental laws and standards are not met after their review, JICA will not undertake Loan Aid, Grant Aid or Technical Cooperation projects.

2.3.2 ADB Environment Safeguard

121. The ADB Safeguard Policy Statement (SPS) governing environment and social safeguards of ADB operations was approved by the ADB Board of Directors in July 2009 and became effective in January 2010. Its goal is to "promote the environmental and social sustainability of ADB supported projects by protecting people and their environment from potential adverse impacts and enhancing the benefits provided by such projects". The SPS applies to all ADB-financed sovereign and non-sovereign projects, and project components that are associated with ADB-supported projects, regardless of whether these are financed by ADB, the borrower/client, or co-financiers. As a matter of policy, ADB will not finance projects that do not comply with SPS requirements nor will it finance projects that do not comply with the host country's laws and regulations, including those where the implementing host country has obligations under International law/s.

122. SPS environmental safeguards requirements support the integration of environmental considerations into the project decision-making process and are triggered if a supposed project is likely to have environmental impacts and risks to the physical, biological, socioeconomic, and/or physical cultural resources in the project's area of influence. ADB borrowers/clients should be aware that compliance to the SPS requirements makes for (i) environmentally sustainable projects are primarily achieved through good design during project preparation and effective environmental management during project implementation; (ii) integrating environmental considerations into the project feasibility study and design calls for the incorporation of environmental assessment and management into the economic, financial, institutional, social and technical analysis of a project; and (iii) good environmental assessment and management enables the continued improvement of environmental performance throughout the life of a project, and can lead to enhanced economic, financial and social outcomes.

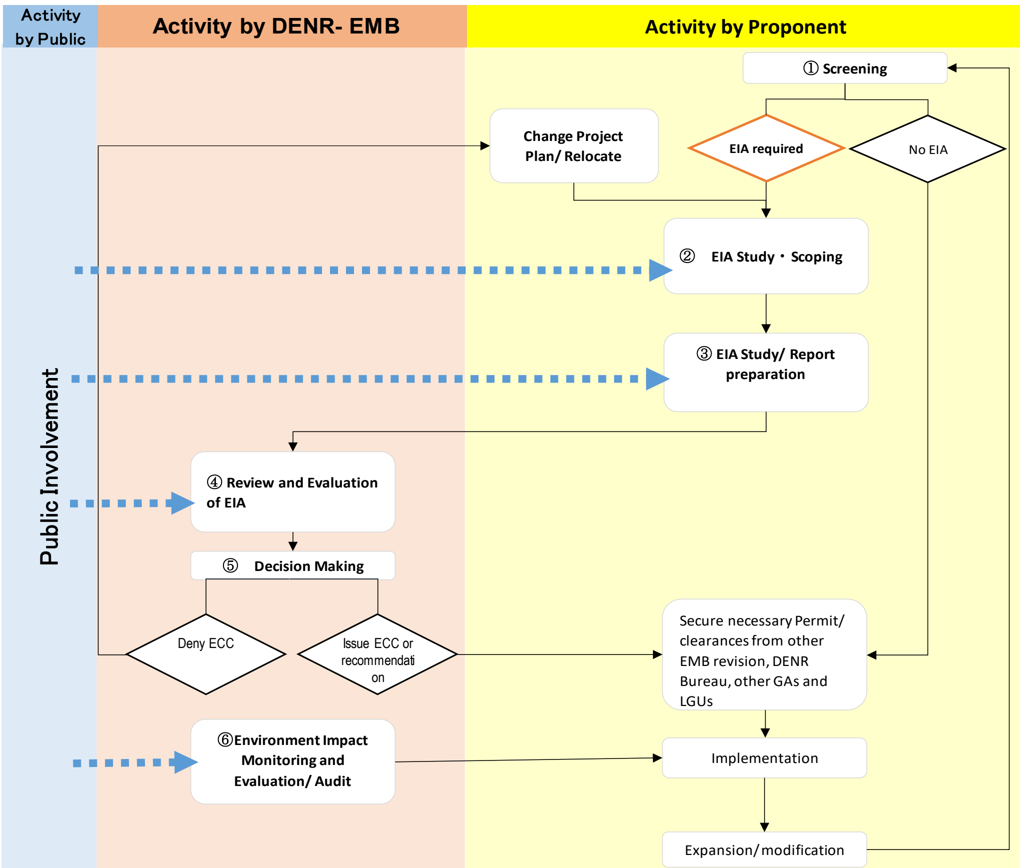
123. Standard Environmental Assessment procedures entail the following: a) environmental assessment throughout the Project cycle (from planning, feasibility study stage to operation management and decommissioning), b) Project screening, and Categorization (Cat. A= projects likely to have significant adverse impacts, Cat. B= potential impacts are less adverse than those in Cat A, Cat. C= where there are minimal or no adverse impacts, and Cat. F1=projects involving investment of ADB funds or through a financial intermediary), c) Scoping for Environmental Assessment, d) Analysis of Alternatives, e) Description of the Project, f) Applicable Policy, Legal and Administrative framework and Standards, g) Baseline environment and social conditions described, h) Impact and Risk analysis, i) development of an EMP, j) Information disclosure, consultation and participation, and lastly, k) Grievance Redress Mechanism. Considering the

impacts, the proposed MCRP is classified as Category A under the ADB SPS System of project categorization.

124. Further, through the Sourcebook, ADB provides technical guidance on the four core environmental issues for environmental assessment and management such as, Health and Safety, Biodiversity Conservation and Sustainable Natural Resource Management, Pollution Prevention and Abatement, and Physical Cultural Resources.

2.4 PHILIPPINES ENVIRONMENTAL IMPACT ASSESSMENT SYSTEM

125. 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 2.4.1**.



Source: Revised Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (2008)

Figure 2.4.1 Summary Flowchart of EIA Process

2.4.1 Projects requested to implement EIA

126. At the Screening, 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 2.4.1**.

Table 2.4.1 Project Groups for EIA 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 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 ECA as declared under Proclamation 2146 and according to the parameters set forth in the succeeding sections. Proponents of these 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

Source: Memorandum Circular No.2014-005, Revised Guidelines for Coverage Screening and Standardized Requirements

2.4.2 Types of Reports Required for ECC

127. The EIA-covered projects will require the hereunder listed documents depending on project type, location, magnitude of potential impacts and project threshold, which differ according to the level of EIA and DENR EMB decision making process.

- Environmental Impact Statement (EIS);
- Programmatic Environmental Impact Statement (PEIS);
- Environmental Performance Report and Management Plan (EPRMP);
- Programmatic Environmental Performance Report and Management Plan (PEPRMP);
- Initial Environmental Examination (IEE) Checklist Report;
- Project Description Report (PDR)

128. All documents should be prepared by the project proponent to be submitted to EMB-Central Office or the EIA Division of the respective EMB-Regional Offices. The outcome of the EIA Process within PEISS administered by the EMB-DENR is the issuance of decision documents. Decision documents may either be an ECC, CNC, or a Denial Letter.

129. For Group A projects, ECC application documents need to be submitted to EMB-Central Office to have decisions by EMB Director or DENR Secretary. While, ECC application for Group B need to be submitted to EMB-Regional Office to have decision making by the EMB Regional Director. **Table 2.4.2** summarizes Project Groups, EIA Report Types, Decision Documents, Deciding Authorities, and Processing Duration.

Table 2.4.2 Summary of Project Groups, EIA Report Types, Decision Documents, Deciding Authorities and Processing Duration

Project Groups		Project	Documents Required For ECC/CNC Application	Decision Document	Deciding Authority
Category A : Environmentally Critical Projects	A-1: New	Co-located	PEIS	ECC	EMB Central Office
		Single	EIS		
	A-2: Existing and to be expanded, modified and/or rehabilitated A-3: Operating without ECC	Co-located	PEPRMP in case programmatic monitoring data are available		
		Single	EPRMP in case monitoring data are available. EIS if no monitoring data are available.		

Project Groups		Project	Documents Required For ECC/CNC Application	Decision Document	Deciding Authority
Category B : Non-Environmentally Critical Projects(NECP) Located in ECA	B-1: New	Co-located	PEIS	ECC	EMB regional office in the region where the project is located
		Single	EIS, IEEC	ECC	
	B-2: Existing and to be expanded, modified and/or rehabilitated B-3: Operating without ECC	Single	EPRMP, EPRMP Checklist	ECC	
		Co-located	PEPRMP	ECC	
Category C: Environmental Enhancement or Direct Mitigation Project		Co-located/ single	PDR (Part I and II)	CNC	EMB regional office in the region where the project is located
Category D: Non-Covered Project			PDR (Part 1 only)	CNC	EMB regional office in the region where the project is located

Note: () optional, subject to laws, rules, and regulations

Source: EMB Memorandum Circular No.2014-005, Revised Guidelines for Coverage Screening and Standardized Requirements

2.4.3 Scope of Items to be Examined and Contents to be Assessed in the EIA

130. Depending on project type, location, magnitude of potential impacts and project threshold, EIS, PEIS, EPRMP, PEPRMP, IEE Checklist Report or PDR will be required. Pursuant to DENR Memorandum Circular No. 2010-14 "Standardization of Requirements and Enhancement of Public Participation in the Streamlined Implementation of the Philippine EIS System" by DENR (June 29 2010), the outline for EIA Reports for proposed new single projects is shown in **Table 2.4.3.**

Table 2.4.3 Outline of EIS for Proposed (New) Single Projects

EXECUTIVE SUMMARY	
1)	Project Fact Sheet
2)	Process Documentation
3)	EIA Summary
MAIN REPORT	
1.	PROJECT DESCRIPTION
1.1.	Project Location and Area
1.2.	Project Rationale
1.3.	Project Alternatives
1.4.	Project Components
1.5.	Process / Technology
1.6.	Project Size
1.7.	Development Plan, Description of Project Phases and Corresponding Timeframes
1.8.	Manpower
1.9.	Indicative Project Investment Cost
2.	ASSESSMENT OF ENVIRONMENTAL IMPACTS
2.1.	The Land
2.1.1.	Land Use And Classification
2.1.1.1.	Impact in Terms of Compatibility With Existing Land Use
2.1.1.2.	Impact on Compatibility With Classification as an Environmentally Critical Area (ECA)
2.1.1.3.	Impact in Existing Land Tenure Issue/S
2.1.1.4.	Impairment of Visual Aesthetics
2.1.1.5.	Devaluation of Land Value As a Result of Improper Solid Waste Management and Other Related Impacts
2.1.2.	Geology/ Geomorphology
2.1.2.1.	Change in Surface Landform/ Geomorphology/ Topography/ Terrain/ Slope
2.1.2.2.	Change in Subsurface Geology/ Underground Conditions
2.1.2.3.	Inducement of Subsidence, Liquefaction, Landslide, Mud/ Debris Flow, Etc.
2.1.3.	Pedology
2.1.3.1.	Soil Erosion/ Loss of Topsoil/ Overburden
2.1.3.2.	Change In Soil Quality/ Fertility
2.1.4.	Terrestrial Ecology
2.1.4.1.	Vegetation Removal and Loss Of Habitat
2.1.4.2.	Threat to Existence and / or Loss Of Important Local Species
2.1.4.3.	Threat to Abundance, Frequency and Distribution of Important Species
2.2.	The Water
2.2.1.	Hydrology/ Hydrogeology
2.2.1.1.	Change in Drainage Morphology/ Inducement of Flooding/ Reduction In Stream Volumetric Flow

2.2.1.2.	Change in Stream, Lake Water Depth
2.2.1.3.	Depletion of Water Resources/ Competition In Water Use
2.2.2.	Oceanography
2.2.2.1.	Change/ Disruption In Water Circulation Pattern, Littoral Current, and Coastal Erosion And Deposition
2.2.2.2.	Change In Bathymetry
2.2.3.	Water Quality
2.2.3.1.	Degradation of Groundwater Quality
2.2.3.2.	Degradation of Surface Water Quality
2.2.3.3.	Degradation of Coastal/ Marine Water Quality
2.2.4.	Freshwater Ecology
2.2.4.1.	Threat to Existence and/ or Loss of Important Local Species and Habitat
2.2.4.2.	Threat to Abundance, Frequency and Distribution of Species
2.2.5.	Marine Ecology
2.2.5.1.	Threat to Existence and/ or Loss of Important Local Species and Habitat
2.2.5.2.	Threat to Abundance, Frequency and Distribution of Species
2.3.	The Air
2.3.1.	Meteorology / Climatology
2.3.1.1.	Change In The Local Micro-Climate E.G. Local Temperature
2.3.1.2.	Contribution in Terms of Greenhouse Gas Emissions (or GHG Mitigation Potential)
2.3.2.	Air Quality (Noise/Vibration)
2.3.2.1.	Degradation of Air Quality
2.3.2.2.	Increase in Ambient Noise Level
2.3.2.3	Vibration
2.4.	People
2.4.1.	Displacement of Settler/S
2.4.2.	In-Migration
2.4.3.	Cultural/ Lifestyle Change (Especially on Indigenous People, If Any)
2.4.4.	Impacts on Physical Cultural Resources
2.4.5.	Threat to Delivery Of Basic Services/ Resources Competition
2.4.6.	Threat to Public Health And Safety
2.4.7.	Generation of Local Benefits From The Project
2.4.8.	Traffic Congestion
3.	ENVIRONMENTAL MANAGEMENT PLAN
4.	ENVIRONMENTAL RISK ASSESSMENT (ERA) AND EMERGENCY RESPONSE POLICY AND GUIDELINES
5.	SOCIAL DEVELOPMENT PLAN (SPD) FRAMEWORK AND INFORMATION, EDUCATION AND COMMUNICATION (IEC) FRAMEWORK
5.1.	Social Development Plan (SDP)
5.2.	Information, Education And Communication (IEC) Campaign
6.	ENVIRONMENTAL COMPLIANCE MONITORING
6.1.	Self-Monitoring Plan
6.2.	Multi-Sectoral Monitoring Framework
6.3.	Environmental Guarantee And Monitoring Fund Commitments
7.	ABANDONMENT / DECOMMISSIONING / REHABILITATION POLICIES AND GENERIC GUIDELINES
8.	INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION FOR THE ENTIRE OPERATION
9.	ANNEXES

Source: DENR Memorandum Circular NO. 2010-14, Annex 1-A, June 2010

2.4.4 Public Participation, Public Consultation and Information Disclosure

131. The PEISS places importance in public participation. According to DAO No. 2017-15, from the early stage of project, the public who have potential to have direct/ indirect impact are provided accurate project information and involved in a series of public discussion. Public participation will be demonstrated through the following activities:

- IEC
- Public Scoping
- Public Hearing
- Information Disclosure of EIA and Environmental Permissions
- Involvement of Indigenous Peoples in Decision-Making Process

2.4.5 Environmental Monitoring and Management Plan needs to be Formulated

(1) Objectives

132. 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) Responsible organization

1) Monitoring by Project Proponent

133. 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.

2) Multi-partite Monitoring Team

134. 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.

3) Environmental Management Bureau

135. The EMB is primarily responsible for the over-all evaluation/audit of the Proponent's monitoring and the MMT's validation.

(3) Disclosure of Monitoring Results

136. During the Operation, Project Proponents are required to continue public participation, public consultation, and information disclosure. CMR, SMR, MMT, and CMVR are subject to public disclosure. The Project Proponent has full accountability to Stakeholders on the latest Environmental Management and Monitoring Plan and any modification of the project and any activities against the ECC conditions.

2.5 COMPARISON OF PEISS AND JICA GUIDELINES/WORLD BANK (WB) /ADB SAFEGUARD POLICIES

137. The results of gap analysis between current relevant regulations in the Philippines to the JICA Guidelines, and World Bank Operational Policy 4. Counter measures are also proposed to fill the gap.

Table 2.4.4 Gap between JICA Environmental Guidelines and Relevant Regulations in the Philippines on EIA

Topic	JICA Environmental Guideline,	ADB	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
EIA	JICA supports and examines appropriate environmental and social considerations undertaken by project proponents etc. to avoid or minimize development projects' impacts on the environment and local communities, and to prevent the occurrence of unacceptable adverse impacts.	Set of specific safeguard requirements that borrowers/clients are expected to meet when addressing social and environmental impacts and risks. Through their due diligence, review, and supervision. ADB will ensure that borrowers/clients comply with these requirements during project preparation and implementation. Over time ADB may adopt additional safeguard requirements or update existing requirements to enhance effectiveness, respond to changing needs, and reflect evolving best practices.	.EIA is a process that involves predicting and evaluating the likely impacts of a project (including cumulative impacts) on the environment during construction, commissioning, operation, and abandonment. It also include designing appropriate preventive, mitigating, and enhancement measures addressing these consequences to protect the environment and the community's welfare". (Revised Procedural Manual for DAO 2003-30,1.0,2))	Basically, there is no gap between harmonized policy and the Philippines law	Not Applicable
Compliance with National legislations and international treaties	• Projects comply with the laws or standards related to the environment and local communities in the central and local governments of host countries; it also confirms that projects conform to those governments' policies and plans on the environment and local communities. • Projects do not deviate significantly from the World Bank's Safeguard Policies, and refers as a benchmark to the standards of international financial organizations; to internationally recognized standards, or international standards, treaties, and declarations, etc.; and to the good practices etc. of developed nations including Japan, when appropriate. (Sec.2/2.6/2, 3)	Apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health, and Safety (EHS) Guidelines.	Proposal for activities which are outside the scope of the management plan for protected areas will be subject to an environmental impact assessment as required by law before they are adopted, and the results thereof will be taken into consideration in the decision-making process. No actual implementation of such activities will be allowed without the required ECC under the PEISS. In instances where such activities are allowed to be undertaken, the proponent will plan and carry them out in such manner as to minimize any adverse effects and take preventive and remedial action when appropriate. The proponent will be liable for any damage due to lack of caution, on indiscretion. (NIPAS Act)	Gap is insignificant	Not Applicable
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, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of	• Avoid, minimize, mitigate and/or offset for adverse impacts and enhancement of positive impacts through environmental planning and management • Conduct an environmental assessment for each proposed project to identify potential direct, indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential transboundary and global impacts, including	• The country's statutory framework requiring EIA for all projects that will affect environmental quality is embodied in Presidential Decree (PD) 1151 of 1977. • Under the EIA process, the proponent will assess the direct and indirect impacts of a project on the biophysical and human environment and ensuring that these impacts are addressed by appropriate environmental protection and enhancement measures. (DAO 2003-30)	No gap in the environment items and content. However, standards on soil, bottom sediment and vibration have not been prepared yet	International standards such as WHO's, IFC's and developed countries' standards will be referred to in order to evaluate these items.

Topic	JICA Environmental Guideline,	ADB	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
	benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety. Items to be addressed in the specific project are narrowed down to the needed ones through the scoping process. • In addition to the direct and immediate impacts of projects, the derivative, secondary, and cumulative impacts as well as impacts associated with indivisible projects will also be assessed with regard to environmental and social considerations, so far as it is rational. The life cycle impact of a project period is also considered. • Various kinds of relevant information are needed in order to assess impacts on the environment and local communities. There are, however, uncertainties in predicting such impacts caused by the incomplete understanding of impact mechanisms and the limited information available. Therefore, if the scale of uncertainty is considered to be large, project proponents etc. provide environmental and social considerations that include preventive measures as much as possible.	climate change. Use strategic environmental assessment where appropriate.			
Alternatives	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.	Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the no project alternative	The PEISS manual requires that the proponent should implement the alternative analysis and incorporate into EIS in the feasibility study stage. PEISS process manual (2008) by DENR requires that the proponent should consider environmental social impacts of the project and implement the initial scoping in the pre-feasibility study stage.	Basically there are no gaps	Not Applicable
EMP	• Impact examination must include analysis of E&S costs and benefits in the most quantitative terms possible as well as qualitative analysis, and they must be conducted in close harmony with economic, financial, institutional, social, and technical analysis of projects. • The findings of the examination must include alternatives and mitigation measures, and be recorded as separate documents or include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle. • EMP also provide for workers - safe and healthy working conditions, and prevent accidents, injury, and disease	• Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and management. • Prepare an EMP that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators. Key considerations for	Specifying the impacts mitigation plan, areas of public information, education and communication, social development program proposal, environmental monitoring plan (with multi-sectoral public participation for EIS-based projects) and the corresponding institutional and financial requirements/ arrangements.	Basically there are no gaps	Not applicable

Topic	JICA Environmental Guideline,	ADB	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
	• Establish preventive and emergency preparedness and response measures to avoid, minimize the adverse impacts and risks to the health and safety of the local communities	EMP preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle.			
Consultation	• Project proponents etc. consult with local stakeholders through means that induce broad public participation to a reasonable extent, in order to take into consideration the environmental and social factors in a way that is most suitable to local situations, and in order to reach an appropriate consensus. • Project proponents etc. to publicize in advance that they plan to consult with local stakeholders, with particular attention to directly affected people, in order to have meaningful meetings. • In the case of Category A projects, encourages project proponents etc. to consult with local stakeholders about their understanding of development needs, the likely adverse impacts on the environment and society, and the analysis of alternatives at an early stage of the project, and assists project proponents as needed. • 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. (Appendix 2)	• Carry out meaningful consultation with affected people and facilitate their informed participation. Ensure women's participation in consultation. Involve stakeholders, including affected people and concerned nongovernment organizations, early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation as necessary to address issues related to environmental assessment. Establish a grievance redress mechanism to receive and facilitate resolution of the affected people's concerns and grievances regarding the project's environmental performance. • For category-A projects, ADB ensures that the borrower or private sector sponsor carries out public consultation at least twice: (a) once during the early stages of EIA field work; and (b) once when the draft EIA report is available, and before loan appraisal by ADB.	• As part of the social preparation process at pre-Scoping, IEC is now explicitly required at the minimum of PEIS/EIS-based applications for which Public Scoping is a requirement. The IEC serves as a basis for preliminary identification of stakeholders and related issues in preparation for the Scoping proper. The conduct of the EIA Study will include local stakeholders, who may serve as local expert sources, aides/guides, and resource persons in primary data collection to optimize access to indigenous knowledge of the environment. • 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 PEIS-based applications. If necessary EMB should conduct Public Consultations.	Basically there are no gaps	Not Applicable
Information Disclosure	• In principle, project proponents etc. disclose information about the environmental and social considerations of their projects. • JICA encourages project proponents etc. to disclose and present information about environmental and social considerations to local stakeholders. (Sec.2/2.1/1, 6) • Project proponents etc. in the preparation of documents in an official or widely used language and in a form understandable by local people. (2.1/1, 6,7) • For Category A project, JICA publishes the status of host countries' submission of major documents on environmental and social considerations on its website. Prior to its environmental review, JICA also discloses EIA reports and environmental permit certifications 120 days prior to concluding agreement documents. JICA	• Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. • Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders	• 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 PEIS-based applications. Before the PH, relevant documents have to be opened to the public. • Full copies of the EIA Report are made accessible at the concerned EMB Offices, libraries/development council offices of the host municipalities. Concerned Barangays are also provided with the Executive Summary of the EIA Report. Copy of ECC is also submitted to other permitting agencies including funding institutions.	Basically there are no gaps between Harmonized Policy and the Philippines' laws.	Not Applicable

Topic	JICA Environmental Guideline,	ADB	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
	discloses a translated version of EIA reports, subject to approval by project proponents etc.				
Monitoring and Disclosure	• JICA confirms with project proponents etc. the results of monitoring the items that have significant environmental impacts. This is done in order to confirm that project proponents etc. are undertaking environmental and social considerations for projects that fall under Categories A, B, and FI. • The information necessary for monitoring confirmation by JICA must be supplied by project proponents etc. by appropriate means, including in writing. When necessary, JICA may also conduct its own investigations. • JICA discloses the results of monitoring conducted by project proponents etc. on its website to the extent that they are made public in project proponents etc. (Sec.3/3.2/3.2.2/1, 7)	Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports.	• The Proponents issued ECCs are primarily responsible for monitoring their projects. They are required to submit two kinds of monitoring reports, the ECC CMR on semi-annual frequency and the SMR on a quarterly basis to the concerned EMB RO. • During project implementation, LGUs are represented in the MMT, teams which are composed of various stakeholders which generally form the pillar for local vigilance to project performance. • Major features of the MMT are: 1. Provides appropriate checks and balances in monitoring of project implementation. 2. Validates the proponent's performance. 3. Recommends courses of action to EMB through the CMVR. • The EMB-DENR remains to be the primary actor for the overall evaluation of the proponents monitoring and the MMTs validation.	Basically there are no gaps between Harmonized Policy and the Philippines' laws	Not Applicable
Site selection	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 (excluding projects whose primary objectives are to promote the protection or restoration of such areas). Projects are also not to impose significant adverse impacts on designated conservation areas. (Appendix 1. 4-2)	• Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources.	All designated, critical habitats will 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. For such purpose, the Secretary may acquire, by purchase, donation or expropriation, lands, or interests therein, including the acquisition of usufruct, establishment of easements or other undertakings appropriate in protecting the critical habitat. (RA 9147)	Gap is insignificant	Not Applicable

Source: JICA Study Team

2.6 ENVIRONMENTAL STANDARDS

2.6.1 Approach

138. Presidential Decree 1152, otherwise known as the “Philippine Environment Code (1977)”, recognizes the establishment of specific environment management policies and prescribing environmental quality standards. This is supplemented by Office of the President Executive Order 192 (1987) which mandates the EMB, among others, to: 1) formulate environmental quality standards such as the quality standards for water, air, land, noise and radiation, 2) recommend rules and regulations for environmental impact assessment and provide technical assistance for their implementation and monitoring, and 3) formulate rules and regulations for the proper disposition of solid wastes, toxic and hazardous substances.

139. JICA and ADB generally recognizes national environmental standards for projects. If national environmental standards do not exist or are considered inappropriate, internationally recognized standards will be used for reference purposes. Moreover, if the national environmental standards differ with international standards, the more stringent standards will be adopted. However, if sufficient justification exists, the country/national standards will apply.

2.6.2 Ambient Air Quality

140. The DAO No. 2000-81 otherwise known as the Implementing Rules and Regulations of Republic Act No. 8749, Clean Air Act of 1999, establishes the national ambient air quality standards for Total Suspended Particulate (TSP), Particulate Matters (PM_{10}), Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Ozone (O_3) and Lead (Pb) while DAO No. 2013-13 establishes the provisional national ambient air quality guideline values for $PM_{2.5}$. **Table 2.6.1** shows the comparison of applicable national and international standards to on ambient air quality. The international standard used in comparison with the Philippine standards is World Health Organization (WHO) Air Quality Guidelines for PM, O_3, NO_2 and SO_2 (2005), which IFC Environmental, Health, and Safety General Guidelines (April 30, 2007) also refers.

Table 2.6.1 National Ambient Air Quality Standards

Parameter	Averaging Time	Philippines DAO 2000-81, DAO 2013-13	WHO
TSP	24 Hours	230 µg/NCM	-
PM10	24 Hours	150 µg/NCM	50 µg/ m3
PM2.5	24 Hours	50 µg/NCM	25 µg/ m3
SO2	24 Hours	180 µg/NCM	20 µg/ m3
NO2	24 Hours	150 µg/NCM	200 µg/m3 (1-hour mean)
CO	1 Hour	35 mg/NCM	35 mg/ m3 (Indoor *1)
O3	1 Hour	140 µg/NCM	100 µg/ m3 (8 hour mean)
Lead (Pb)	24 Hours	1.5 µg/NCM	0.5- 1.0 µg/m3 (annual*2l)

Sources: DAO 2000-81, DAO 2013-13, WHO Air Quality Guidelines for PM, O_3, NO_2 and SO_2 (2005),
*1: WHO Guidelines for Indoor Air Quality (2009)
*2: WHO air quality guidelines for Europe (1987)

2.6.3 Surface Water Quality

141. The DAO No. 2016-08 provides water usage and classification as well as the water quality guidelines and general effluent standards. **Table 2.6.2** shows the water quality criteria by class. **Table 2.6.3** and **Table 2.6.4** present the comparison of applicable national and international standards on surface water and effluent quality.

Table 2.6.2 Water Body Classification

Classes	Description
Class AA	Public Water Supply Class I – Intended primarily for waters having watersheds, which are uninhabited and/or otherwise declared as protected areas, and which require only approved disinfection to meet the latest Philippine National Standards for Drinking Water (PNSDW)
Class A	Public Water Supply Class II – Intended as sources of water supply requiring conventional treatment (coagulation, sedimentation, filtration and disinfection) to meet the PNSDW
Class B	Recreational Water Class I – Intended for primary contact recreation (bathing, swimming, etc.)
Class C	1) Fishery Water for the propagation and growth of fish and other aquatic resources; 2) Recreational Water Class II – for boating, fishing, or similar activities 3) For agriculture, irrigation, and livestock watering
Class D	Navigable waters

Source: DAO No. 2016-08

Table 2.6.3 Surface Water Quality

Parameter	DAO 2016-08			Japan (Class C)
	Class A	Class B	Class C	
Color	50	50	75 TCU	-
Temperature	26-30°C	26-30°C	25-31°C	-
pH (Range)	6.5-8.5	6.5-8.5	6.5-9.0	6.5-8.5
Dissolved Oxygen (DO)	5 mg/L	5 mg/L	5 mg/L	≥5 mg/L
Biochemical Oxygen Demand (BOD)	3	5 mg/L	7 mg/L	≤5 mg/L
Total Suspended Solids (TSS)	50 mg/L	65 mg/L	80 mg/L	≤50 mg/L
Surfactants (MBAS)	0.2 mg/L	0.3 mg/L	1.5 mg/L	-
Oil and Grease (Petroleum Ether Extracts)	1 mg/L	1 mg/L	2 mg/L	-
Nitrate as Nitrogen	7 mg/L	7 mg/L	7 mg/L	≥10 mg/L
Phosphate as Phosphorus	0.5 mg/L	0.5 mg/L	0.5 mg/L	≤0.1 mg/L
Phenolic Substances and Phenols	<0.001 mg/L	<0.001 mg/L	0.05 mg/L	-
Total Coliforms				≤100 MPN/100mL
Fecal Coliforms	1.1 MPN/100mL	100 MPN/100mL	200 MPN/100mL	-
Chloride as Cl	250	250	350 mg/L	-
Copper (Dissolved Copper)	0.02 mg/L	0.02 mg/L	0.02 mg/L	-
Arsenic (As)	0.01 mg/L	0.01 mg/L	0.02 mg/L	≤0.01 mg/L
Cadmium (Cd)	0.003 mg/L	0.003 mg/L	0.005 mg/L	≤0.01 mg/L
Chromium (Hexavalent)	0.01 mg/L	0.01 mg/L	0.01 mg/L	≤0.05 mg/L
Cyanide (CN-)	0.07 mg/L	0.07 mg/L	0.1 mg/L	Not detectable
Lead (Pb)	0.01 mg/L	0.01 mg/L	0.05 mg/L	≤0.01 mg/L
Total Mercury (Hg)	0.001 mg/L	0.001 mg/L	0.002 mg/L	≤0.005 mg/L
Organophosphate as Malathion	1 µg/L	1 µg/L	3 µg/L	-

Sources: DAO No. 2016-08, Environmental water quality standards for protecting human health, Japan

Table 2.6.4 General Effluent Standards

Parameter	DAO 2016-08				IFC	Japan
	Class A	Class B	Class C	Class D		
Color	100 TCU	100 TCU	150 TCU	300 TCU	-	-
Temperature	3 ºC change	3 ºC change	3 ºC change	3 ºC change	-	-
pH (Range)	6.0-9.0	6.0-9.0	6.0-9.5	5.5-9.5	6.0-9.0	-
Dissolved Oxygen (DO)	-	-	-	-	-	-
Biochemical Oxygen Demand (BOD)	2	2 mg/L	3 mg/L	12 mg/L	30 mg/L	160 mg/L (daily ave. 120 mg/L)
Total Suspended Solids (TSS)	70 mg/L	85 mg/L	100 mg/L	150 mg/L	50 mg/L	200 mg/L (daily ave. 150 mg/L)
Surfactants (MBAS)	2 mg/L	3 mg/L	15 mg/L	30 mg/L	-	-
Oil and Grease (Petroleum Ether Extracts)	5 mg/L	5 mg/L	5 mg/L	15 mg/L	10 mg/L	-
Nitrate as Nitrogen	14 mg/L	14 mg/L	14 mg/L	30 mg/L	10 mg/L	120 mg/L (daily ave. 60 mg/L)
Phosphate as Phosphorus	1 mg/L	1 mg/L	1 mg/L	10 mg/L	2 mg/L	16 mg/L (daily ave. 8 mg/L)

Parameter	DAO 2016-08				IFC	Japan
	Class A	Class B	Class C	Class D		
Phenolic Substances and Phenols	0. 01 mg/L	0.01 mg/L	0.5 mg/L	5 mg/L	-	5 mg/L
Total Coliforms	3,000 MPN/100mL	3,000 MPN/100mL	10,000 MPN/100mL	15,000 MPN/100mL	400 MPN/100mL	daily ave. 3,000 cm^3
Fecal Coliforms	4 MPN/100mL	200 MPN/100mL	400 MPN/100mL	800 MPN/100mL	-	-
Chloride as Cl	350	350	450 mg/L	500 mg/L	-	-
Copper (Dissolved Copper)	0.04 mg/L	0.04 mg/L	0.04 mg/L	0.08 mg/L	-	0.3 mg/L
Arsenic (As)	0.02 mg/L	0.02 mg/L	0.04 mg/L	0.08 mg/L	-	0.1 mg/L
Cadmium (Cd)	0.006 mg/L	0.006 mg/L	0.01 mg/L	0.02 mg/L	-	0.03 mg/L
Chromium (Hexavalent)	0.02 mg/L	0.02 mg/L	0.02 mg/L	0.04 mg/L	-	0.5 mg/L
Cyanide (CN-)	0.14 mg/L	0.14 mg/L	0.2 mg/L	0.4 mg/L	-	1 mg/L
Lead (Pb)	0.02 mg/L	0.02 mg/L	0.1 mg/L	0.2 mg/L	-	0.1 mg/L
Total Mercury (Hg)	0.002 mg/L	0.002 mg/L	0.004 mg/L	0.008 mg/L	-	0.0005 mg/L
Organophosphate as Malathion	1 µg/L	1 µg/L	3 µg/L	6 µg/L	-	-

Sources: DAO No. 2016-08, IFC Indicative Guideline Values for Treated Sanitary Sewage Discharges (2007), Japan National Effluent Standards (2015)

2.6.4 Groundwater Standards

142. The Department of Health (DOH) AO No. 2017-0010 otherwise known as Philippine National Standards for Drinking Water (PNSDW) of 2017 establishes the criteria for drinking water quality. In cases where the criteria for certain parameters are not available in PNSDW, the guideline values from DAO 2016-08 Water Quality Guidelines (WQG) for Class AA Waters will be used. **Table 2.6.5** shows the comparison of applicable national and international standards on groundwater quality. The international standards used in comparison with Philippine standards are the WHO Guidelines for Drinking-Water Quality (2011).

Table 2.6.5 Ground Water Quality Standards

Parameter	Holding Time	PNSDW	WHO Guidelines for Drinking-Water Quality
Physical Characteristics			
pH	Not to exceed 6 hours	6.5-8.5	Not of health concern at levels found in drinking-water
Colour	24 hours	10 CU	No health-based guideline value is proposed for colour in drinking-water. Drinking-water should ideally have no visible color but most people can only detect color above 15 TCU in a glass of water. Levels of color below 15 TCU are often acceptable to consumers. High color from natural organic carbon (e.g. humics) could also indicate a high propensity to produce by-products from disinfection processes.
Temperature	-	26-30°C	Cool water is generally more palatable than warm water, and temperature will have an impact on the acceptability of a number of other inorganic constituents and chemical contaminants that may affect taste. High water temperature enhances the growth of microorganisms and may increase problems related to taste, odor, color, and corrosion.
Cations and Anions			
Sodium (Na)	28 days	200 mg/L	Not of health concern at levels found in drinking-water but may affect acceptability of drinking water
Potassium (K)	-	-	Occurs in drinking-water at concentrations well below those of health concern but may affect acceptability of drinking water
Calcium (Ca)	-	-	Not of health concern at levels found in drinking-water but may affect acceptability of drinking water
Magnesium (Mg)	-	-	Not of health concern at levels found in drinking-water but may affect acceptability of drinking water
Bicarbonate (HCO3-)	-	-	Not of health concern at levels found in drinking-water but may affect acceptability of drinking water
Chloride (Cl-)	28 days	250 mg/L	Not of health concern at levels found in drinking-water but may affect acceptability of drinking water
Sulphate (SO-2)	28 days	250 mg/L	Not of health concern at levels found in drinking-water but may affect acceptability of drinking water
Nitrate (NO3-)	24 hours	50.00 mg/L	50 mg/L as nitrate ion (or 11 mg/L as nitrate-nitrogen)
Toxic and Other Deleterious Substances			

Parameter	Holding Time	PNSDW	WHO Guidelines for Drinking-Water Quality
Arsenic (As)	28 days	0.01 mg/L	0.01 mg/L
Cadmium (Cd)	28 days	0.003 mg/L	0.003 mg/L
Chromium (Cr)	28 days	0.05 mg/L	0.05 mg/L
Cyanide (CN-)	24 hours	0.05 mg/L	Occurs in drinking-water at concentrations well below those of health concern, except in emergency situations following a spill to a water source
Lead (Pb)	28 days	0.01 mg/L	0.01 mg/l
Mercury, Total (Hg)	28 days	0.001 mg/L	0.006 mg/l (for inorganic)
Microbiological Quality			
Total Coliforms	<1.1 MPN/100mL	<1.1 MPN/100mL	Must not be detectable in any 100 ml sample
Fecal Coliforms	<1.1 MPN/100mL	<1.1 MPN/100mL	Must not be detectable in any 100 ml sample

Source: DAO 2007-012, DAO 2016-08, WHO Guidelines for Drinking-Water Quality (2011)

2.6.5 Noise and Vibration

2.6.5.1 Noise Standard

143. The measured noise levels were compared to the Ambient [Noise] Quality and Emission Standards for Noise stipulated in National Pollution Control Commission (NPCC) Memorandum Circular No. 1980-002 (**Table 2.6.6**) for noise in general areas with correction factor for areas directly facing a public transportation route and the Guidelines for Community Noise of World Health Organization (WHO), 1999 (**Table 2.6.7**).

Table 2.6.6 NPCC Standards for Noise in General Areas

Class	Maximum Allowable Noise Level (dBA)		
	Daytime (9 AM – 6 PM)	Morning (5 AM-9 AM)/ Evening (6 PM – 10 PM)	Nighttime (10 PM – 5 AM)
AA	50	45	40
A	55	50	45
B	65	60	55
C	70	65	60
D	75	70	65

Notes: AA - a section or contiguous area which requires quietness, such areas within 100m from school sites, nursery schools, hospitals and special homes for the aged.
A - a section or contiguous areas which is primarily used for residential purposes
B - a section or contiguous areas which is primarily a commercial area
C - a section primarily reserved as light industrial area
D - a section which is primarily reserved as heavy industrial area

144. Moreover, , as stipulated in the NPCC MC 1980-002 for areas directly facing a public transportation route or an urban traffic artery, the foregoing standards plus a correction factor equivalent to the following will apply:

i – Areas directly fronting or facing a four-lane road …………………………….. + 5 dBA
ii – Areas directly fronting or facing a four-lane or wider road ………………….. + 10 dBA

145. For areas directly fronting or facing less than four-lane road, Environmental Quality Standards for Noise in General Areas will apply.

Table 2.6.7 Guidelines for Community Noise of WHO, 1999

Receptor	One Hour LA_{eq} (dBA)[1]	
	Daytime (0700 H – 2200 H)	Nighttime (2200 H – 0700 H)
Residential; institutional; educational[2]	55	45
Industrial; commercial	70	70

Notes: [1] Guideline values are for noise levels measured out of doors
[2] For acceptable indoor noise levels for residential, institutional and educational settings refer to WHO (1999).

Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

2.6.5.2 Vibration Standard

146. There is no national standard for vibration in the Philippines. At the same time, there are limited available International Standards. Under such situation, this report uses the British Standards BS 5228-2:2009 Code of practice for noise and vibration control on construction and open sites - Part 2: Vibration, provides source data, prediction methodologies, mitigation measures and management. Additionally, the British Standard includes guidance on the levels of vibration that cause varying degrees of human response and damage to buildings or services. These are specified in terms of a component peak particle velocity (ppv).

Table 2.6.8 Guidance on Effects of Vibration Levels

Vibration Level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Source: BS 5228-2:2009

147. The standard for the building damage caused by the vibration energy are described in both British standard BS 7385-2:1993 Evaluation and measurement for vibration in buildings.

Table 2.6.9 Transient Vibration Guide Values for Cosmetic Damage

Place and time	Peak Components Particle Velocity in Frequency Range of Predominant Pulse (mm/s)	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4Hz and above	
Unreinforced or light framed structure. residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50mm/s at 40Hz and above

Source: BS 7385-2:1993

2.6.6 Soil Quality and Contamination

2.6.6.1 Soil Quality

148. The Bureau of Soils and Water Management (BSWM) provides a standard soil fertility rating for certain parameters such as levels of pH, organic matter, primary nutrients (Nitrogen, Phosphorus, Potassium), secondary nutrients (Calcium, Manganese), micronutrients (Copper, Zinc, Iron, Manganese) and trace metals (Lead, Arsenic, Mercury, Cadmium, Chromium Hexavalent).

Table 2.6.10 Soil Fertility/Quality Standards

Parameter	Philippines	International		
	PNS/ BAFS 40:2016 (Organic Soil Amendments)	General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy(adopted by BSWM)	Dutch Target and Intervention Values, 2000	
			Target Values	Intervention Values
pH	-	5.5-8.5	-	-
Organic Matter	≥ 20%	1-8; >3**	-	-
Primary Nutrients				
Total Kjeldahl Nitrogen	-	-	-	-
Phosphorus	-	>10 >20**	-	-
Potassium	-	>0.25	-	-

Parameter	Philippines	International		
	PNS/ BAFS 40:2016 (Organic Soil Amendments)	General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy(adopted by BSWM)	Dutch Target and Intervention Values, 2000	
			Target Values	Intervention Values
Total NPK (N, P, K were analyzed separately)	5-10%	-	-	-
Secondary Nutrients				
Calcium	-	-	-	-
Magnesium	-	>0.50	-	-
Micronutrients				
Available Iron	-	>4.5	-	-
Available Copper	300 mg/kg	>0.2	-	-
Available Manganese	-	>1.0	-	-
Available Zinc	5 mg/kg	>1.5; >1.0**	-	-
Trace Metals				
Lead	50 mg/kg	-	85 mg/kg	530 mg/kg
Arsenic	20 mg/kg	-	29 mg/kg	55 mg/kg
Mercury	2 mg/kg	-	0.3 mg/kg	10 mg/kg
Cadmium	5 mg/kg	-	0.8 mg/kg	12 mg/kg
Chromium Hexavalent	150 mg/kg	-	100 mg/kg	380 mg/kg

*Indicative levels for serious soil contamination
** Limits applicable to dry land crops

Source: BSWM, Dutch Target and Intervention Values (2000)

Table 2.6.11 Soil Fertility Evaluation Criteria Standard

Parameter	High/ Adequate	Medium/ Moderate	Low/ Deficient
pH	5.6-6.7	5.6-4.6	>6.8*; <4.5*
Organic matter	>4.6%	2.1-4.5%	<2
Available Phosphorus	>10	2.1-9.9	<2
Extractable Potassium	>151	76-150	<75

Note: *pH 4.5 and 6.8 is considered problem in soils for rice

2.6.6.2 Soil Contamination

149. The TCLP limits prescribed in Table 2.1 Classification of Hazardous Wastes of the DAO 2013-22, Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36) were adopted in determining whether the soil samples collected in Stations CS1 and CS2 are contaminated with Acid wastes, Alkali wastes, waste with Cyanide and/or waste with Inorganic Chemicals.

Table 2.6.12. TCLP Limits

Parameters	TCLP Limits (based on Table 2.1 Classification of Hazardous Wastes of DAO 2013-22)
pH	$\leq$2 Acid; $\geq$12.5 Alkali
Arsenic, mg/L	>1
Barium, mg/L	>70
Copper, mg/L	-
Zinc, mg/L	-
Iron, mg/L	-
Cadmium, mg/L	>0.3
Chromium, mg/L	>5
Lead, mg/L	>1
Manganese, mg/L	-
Mercury, mg/L	>0.1
Selenium, mg/L	>1
Nickel, mg/L	-
Oil and Grease, mg/L	-
Cyanide, mg/L	>70

Source: DAO 2013-22, Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36)

2.7 OTHER ENVIRONMENTAL LAWS AND REGULATIONS CONCERNING THE PROJECT

2.7.1 International Treaties, Agreements and Related Documents

150. **Table 2.7.1** shows the list of international regulations/agreements that the Philippines has ratified.

Table 2.7.1 International Treaties/Agreements that the Philippines has ratified

Category	Name of treaty	Year Ratified
Biodiversity	Convention on Biological Diversity, 1992	1992 June
	Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973	1981, November
	Convention on Wetlands of International Importance, 1971	1994, November
	Convention on the conservation of Migratory Species of Wild Animals, 1983	1994, February
	Cartagena Protocol on Biosafety, 2000 (to the Convention on Biological Diversity)	2006 October
	Nagoya Protocol on Access to Genetic Resources & the Fair & Equitable Sharing of Benefits Arising from their Utilization-Supplementary Agreement to the Convention of Biological Diversity	2015 September
Climate Change	Montreal Protocol on Substances that Deplete the Ozone Layer, 1987	1991, July
	Vienna Convention for the Protection of the Ozone Layer, 1985	1991, July
	London Amendment (to the Montreal Protocol), 1990	1993, August
	United Nations Framework Convention on Climate Change, 1994	2003 November
	Kyoto Protocol to the United Nations Convention on Climate Change 1998	2003
	Paris Agreement Adopted in the 21st Session of the Conference of Parties to the United Nations Framework Convention on Climate Change, 2015	2017 December RP Accession
	United Nations Convention to Combat Desertification, 1994	2000, February
Pollution	Basel Convention on the Control of Transboundary Movements of Hazardous wastes and their Disposal, 1992	1993, October
	Stockholm Convention on Persistent Organic Pollutants 2001	2004 May
	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemical and Pesticides in International Trade, 2004	2006 July
Historical/ Cultural Heritage	UNESCO Convention Concerning the Protection of the World Cultural and National Heritage, 1972	1985, May
Forestry	International Tropical Timber Agree, 1994	1983, November
Social	Convention on the Elimination of all Forms of Discrimination against Women, 1979	1981
	International Convention on the Elimination of all forms of racial discrimination 1965	1967 September
	International Covenant on Civil and Political Rights 1976	1986
	International Covenant on Economic, Social and Cultural Rights 1976	1974 June
	Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment 1987	1986 June
	Convention on the Rights of the Child 1990	1990 July
	International Convention on the Protection of the Rights of all migrant Workers and members of their families, 1996	1995 July
	International convention for protection of all persons from enforced Disappearance 2010	
	Convention on the Rights of Persons with Disabilities 2008	2008 April

Source: www.ohchr.org/EN/ProfessionalInterest/Pages/CMW.aspx

2.7.2 National Strategy and Plan Relevant to Environment and Social Consideration

151. The following are national level Action Plans and Strategies (including systems) on various Natural Resources components and Environmental Management which impact on projects and activities. These are implemented by national government agencies and instrumentalities in coordination with appropriate stakeholders and partners. This reflects the cross sectoral approach to environmental management concerns.

Table 2.7.2 National Strategy and Plan relevant to Environment and Social Consideration

Category	Name
Biodiversity	Philippines: National Biodiversity Strategy and Action Plan (NBSAO) 1997
	Philippine Biodiversity Conservation Priorities, 2002
	A National Wetland Action Plan for Philippines 2011-2016
	Philippine Plant Conservation Strategy and Action Plan 2003

Category	Name
Pollution	DAO 2007-22 Guidelines on the requirements for Continuous Emission Monitoring System
	DAO 2000-82 Integrated Air Quality Improvement Framework-Air Quality Control Action Plan
	Adopt an Estero/Waterbody Program, 2010
	DAO's Implementing Sec. 5 of RA 9275,on the Designation of Certain Areas as Water quality Management Areas
	Integrated Persistent Organic Pollutants Management Project
	Adoption of a National Strategy for the Management of POP's Contaminated Sites in the Philippines, EMB Memorandum February 2016
	National Solid Waste Management Framework, 2004
Social	Philippine Development Plan 2017-2022
	Philippine Environmental Partnership Program
	Government Poverty Reduction Programs and Plans
	Philippine Plan for Gender responsive Development Plan 1995-2025
	National Plan of Action for Children 1991
	22 point platform and policy Pronouncements on Labor and employment 2010
Climate Change	Second National Communication Plan on Climate Change
	Philippine Energy Plan 2009- 2030
	Philippine Strategy on Climate Change Adaptation 2010-2022
	National Framework strategy on Climate change 2010 – 2022
	National Climate Change Action Plan, DILG

Source: JICA Study Team

2.7.3 Other related Laws and Regulations

152. Major environmental laws and regulations, which may be relevant to the infrastructure/interchange projects, must be observed. The PEISS states obligations to strictly comply with the environmental laws, regulations and standards, which have been established by the Philippine Government.

Table 2.7.3 Philippines Environmental Laws, Regulations, and Environmental Quality Standards

Items	Laws, Regulations and Environmental Quality Standards
Biodiversity	National Integrated Protected Areas System Act, Republic Act No.7586 (1992)
	RA No. 9147 (2001), Wildlife Resources Conservation and Protection Act
	Executive Order 247, Prescribing Guidelines and Establishing a Regulatory Framework for the Prospecting of Biological and Genetic resources, there by-products and derivatives for Scientific Purposes and for other Purposes
	DENR Administrative Order 2004-15 Establishing the List of Terrestrial Threatened Species and their Categories and the List of other Wildlife species pursuant to RA 9147 otherwise known as the Wildlife Resources and Conservation Act of 2001
	DAO 2007-24 Establishing the National List of Threatened Plants and their categories and the List of other Wildlife Species
Forestry	Presidential Decree (PD) No. 705 (1975), Forestry Reform Code
	PD 953 (1976), Requiring the planting of trees in certain places and penalizing the unauthorized cutting, destruction, damaging and injury of certain trees, plants, and vegetation
	EO No. 193 s. 2015, Expanding the Coverage of the National Greening Program (NGP)
Pollution Control (Water)	Presidential Decree No. 1067 (1976), Water Code
	DENR Department Order DAO No.08, series of 2016, Water Quality Guidelines and General Effluent Standards of 2016,
	Republic Act No. 9275 (2004), Clean Water Act
	DAO 2005-10, IRR of the Clean Water Act
	Department of Health (DOH) Administrative Order (AO) No. 2017-0010, Philippine National Standards for Drinking Water (PNSDW)
Pollution Control (Air)	Republic Act No. 8749 (1999), Clean Air Act of 1999
	DAO No. 2000-81, Ambient Air Quality and Emission Standards
	DAO No. 2013-13, Provisional National Ambient Air Quality Guideline Values for Particulate Matter 2.5 (PM2.5)
Pollution Control (Waste)	Republic Act No. 6969 (1990), Toxic Substances, Hazardous and Nuclear Wastes Control Act
	PD 825, Sanitation Code
	DAO 2006-10, Guidelines on the Categorized Final Disposal Facilities
	DAO 2013-22 Implementing Rules and Regulations of RA 6969
	RA9003, Ecological Solid Waste Management Act
	DAO 1998-49 Technical Guidelines for Municipal Solid Waste Disposal
	DAO 1994-28, Interim Guidelines for the Importation of Recyclable Materials containing Hazardous Substances

Items	Laws, Regulations and Environmental Quality Standards
	DAO 1997-28, Amending Annex A of DAO 1994-28
	DAO 2001-34, IRR of RA 9003
Pollution Control (Noise)	National Pollution Control Commission (NPCC) Memorandum Circular No.002 Series of 1980, Section 78 (1980), Noise environment standards
Historical/ Cultural Heritage	Republic Act No 10066, National Cultural Heritage Act of 2009, Providing for the Protection and Conservation of the National Cultural Heritage, Strengthening the National Commission for Culture and Arts (NCCA) and its Affiliated Cultural Agencies and for Other Purposes
	RA No. 10086 (2010), Strengthening Peoples' Nationalism through Philippine History by changing the nomenclature of the National Historical Institute into the National Historical Commission of the Philippines (NHCP), Strengthening its powers and functions, and for other purposes
Ancestral Domain, Indigenous People	Republic Act 8371, Indigenous Peoples Rights Act of 1997,
	NCIP AO No.1 series of 1998, Rules and Regulations implementing RA 8371 otherwise known as "Indigenous Peoples Rights Act of 1997
	NCIP AO No.1 series of 2004 Guidelines on the Formulation of the Ancestral Domain Sustainable Development and Protection Plan
	NCIP AO No.1 series of 2006, The Free and Prior Informed Consent Guidelines of 2006
	NCIP AO No. 3, series of 2012, Revised Guidelines on Free and Prior Informed Consent and related Processes
Climate Change	RA 9729 (2009), Climate Change Act
	Climate Change Commission (CCC) AO No. 2010-01, IRR of RA 9729
	EO No. 174, Institutionalizing Philippine Greenhouse Gas Inventory Management and Reporting System
	RA 10121 (2010), Philippine Disaster Risk and Management Act
	RA 10174 (2012), People's Survival Fund
	EMB MC 2011-005 EIA Technical Guidelines Incorporating Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) concerns

Source: JICA Study Team

2.7.4 Permit to be Obtained for the Project Operation

153. Prior to the project implementation, following permits have to be obtained.

Table 2.7.4 Permits Required for the Project

Permit	Authority Involved
NHCP Endorsement on Historical Structures (Old PNR structures)	NHCP, NCCA, NM
Free and Prior Informed Consent documentation (FPIC), Certificate of No Overlap (CNO)	NCIP
Tree Cutting permit	DENR –NCR. DENR-Reg3, Region IV-A
Wastewater Discharge Permit	Laguna Lake Development Authority (LLDA) for Manila EMB-NCR for Makati, Pasay, Parañaque, EMB-Reg 4A for Laguna EMB-Reg3 for Bulacan, Pampanga, Tarlac
LLDA Clearance for Development Projects	LLDA for Manila and Laguna
Permit To Operate for Power Generator Sets (APSI)	EMB-NCR for Metro Manila, EMB-Reg3 for Bulacan, Pampanga, Tarlac EMB-Reg4A for Laguna
ECC for Construction Work Areas/Batching Plants	EMB-NCR for Metro Manila EMB-Reg3 for Bulacan, Pampanga, Tarlac EMB-Reg4A for Laguna
Quarry Permit	LGU where quarry is located
Permit for structures over water bodies	DPWH (as mandated by the Water Code)

Source: JICA Study Team

154. Some of permits required prior to implementation are further detailed below:

(1) Tree Cutting Permit

155. **Table 2.7.5** shows the detailed guideline and procedure to obtain the permit.

Table 2.7.5 Tree Cutting Permit Guidelines

Relevant Policies/Guidelines	
1	DENR Memorandum on Guidelines and Procedures on the Planting, Maintenance, and Removal of Trees in Urban Areas and in Areas Affected by Government Infrastructure Projects. (27 November 2009)
2	DENR Memorandum Order (DMO) No. 2012-02, Uniform Replacement Ratio for Cut or Relocated Trees. (5 November 2012)

Relevant Policies/Guidelines	
3	DENR Memorandum Circular (DMC) No. 2011-01, Guidelines, and Procedures in the implementation of the National Greening Program. (8 March 2011)
4	DAO 20 s 2016, Implementing Rules and Regulations of EO 193. (29 June 2016)
5	Forest Management Bureau (FMB) Technical Bulletin No.3, Measurement Standards, and Procedures in the conduct of inventory for standing trees. (April 2014)

156. The application procedure for the issuance of tree cutting permit is shown in **Table 2.7.6**. On the average, the processing of application takes about two (2) months from the day application, due to a number of government entities involved in the procedure. If Coconut trees are affected, tree cutting guidelines of the Philippines Coconut Authority (PCA), pursuant to Republic Act No. 10593, will apply.

Table 2.7.6 Procedure to obtain Tree Cut Permit

Procedure		Responsible Entity
1	Submit application documents to the concerned CENRO: - Application Letter - LGU Endorsement/ Certificate of No Objection - Copy of the Land Title for Private Property - Photographs of trees to be removed - Site Development Plan and ECC	DOTr
2	Review the submitted requirements, assign inspecting officer and issue order of payment	CENRO
3	Receive the OP and pay tree inventory fee but no payment required for less than 20 trees	DOTr
4	Conduct 100% inventory or inspection of the area and prepare Inspection Report with geotagged photos	CENRO (Inspection Personnel)
5	a. Review and approve inspection report b. Sign endorsement to PENRO	CENRO
6	a. Review, and approve CENRO recommendation b. Sign endorsement to RD	PENRO
7	a. Review and approve endorsement to FMB b. Furnish a copy to the USEC for Field Operations c. Release endorsement to FMB	DENR Regional Office / Regional Director
8	a. Review, evaluate and conduct data analysis b. Prepare Memorandum of Endorsement to USEC for Field Operations c. Draft clearance for the issuance of tree cutting permit d. Review and Sign Memorandum of Endorsement to USEC for Staff Bureaus	FMB
9	Review and forward to USEC for Field Operations	USEC for Staff Bureaus
10	Review and approve/sign Clearance to Issue Permit to Cut	USEC for Field Operations
11	a. Receive Clearance to Issue Permit to Cut b. Transmit to concerned Regional Office	FMB
12.	Prepare and Sign Tree Cutting Permit	DENR Regional Office/ RD
13	Receive Tree Cutting Permit	DOTr

(2) NHCP Endorsement on Historical Structures (Old PNR Structures)

157. **Table 2.7.7** shows the detailed guideline and procedure to obtain the NHCP endorsement.

Table 2.7.7 NHCP Guidelines

Relevant Policies/Guidelines	
1	NHCP Guidelines on the Identification, Classification, and Recognition of Historic Sites and Structures in the Philippines. (2011)
2	NHCP Universal Guidelines of the Restoration and Preservation of Monuments and Historic Sites
3	NHCP Process of Architectural Restoration
4	NHCP Techniques involved in the Restoration of Historic Structures
5	NHCP Standards and Guidelines in Maintaining Historic Sites and Structures. (2010)
6	Republic Act No. 10066, An Act Providing for the Protection and Conservation of the National Cultural Heritage, Strengthening the National Commission for Culture and Arts (NCCA) and its Affiliated Cultural Agencies and for Other Purposes
7	Republic Act No. 6541, National Building Code of the Philippines

158. The process of architectural restoration by the NHCP is summarized into seven (7) steps as shown in the **Table 2.7.8**.

Table 2.7.8 Procedure to obtain NHCP endorsement

Procedure		Responsible Entity
1	Inventory of Historical Structures	DOTr, PNR, NHCP
2	Identification of Necessity of Restoration	DOTr
3	Declaration as Monument	NHCP
4	Planning for Preservation Scheme	DOTr, PNR
5	Approval of Scheme	NHCP
6	Implementation	DOTr, PNR
7	Re-use and Maintenance	DOTr, PNR

Source: NHCP Techniques involved in the Restoration of Historic Structures

159. To obtain the NHCP endorsement, Protection and Conservation Plans for historical structures will be prepared by the DOTr and PNR. The Protection Plan will cover the measures for the protection of historical structures during project construction while the Conservation Plan provides a program for the preservation of sites and structures during operation. The plans will be submitted to and deliberated on by the three agencies concerned on historical, cultural heritage such as the NHCP, the National Museum (NM), and the National Commission on Culture and the Arts (NCCA).

(3) Free and Prior Informed Consent Documentation, Certificate of No Overlap

160. Following shows the detail guideline and procedure to obtain the Free and Prior Informed Consent (FPIC).

Table 2.7.9 FPIC Guidelines

Relevant Policies/Guidelines	
1	NCIP Administrative Order No. 1, Series of 2012 The Indigenous Knowledge Systems and Practices (IKSPs) and Customary Laws (CLs) Research and Documentation Guidelines of 2012
2	NCIP Administrative Order No. 3 series of 2012, Revised Guidelines on FPIC and Related Processes of 2012

161. The procedure in applying for FPIC documentation and/or Certificate of No Overlap (CNO) requires the conduct of Field Based Investigation (FBI).

Table 2.7.10 Procedure to Obtain NCIP Endorsement

<table>
<tr><th colspan="2">Procedure</th><th>Responsible Entity</th><th colspan="2">Duration</th></tr>
<tr><td>1</td><td>Conduct the Pre-FBI Conference</td><td>NCIP, Proponent, concerned ICCS/ IP representatives</td><td colspan="2">1 day</td></tr>
<tr><td>2</td><td>Prepare the Work and Financial Plan for the Conduct of the FBI</td><td>Proponent</td><td colspan="2">2 days</td></tr>
<tr><td>2</td><td>Conduct the FBI</td><td>FBI Team</td><td colspan="2" rowspan="2">20 days (to commence within 10 days from FBI fee payment date and to be completed within 10 working days from actual commencement)</td></tr>
<tr><td>3</td><td>Prepare, under oath, and submit FBI Report</td><td>FBI Team, NCIP Regional Director</td></tr>
<tr><td rowspan="2">4</td><td>Mobilize the FPIC Team (AD to be affected by the proposed project)</td><td>NCIP Regional Director</td><td colspan="2">--</td></tr>
<tr><td colspan="2">Issue CNO (AD not affected by the proposed project)</td><td>NCIP Regional Director, with concurrence of concerned Commissioner</td><td>3 days</td></tr>
</table>

Source: NCIP Administrative Order No. 3 series of 2012

3. ASSESSMENT OF ENVIRONMENT IMPACTS

163. This chapter discusses the state of the existing environment before the onset of the proposed MCRP. The baseline data presented in this section are based on primary and secondary data collection. Primary data were obtained through field surveys, consultation meeting, and interviews with key stakeholders, and sampling and analyses of environmental parameters. For this study, the field surveys were conducted during the dry season. Secondary data were collected from the Comprehensive Land Use Plan (**CLUP**) of the affected LGUs and relevant data soursees from different government authorities (e.g. MGB, PHIVOLCS, PAGASA, DENR, etc.).

164. At the end of each section, impact identification, prediction, assessment and mitigation are summarized in **Table 3.1.28**, **Table 3.2.14**, **Table 3.3.30** and **Table 3.4.63**, respectively.

3.1 LAND

3.1.1 Land Use and Classification

165. The proposed MCRP will utilize the existing ROW of the PNR approximately 51 km in length traversing eight (8) municipalities/cities, namely, Malolos and Calumpit in Bulacan; and Apalit, Minalin, Sto. Tomas, San Fernando, Angeles and Mabalacat in Pampanga. The length of the alignment outside the PNR ROW is approximately 21.5 km utilizing a spur line passing through the CIA of the CSEZ property onto the Mabalacat Depot. From there, it goes through portions of the BCDA property, private properties, and other agricultural areas in Bamban and Capas in Tarlac, ending at the NCC development. Additionally, the seven (7) stations will be extended to 30 m from the existing width of the PNR ROW of 30 m or a total of 60 m at a length of 180 m to 220 m. The railway project is a combination of viaducts, bridges, embankments, drainage and some tunnel structures running through its whole length. Some land acquisition will be done in areas where the alignment veers away from the PNR ROW and other rail structures needing additional areas.

3.1.1.1 Existing Land Use

166. The land use within the vicinity of the PNR ROW includes commercial, agricultural, aquaculture, industrial, and residential, etc. and the areas become more densely built-up within urban centers of San Fernando and Angeles. Hence, land uses and development conditions within the vicinity of the proposed MCRP are predominantly built-up areas. The summary of the existing land uses by host LGU is presented below.

<u>Malolos</u>

167. Majority of the land in Malolos are used for agriculture and fisheries. For the agricultural and fisheries types of land use, they cover 45.4% and 24.6% respectively. For the residential, commercial, institutional, and industrial types of land use, they cover 20.1%, 1.8%, 1.4%, and 1.8%, respectively.

168. The proposed MCRP will utilize approximately 2.2 km of the PNR ROW passing through the Barangays of Bulihan and Longos in Malolos (**Figure 3.1.1**). The viaduct columns, Malolos station (to be developed under the NSCR Project), service access and drainage facilities will be built along the PNR ROW, which is adjacent to residential and institutional areas. Predominantly, the lands adjacent to the PNR ROW are used for residential and commercial, with some institutional facilities due to its close proximity to the McArthur Highway. Notable institutional structures situated in the immediate vicinity of the proposed MCRP are the Malolos Maternity Hospital, Sacred Heart Hospital, La Consolacion University, Gat Blas Ople Museum, Bulacan Provincial Capitol, Bulacan State University, and Centro Escolar University.

Calumpit

169. Predominantly, the land in Calumpit is used for agricultural use. The land area for agricultural use covers 66.8% of the total land area of Calumpit, while the residential, industrial, and commercial areas, covers 10.4%, 2.5%, and 0.9%, respectively. The remaining lands are designated for other purposes. DOTr will utilize approximately 8 km of the PNR ROW passing through the Barangays of Pio Cruzcosa, San Marcos, Palimbang, Iba Este, Calumpang, Iba O'Este, Balungaw and Gatbuca in Calumpit (**Figure 3.1.2**). Within the total alignment, a length of 0.5 km will run outside the PNR ROW. The proposed Calumpit Station, viaduct columns, drainage and related facilities will be built along the PNR ROW which is adjacent to industrial, commercial and residential areas. Majority of the land adjacent to the PNR ROW are used for residential and commercial.

170. The industrial zones adjacent to the PNR ROW are being utilized by the Teh Hsin Enterprise Phils. Corporation for its Concrete Product Manufacturing Plant and United Pulp and Paper Co., Inc. for its Paper Manufacturing Plant. Notable institutional structures situated in the immediate vicinity of the proposed MCRP are the Colegio de Calumpit, Inc., Calumpit National High School, and Calumpang Elementary School. An area used as a former dumpsite for municipal waste by the LGU is located right along the alignment in Brgy. Iba O'Este. To confirm this situation, sampling survey was conducted at this location and the results was checked against existing standards to determine the extent of contamination, if any (refer to Section 3.1.3.3).

Apalit

171. All lands in Apalit are classified as alienable and disposable (A&D) land due to the flat terrain. These consist mostly of broad plains that are slight to moderately susceptible to flooding, swamps, and marshes, and alluvium, which is suitable for fishpond use. Broad plains comprise 59 km^2 (5,904.2 hectares) or 96.1% of the total municipal area, consisting of the built-up and agricultural areas. Swamps and marshes are 1.6 km^2 (163.5 hectares) or 2.6%, and fishpond alluvium are 0.79 km^2 (79.3 hectares) or 1.3% of the whole Apalit land area.

172. The proposed MCRP will utilize approximately 4.3 km of the PNR ROW passing through the Barangays of Capalangan, Sulipan, and San Vicente in Apalit (**Figure 3.1.3**). The Apalit Station, including viaduct columns, service access and related drainage structures etc., will utilize portions of residential and agricultural land. Majority of the land adjacent to the PNR ROW are used for agricultural, aquaculture and residential purposes. Notable institutional structures situated in the immediate vicinity of the proposed MCRP are the Blueridge School of Apalit, Inc. and the Christ, The Eternal High Priest, Parish Church.

Minalin

173. The land in Minalin is predominantly for fisheries. The land designated for fishpond/ inland water use covers 63.3% of the total land area of Minalin. The infrastructure, utilities, and river system land use cover a total of 13%. The residential area only covers about 9.8% of the total land area. The primary produce of the municipality is Tilapia (Oreochromis niloticus/Tilapia Mossambica), a fish species and common Filipino food.

174. The proposed MCRP, including viaduct columns, service access, and drainage facilities will utilize approximately 4.0 km of the PNR ROW traversing the Barangays of Lourdes, San Isidro, Sta. Catalina and San Pedro of Minalin. Based on the Land Use Map (**Figure 3.1.4**), majority of the land adjacent to the PNR ROW is used for aquaculture/fishpond and agriculture. Although no station is planned in Minalin, there is reportedly a Municipal Resolution requesting that a railway station be located in the municipality.

Sto. Tomas

175. Sto. Tomas is predominantly comprised of agricultural land use (43.6%), including aquaculture/ fishponds (21.0 %, and residential land uses (17.9%) of the total land area. Other major land uses present in the area include commercial (2.8%), industrial (2.4%) and agri-industrial land uses (2.0%). The old and dilapidated PNR station is located within a residential area in Barangay Sapa. Although no station is planned in Sto. Tomas, the Mayor has requested that a station be located here as there is enough land for the purpose.

176. The proposed MCRP, including viaduct columns, service access, drainage, and other facilities will utilize approximately 4.0 km of the PNR ROW passing through the Barangays of Poblacion, San Matias, Sapa, and Moras de la Paz in Sto. Tomas (**Figure 3.1.5**). Based on the Land Use Map, majority of the land adjacent to the PNR ROW are used for agricultural, aquaculture and residential. Notable institutional structures situated in the immediate vicinity of the proposed MCRP are the Sapa Elementary School and the Christ, Sto. Niño Chapel.

San Fernando

177. In San Fernando, the dominant land use is represented by residential and agricultural types. Almost 45.0% of the total land area of San Fernando is devoted for agricultural uses, while approximately 37.0 % of the total land use is devoted to residential uses. The land uses at the vicinity of the old PNR station is residential and heavily built-up.

178. The proposed MCRP, including viaduct columns, service access, drainage, and other facilities will utilize approximately 16.2 km of the PNR ROW passing through the Barangays of San Nicolas, Lourdes, Sto. Niño, Dolores, Maimpis, Quebiawan, Pulung Bulu, San Agustin, San Pedro Cutud, Sta. Lucia, Malpitic, Sindalan, Calutcut, Panipunan, and Baliti in San Fernando. The planned San Fernando Station will be built along PNR ROW adjacent to the old PNR station, which has been converted into a museum by the local government. Majority of the land adjacent to the PNR ROW are used for residential, agricultural, and industrial uses, with some institutional facilities (**Figure 3.1.6**). Some notable establishments proximal to the alignment of the railway are the SM City San Fernando, Lazatin Heritage House, Pampanga High School, Jose B. Lingad Memorial Hospital, San Fernando Hospital, etc. In addition to the planned station, the local government is requesting for another station to be located in Brgy. Sindalan, which they intend to develop as a commercial area.

Angeles

179. In Angeles, the predominant land use is residential. Approximately, 47.3% of the total land area is devoted to residential use, while 20.2% and 11.5% are devoted to production and infrastructure areas, respectively.

180. The proposed MCRP, including viaduct columns, service access, drainage, and other facilities will utilize approximately 6.8 km of the PNR ROW passing through the Barangays of Pulung Bulu, Tabun, Claro M. Recto, Sta. Teresita, Agapito del Rosario, Balibago, Lourdes Sur, Lourdes Sur East, Sto. Cristo, and Malabañas in Angeles. The Angeles Station will be built along the PNR ROW adjacent to a cemetery and commercial and industrial areas. Majority of the land adjacent to the PNR ROW are used for residential with some institutional facilities (**Figure 3.1.7**). Some of the notable structures that are proximal to the alignment of the railway project are the Angeles City Museum, Sacred Heart Medical Center, Carmelite Monastery, Dr. Clemente N. Dayrit Sr. Elementary School, Robinsons Angeles, and Red Planet Angeles.

Mabalacat

181. The land uses of Mabalacat City are classified as built-up, agricultural, commercial, industrial, infrastructure, institutional, residential, river, and road (**Figure 3.1.8**). Agricultural lands, which include idle lands for development and crop production areas, has the largest area with

120.1 km^2, comprising 72.0 % of the total land area of the city. This is due to the fact that only its eastern side of the city has been developed. Infrastructure areas constitute the smallest land area of 0.1 km^2, about 0.1 % of the total land area.

182. The express line of the proposed MCRP will extend approximately 15 km passing through CSEZ from the boundary of Mabalacat and Angeles to the Clark and CIA Stations which will be connected underground. On the other hand, the commuter line will extend approximately 8.8 km from the CSEZ in the Barangays of Lakandula and San Joaquin to the Barangays of Dau, Poblacion, Dolores and Tabun in Mabalacat. From the CIA Station, the route will extend approximately 3.8 km to the Mabalacat Depot in the vicinity of the BCDA property adjacent to ancestral domain areas. CIA and Clark Stations will be built at the CSEZ under the property of BCDA; while the Mabalacat Depot will be built within an Agricultural (Production) area situated beside the embankment of Sacobia River, where flood defense walls were built by DPWH after Mt Pinatubo eruption. Majority of the land adjacent to the proposed MCRP are used for residential, agriculture, special economic zone, and ancestral domain areas.

Bamban

183. Bamban is comprised of extensive military reservation, agricultural land and SACOBIA Resettlement Area. Approximately 55 % of the total land area of Bamban is devoted for military reservation use and about 25 % of the total land area is for agricultural use. The vast area under the Sacobia Development Authority includes the land areas of Barangays San Vicente and Sto. Niño, notwithstanding the boundary dispute of Bamban and Mabalacat. Though 10, 684 ha now falls under Certificate of Ancestral Domain Title (CADT) No. R03 BAM-12-4-025 of Bamban Aetas, this area will be avoided by the two alignment options from the Mabalacat depot to the last station in NCC. Ancestral domains/ancestral lands are land areas inhabited by groups of indigenous peoples whose rights are recognized and protected under Rep. Act 8371 (Indigenous Peoples Rights Act of 1997). Also within the territorial jurisdiction of Bamban are Zone F and Zone C which are reverted areas returned to the Philippines after the expiration of the RP-US Military Bases Agreement of 1947.

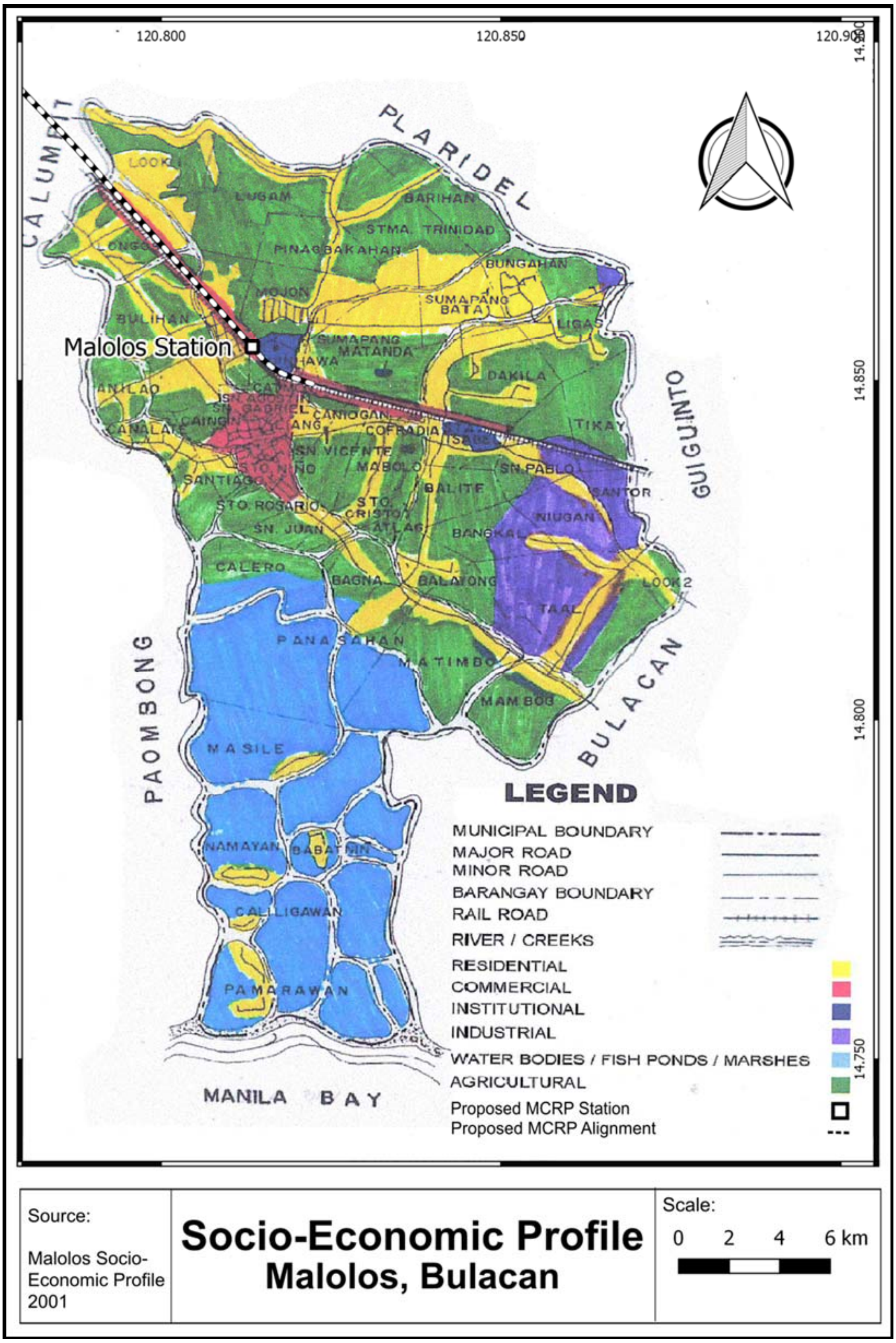
184. In Bamban, DOTr has two (2) route options with the length of approximately 6 km and 5 km for Option 1 and Option 2, respectively. Both route options will pass through the Barangays of Sto. Niño, and San Vicente in Bamban, with both options considering tunnel structures. Based on the letter provided by the NCIP dated April 24, 2018, both options will not traverse or overlap the Ancestral Domain areas in Bamban. Majority of the land adjacent to the proposed MCRP are used for agriculture (**Figure 3.1.9**) and a military reservation. Some of the notable structures proximal to the railway alignment are the Grotto of Our Lady of Lourdes, Don Dominciano Tizon Elementary School, and Pagasa Elementary School.

Capas

185. In Capas, the predominant types of land use are for military reservation covering 53.1% comprising of the O'Donnell Transmitter Station, O'Donnell Excepted Area, and Crow Valley Watershed, with forest areas (15.3%) and agriculture areas (16.3%) within the military reservation. In addition, the military reservation covers portions of Barangays Aranguren, O'Donnell, Maruglu, Sta. Lucia, Bueno, and Sta. Juliana for the establishment of Armed Forces of the Philippines (AFP) facilities and utilities.

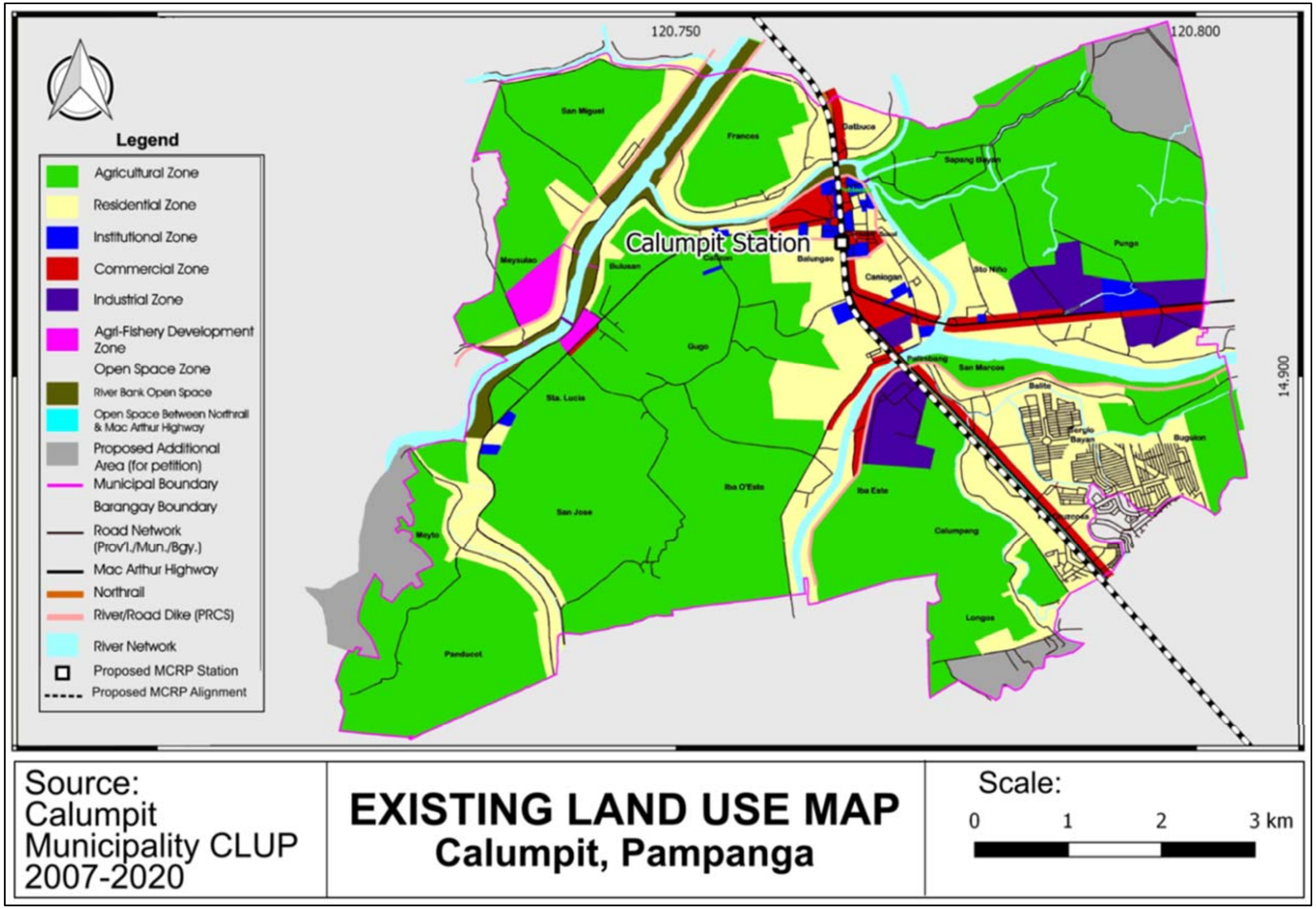
186. The proposed MCRP, viaduct columns, drainage and related facilities, will extend approximately 6 km passing through the proposed NCC managed by the BCDA in the Barangays of Maruglu, Cutcut II and Aranguren in Capas. The NCC Station will be built within the agricultural area (planned to be developed by the BCDA), as presented in (**Figure 3.1.10**). Majority of the land adjacent to the proposed MCRP are agricultural areas and open spaces.

187. NCC is a planned community to be developed and located in Capas, Tarlac covering an area of approximately 7,500 hectares and managed by the BCDA. It will host the National Government Administrative Center, business and institutional facilities, the BCDA's most ambitious project to date. Once developed, the NCC is envisioned to be at par with modern cities in the world.



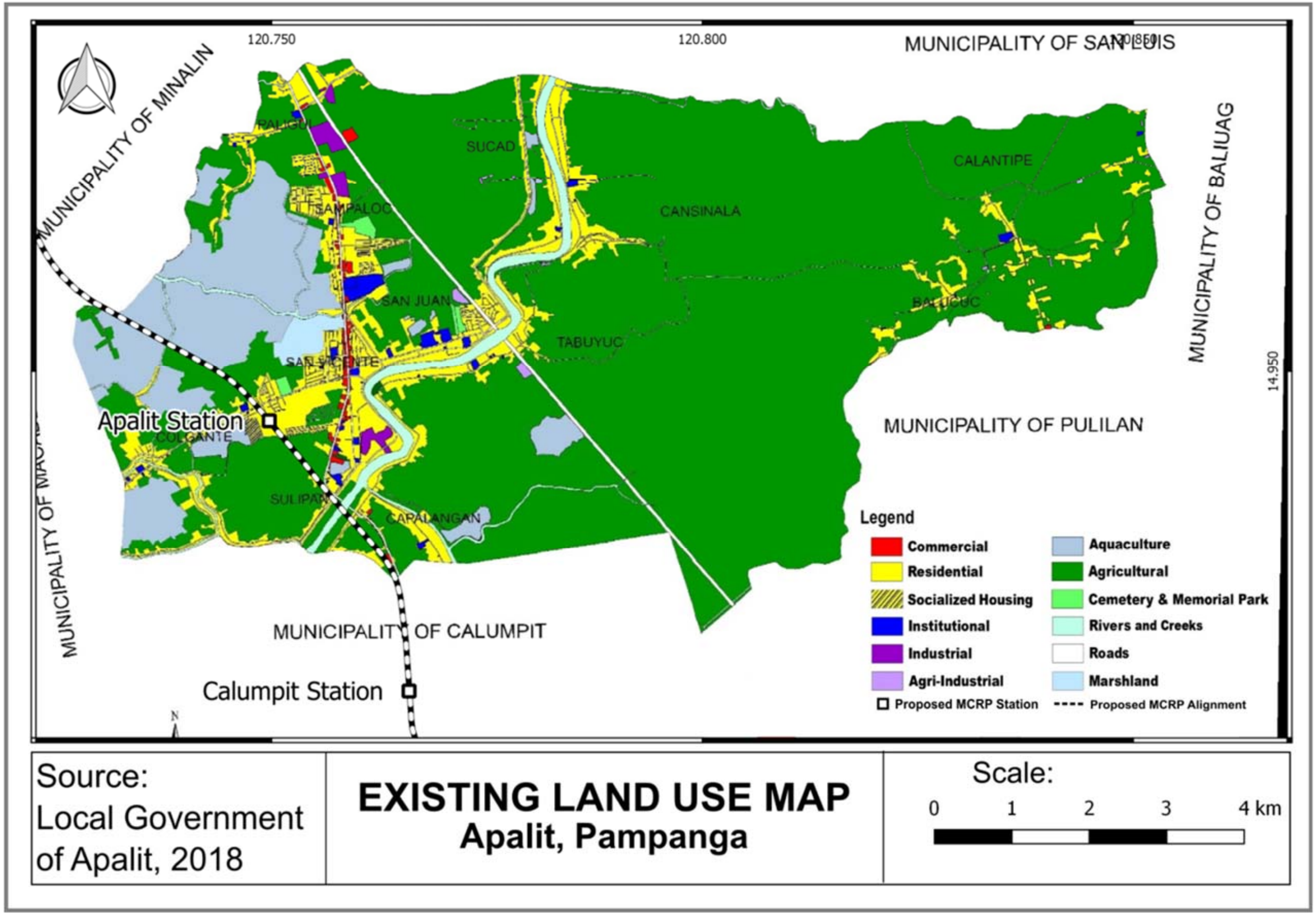
Source: Land Use Map, Socio Economic Profile, 2001

Figure 3.1.1 Malolos City Land Use Map Showing MCRP Alignment



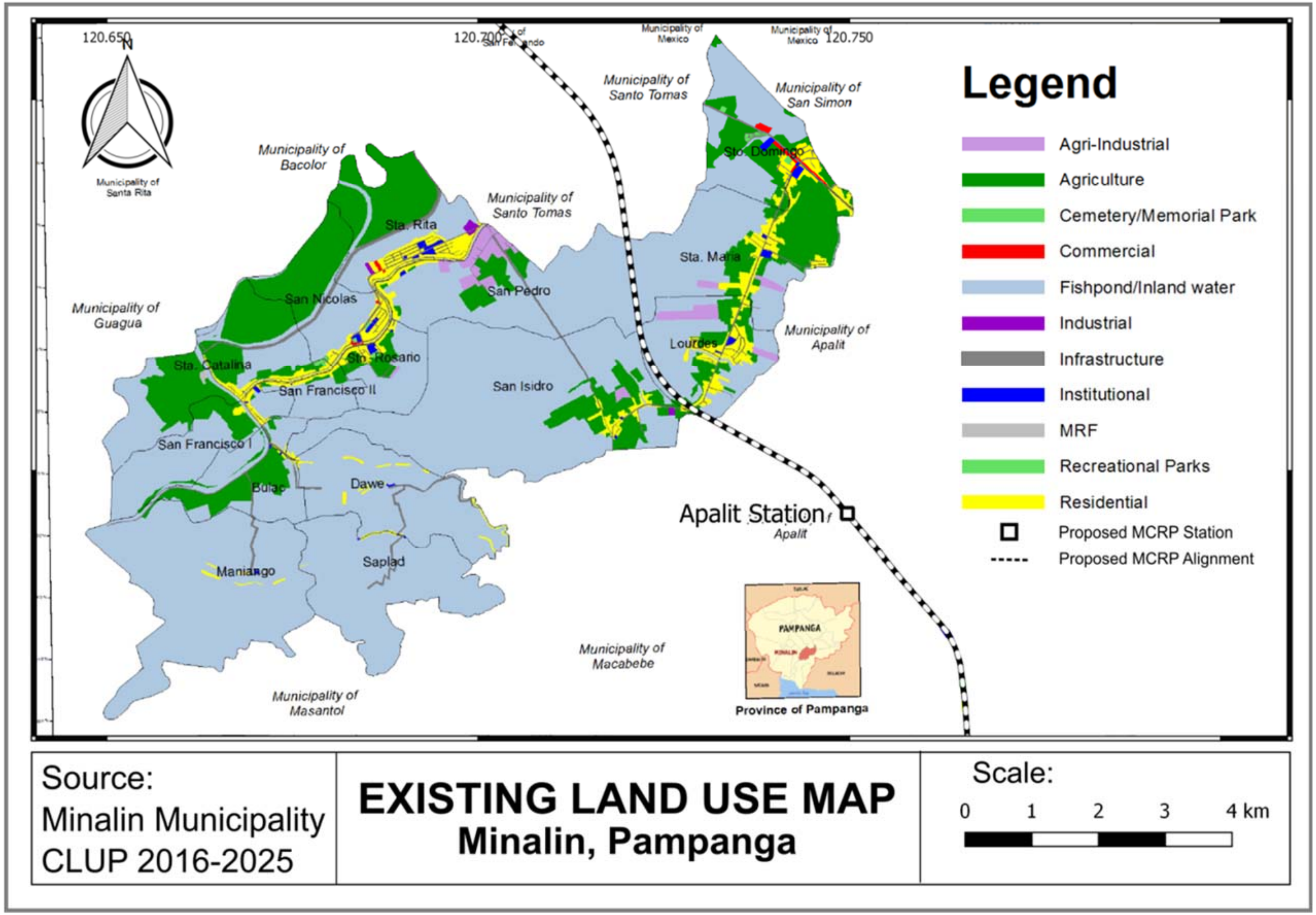
Source: Zoning Map, Calumpit Municipal CLUP, 2007-2020

Figure 3.1.2 Calumpit Land Use Map showing MCRP Alignment



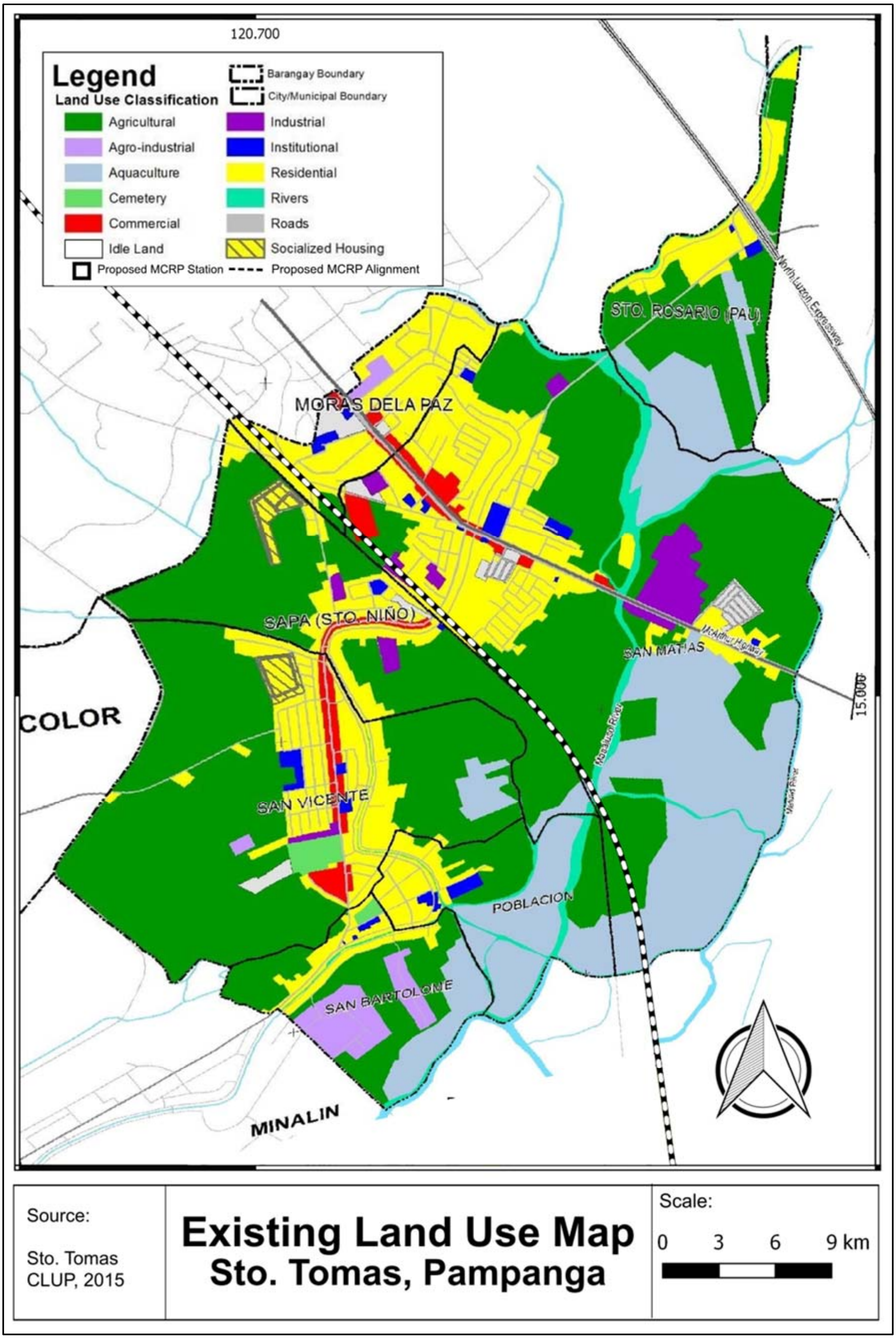
Source: Apalit Municipal CLUP, 2016-2025

Figure 3.1.3. Apalit Land Use Map Showing MCRP Alignment



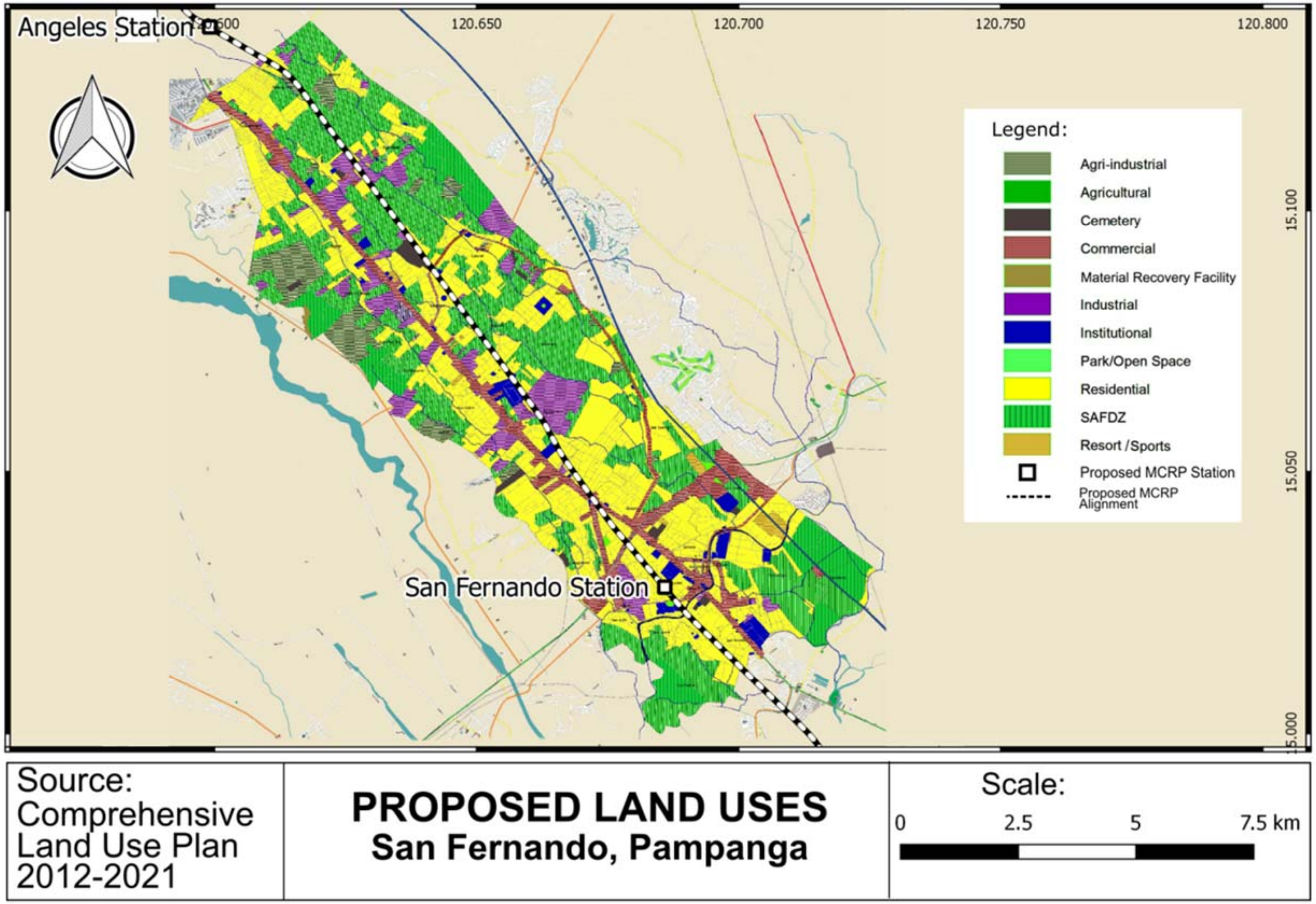
Source: Minalin Municipal CLUP 2016-2025

Figure 3.1.4 Minalin Land Use Map Showing MCRP Alignment



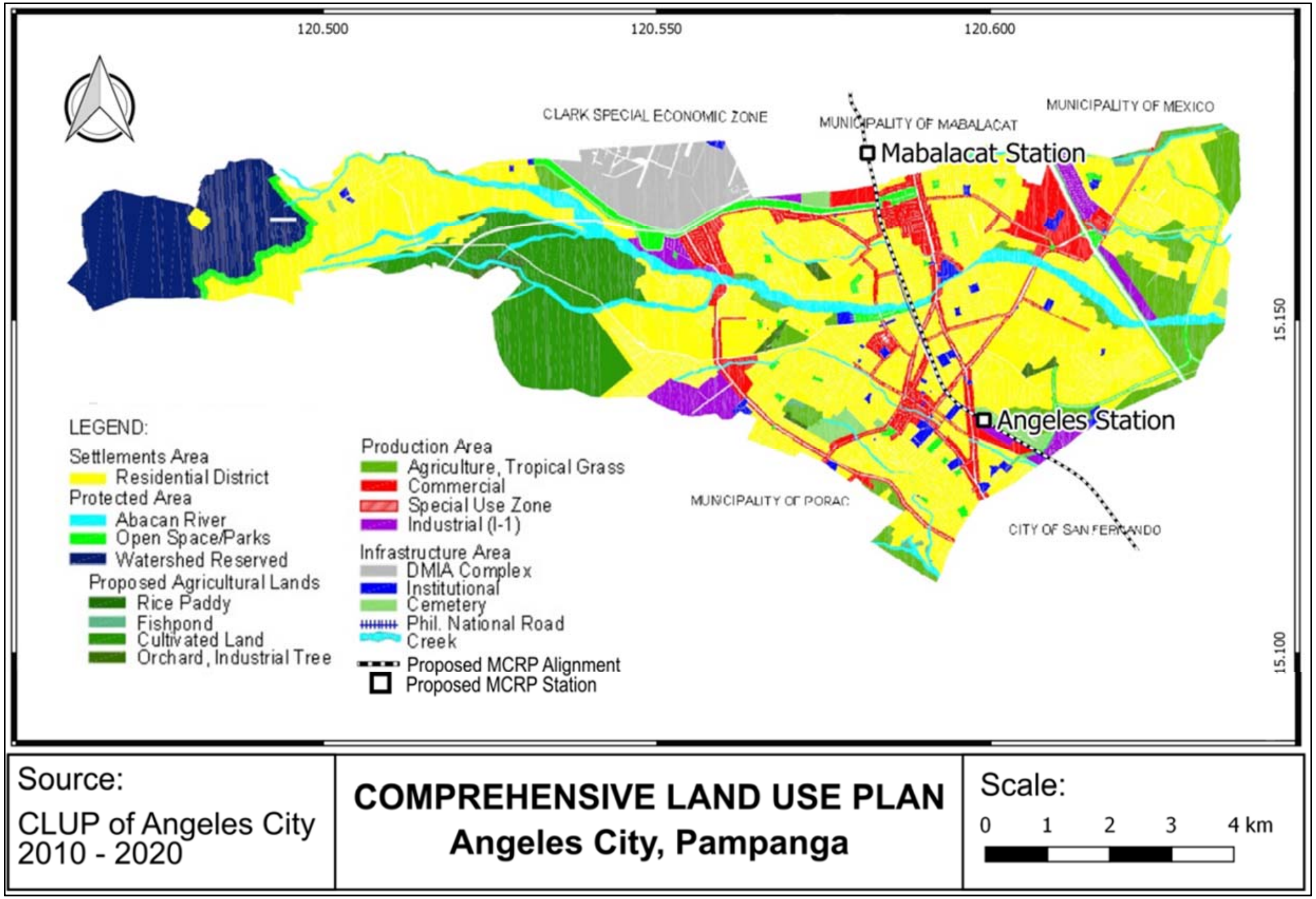
Source: Sto. Tomas Municipality CLUP, 2016-2025

Figure 3.1.5 Sto. Tomas Land Use Map showing MCRP Alignment



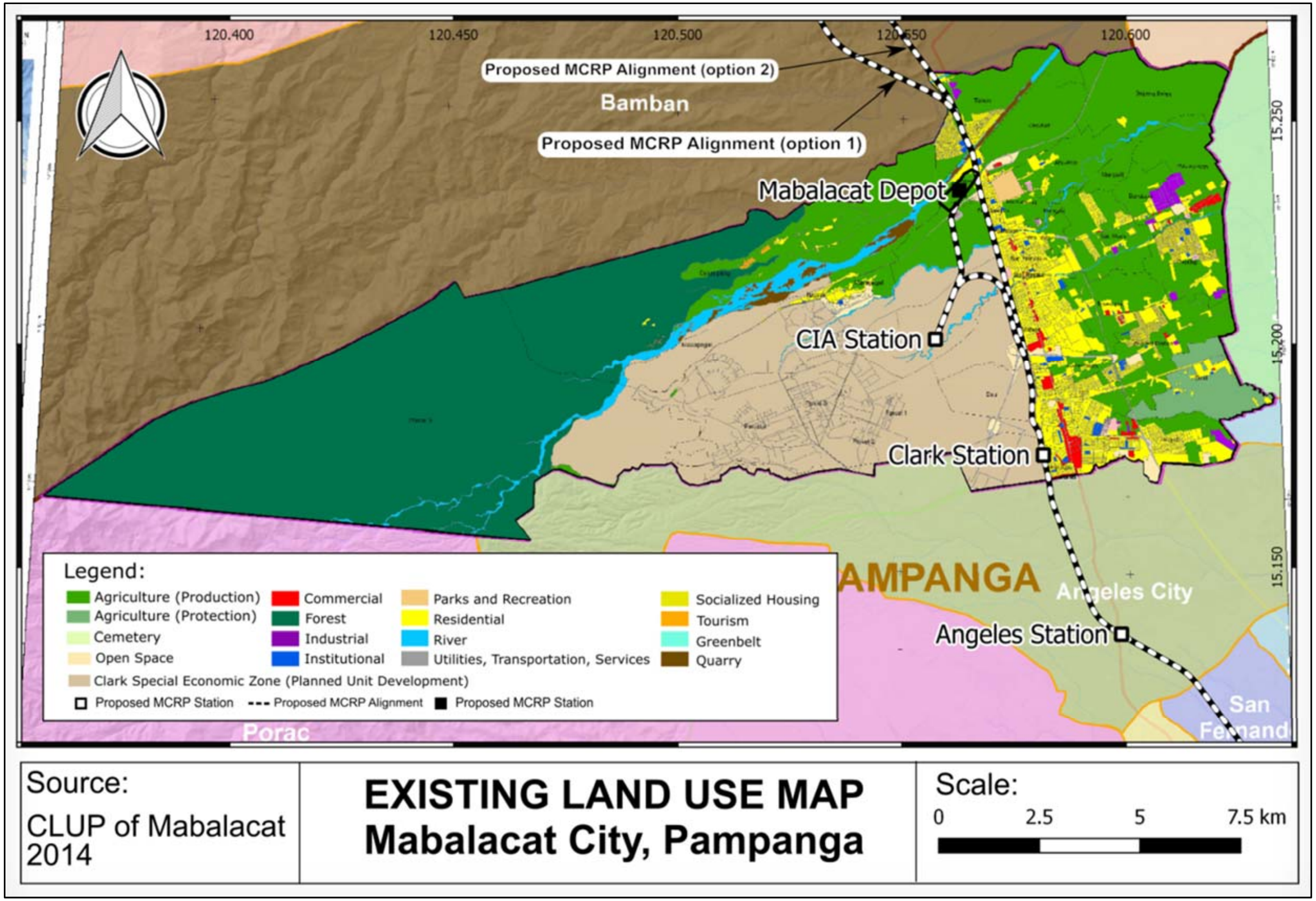
Source: San Fernando City CLUP, 2012-2021

Figure 3.1.6 San Fernando Land Use Map showing MCRP Alignment



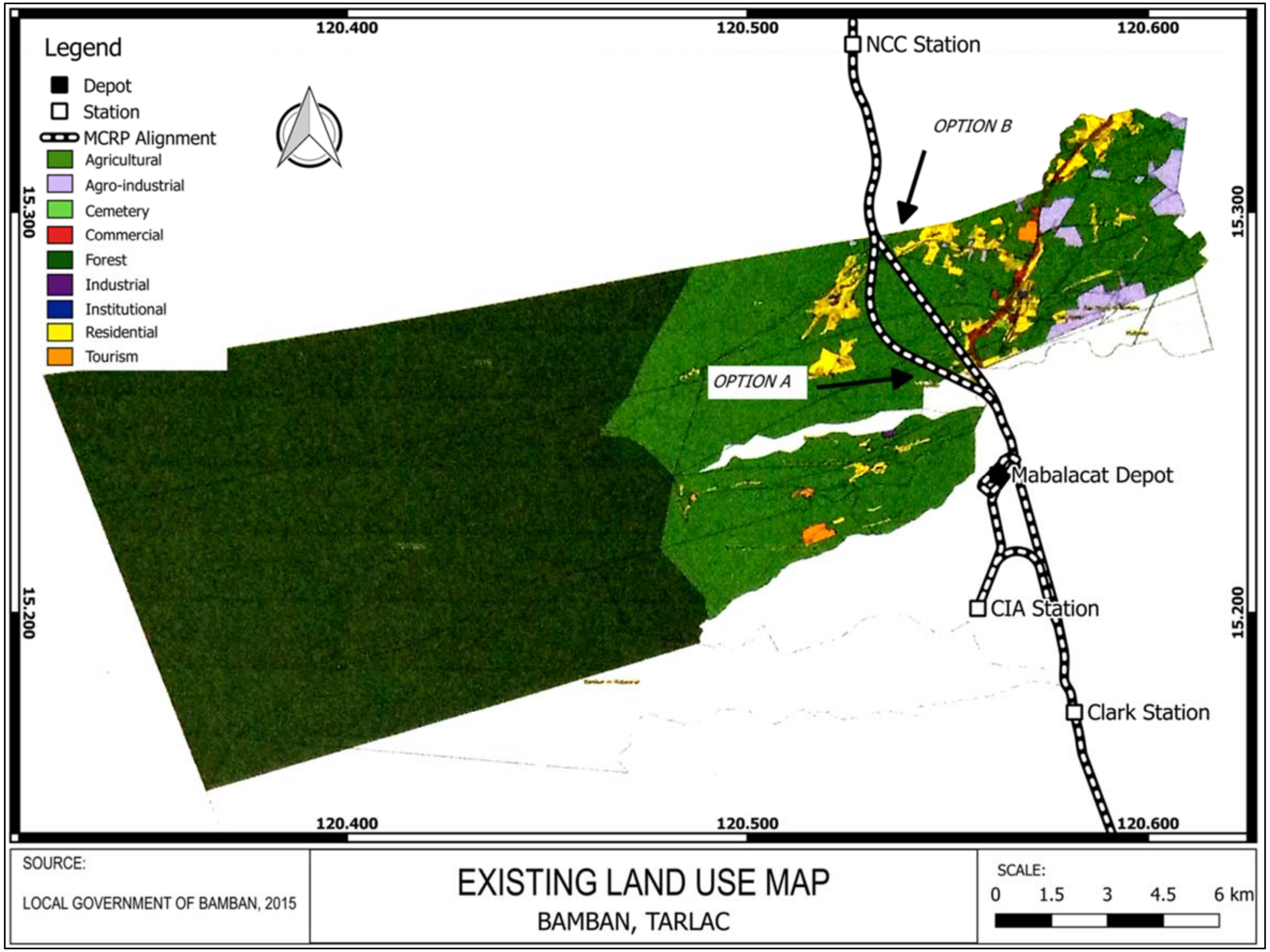
Source: Angeles City CLUP, 2010-2020

Figure 3.1.7 Angeles Land Use Map showing MCRP Alignment



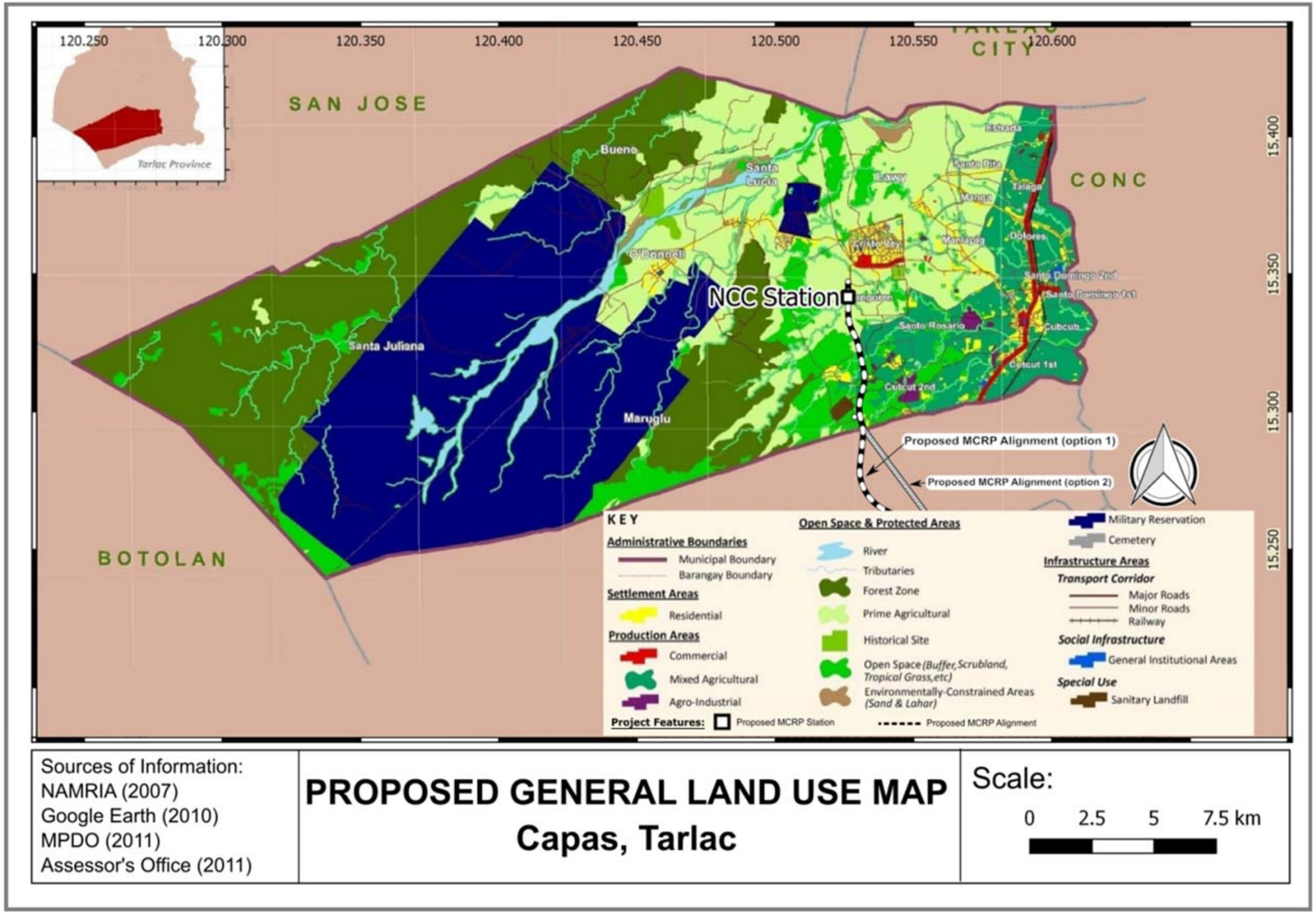
Source: Existing Land Use Map, Mabalacat City CLUP, 2011-2020

Figure 3.1.8 Mabalacat Land Use Map showing MCRP Alignment



Source: Bamban Municipal CLUP

Figure 3.1.9 Bamban Land Use Map showing MCRP Alignment



Source: Capas Municipality CLUP, 2011

Figure 3.1.10 Capas Land Use Map showing MCRP Alignment

3.1.1.2 Environmental Critical Area

188. Environmentally Critical Areas (ECAs) are environmentally sensitive areas declared under Presidential Proclamation No. 2146 of 1981 where significant environmental impacts are expected if certain types/thresholds of proposed project are located, developed or implemented in it.

189. The following paragraphs describes the ECAs traversed or within the proximity of the proposed MCRP. **Table 3.1.1** shows the ECA in the proposed Project Site.

Table 3.1.1 List of ECA and Relevance to the Project Site

Environmentally Critical Areas		Relevance to the Proposed Project Site
1	All areas declared by law as national parks, watershed reserves, wildlife preserves and sanctuaries	The proposed alignment of the MCRP will traverse portions of Manila Bay IBA and KBA in Malolos, Minalin and Sto. Tomas
2	Areas set aside as aesthetic, potential tourist spots	San Fernando City Old PNR Station converted to Museum
3	Areas which constitute the habitat for any endangered or threatened species of Indigenous Philippine wildlife (Flora and Fauna)	The project will not traverse this type of ECA classification
4	Areas of unique historic, archaeological, geological, or scientific interests	Identified old PNR structures to be maintained will be conserved in accordance with the guidelines of the National Historical Commission of the Philippines (NHCP)
5	Areas which are traditionally occupied by cultural communities or tribes	The proposed alignment will not traverse CADT/CADC which will be verified through an FBI by NCIP.
6	Areas frequently visited and or hard hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity, etc.)	The proposed MRCP will traverse an area with High Risk to typhoon passage. The segments from San Fernando Station to Malolos Station have high susceptibility to flooding.
7	Areas with critical slope: All lands with slope of 50% or more classified as geohazard by MGB	The proposed MCRP is not expected to traverse areas with critical slope.
8	Areas classified as prime agricultural lands	The areas in Bamban and Capas which will be traversed by the MCRP are prime agricultural lands. Similarly, the immediate vicinity of proposed MCRPare fishponds or aquaculture areas in Apalit, Minalin and Sto. Tomas. However, these will not be encroached by the proposed MCRP since it will utilize the existing ROW of the PNR.
9	Recharge areas of aquifers	No identified recharge areas of aquifers along the alignment of MCRP.
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.	This type of ECA is not relevant to the proposed MCRP. Although, there are fishponds or aquaculture areas located in Apalit, Minalin and Sto. Tomas. However, these areas will not be encroached by the proposed MCRP since it will utilize the existing ROW of the PNR.
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.	This type of ECA is not relevant for the proposed MCRP.
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 breakwater of coastlines.	This type of ECA is not relevant for the proposed MCRP.

Source: Presidential Proclamation No. 2146 (1981)

(1) Areas Declared by Law as National Parks, Watershed Reserves, Wildlife Preserves and Sanctuaries

1) Protected Areas based on International Laws

190. International Union for Conservation of Nature (IUCN) protected area management categories classify protected areas according to their management objectives. The categories are recognized by international bodies such as the United Nations and by many national governments

as the global standard for defining and recording protected areas and as such are increasingly being incorporated into government legislation.

191. Based on the IUCN, Philippines has a total of 390 protected areas composed of National Park (37), Natural Monument or Feature (8), Habitat/Species Management Area (17), Protected Landscape/ Seascape (145), and Protected area with sustainable use of natural resources (183).

Table 3.1.2 Classification of IUCN Protected Area

	Classification	Feature	Number of Protected Area in Philippines
I	Strict Nature Reserve/ Wilderness Area	Areas set aside to protect biodiversity and also possibly geological/geomorphic features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values / protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition	0
II	National Park	To protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities	37
III	Natural Monument or Feature	To protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove	8
IV	Habitat/Species Management Area	To protect particular species or habitats and management reflects this priority	17
V	Protected Landscape/ Seascape	Area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values	145
VI	Protected area with sustainable use of natural resources	Areas conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems	183

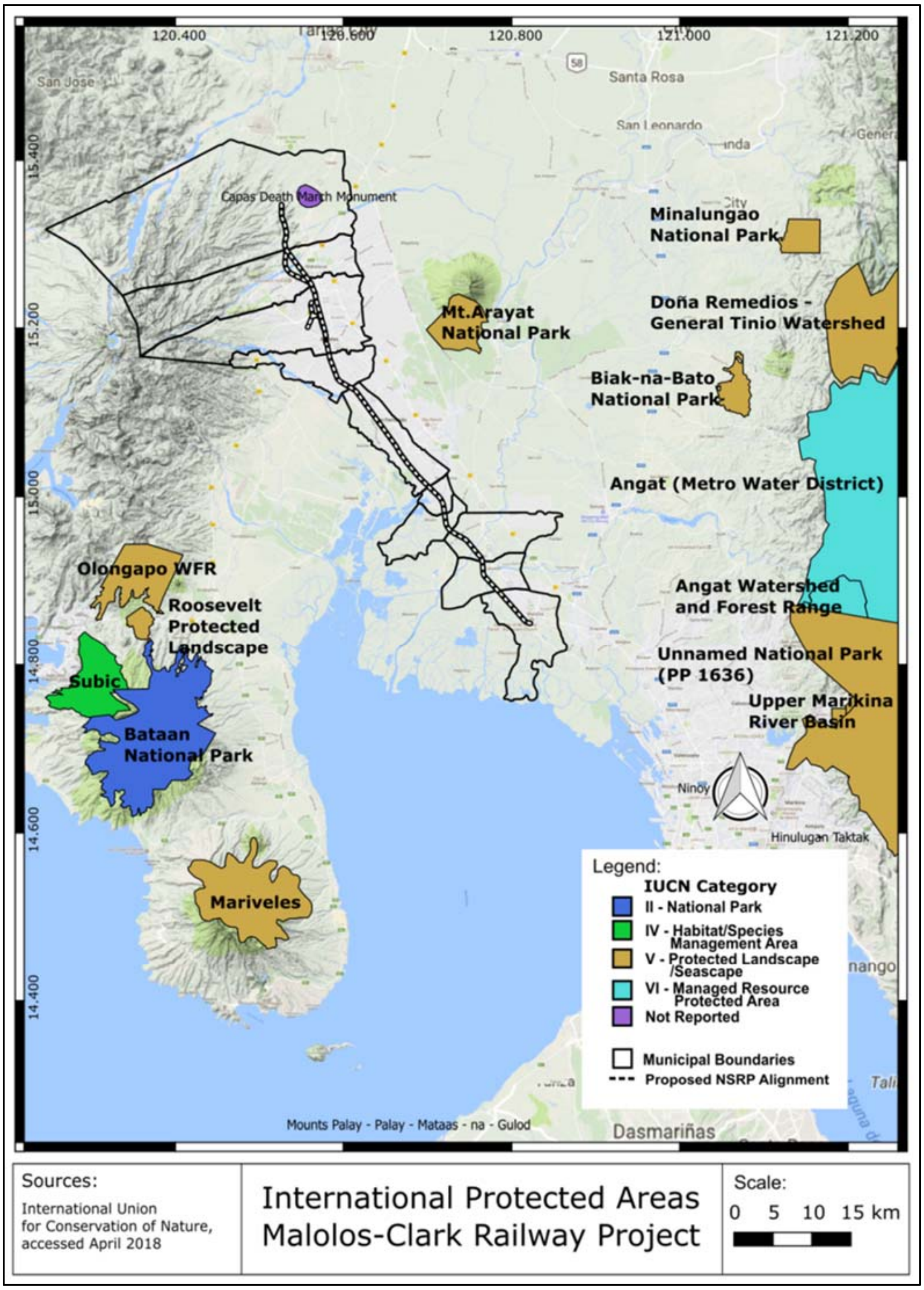
Source: IUCN, http://www.iucn.jp/park/protection/reserve/reserve (Access in January 2018)

192. The protected areas located within 50 km from the project alignment are presented in **Table 3.1.3** and **Figure 3.1.11**. The alignment of MCRP does not traverse the protected area.

Table 3.1.3 International Protected Area nearby Project Area

Category	Protected area	Location	Area (ha)	Distance from the Project (km)
II	Bataan National Park	Morong, Bataan	31,000	45
IV	Subic Watershed Forest Reserve	Subic, Zambales	84,500	47
V	Roosevelt Protected Landscape	Olongapo, Zambales and Dinalupihan, Bataan	786	45
V	Olongapo Naval Base Perimeter	Olongapo, Zambales	582	30
V	Mt. Arayat National Park	Arayat and Magalang, Pampanga	3,715	13
V	Biak - na – Bato National Park	Antipolo and Rodriguez, Rizal	2,117	40
VI	Mt. Angat Watershed Forest Reserve (Metro Water District)	Angat, Bulacan	62,309	40
Not Reported*	Capas Death March Monument	Capas, Tarlac	7	5.5

Note: The classification of IUCN Management Category (Ia, Ib, II, III, IV, V or VI) adopted for national protected areas. For reporting on international protected areas the option of listing ‘Not Applicable’ is accepted. For national protected areas where an IUCN category has not been adopted ‘Not Reported’can be listed.



Source: IUCN (Accessed in April 2018)

Figure 3.1.11 International Protected Areas

2) Protected Area under the Philippine Law

193. The National Integrated Protected Areas System (NIPAS) Act of 1992 (Republic Act No. 7586) and its Implementing Rules and Regulations (DAO No. 92-25) as amended by DAO 2008-26 (2009) provides the legal framework for the establishment and management of protected areas in the Philippines. There are eight (8) categories of protected areas under the NIPAS namely, Strict Nature Reserve, Natural Park, Natural Monument/Natural Landmark, Wildlife Sanctuary, Protected Landscape and Seascapes, Resource Reserve Natural Biotic Areas/Anthropological Reserve, and Other categories.

Table 3.1.4 Classification of NIPAS[1]

	Category	Features	Number of Protected Area in Philippines (as of December 2008)[2]
1	Strict Nature Reserve	SNR is an area possessing some outstanding ecosystem, features and/or species of flora and fauna of national scientific importance, maintained to protect nature and maintain processes in an undisturbed state in order to have ecologically representative examples of the natural environmental monitoring, education and for maintenance of genetic resources in a dynamic and evolutionary state.	2
2	Natural Park	NP is a relatively large area not materially altered by human activity where extractive resource uses are not allowed and which are maintained to protect outstanding natural and scenic areas of national or international significance for scientific, educational, and recreational use.	27
3	Natural Monument/Natural Landmark	NM/NL is a relatively small area focused on protection of small features to preserve nationally significant natural features on account of their special interest or unique characteristics.	4
4	Wildlife Sanctuary	WS comprises an area which assures the natural conditions necessary to protect nationally significant species, groups of species, biotic communities, or physical features of the environment where these may require specific human manipulation for their perpetuation.	9
5	Protected Landscape and Seascapes	PL/S are areas of national significance which are characterized by the harmonious interaction of man and land while providing opportunities for public enjoyment through recreation and tourism within the normal lifestyles and economic activity of these areas.	57
6	Resource Reserve	RS is an extensive and relatively isolated and uninhabited area normally with difficult access designated as such to protect natural resources of the area for future use and prevent or contain development activities that could affect the resources pending the establishment of objectives which are based upon appropriate knowledge and planning.	3
7	Natural Biotic Areas/ Anthropological Reserve	Natural Biotic Areas/Anthropological Reserve is an area set aside to allow the way of life of societies living in harmony with the environment to adopt to modern technology at their pace.	4
8	Other categories	This refer to those areas established by law, conventions, or international agreements which the Philippine Government is a signatory.	1

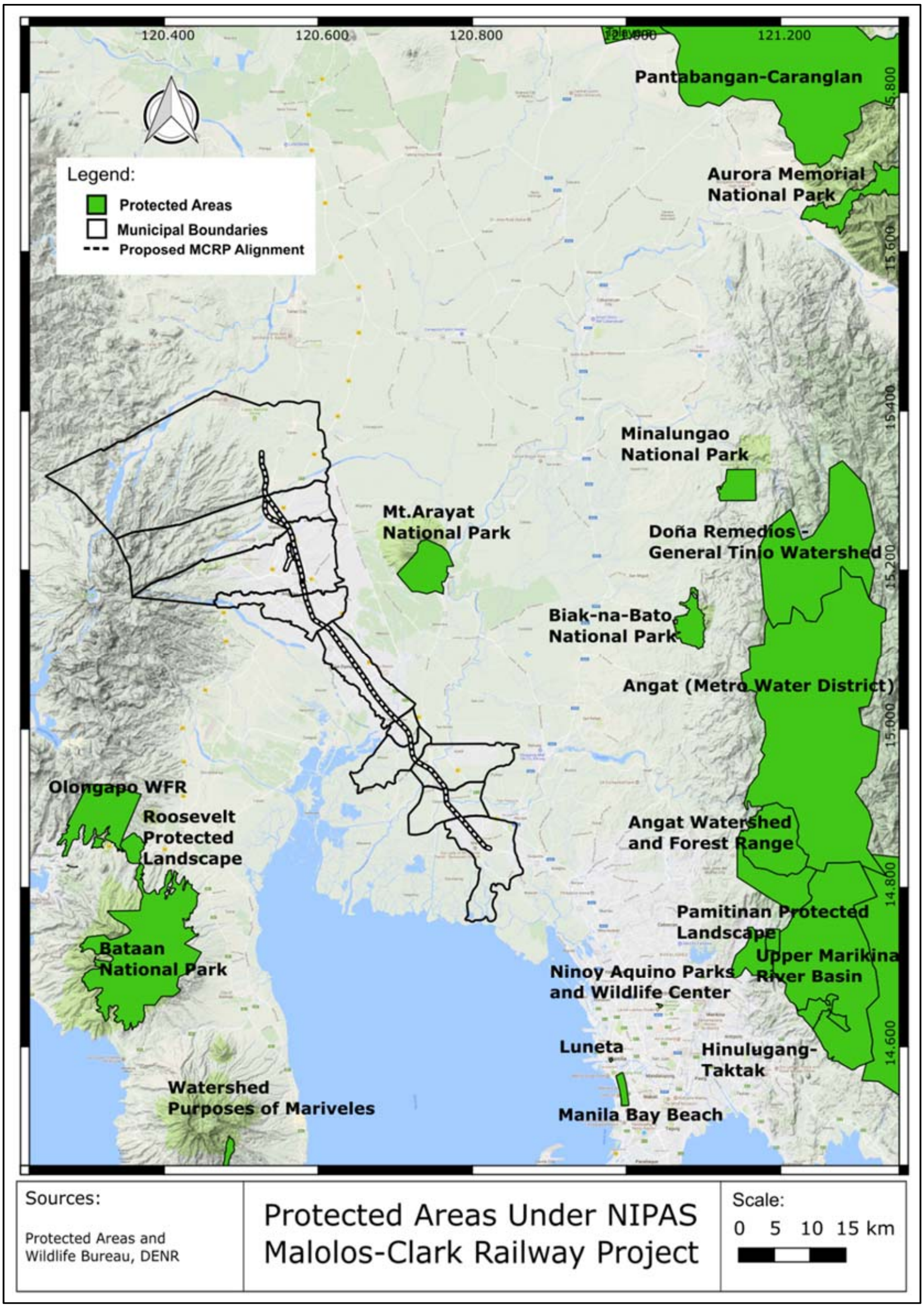
Source: Memorandum Circular No.2004-09
[2]Legal Framework for Protected Areas: Philippines, http://cmsdata.iucn.org/downloads/philippines.pdf

194. Protected areas located within 50 km from the project alignment are shown in **Table 3.1.5** and **Figure 3.1.12**. The alignment of MCRP does not traverse the protected area.

Table 3.1.5 Protected Area nearby the Proposed MCRP

Category	Protected Area	Location	Area (ha)	Distance from the Project (km)
Natural Park	Mt. Arayat National Park	Arayat and Magalang, Pampanga	3,715	13
	Biak-na-Bato National Park	San Miguel and Doña Remedios Trinidad, Bulacan	2,117	40

Source: Protected Areas and Wildlife Bureau, DENR



Source: Protected Areas and Wildlife Bureau, DENR

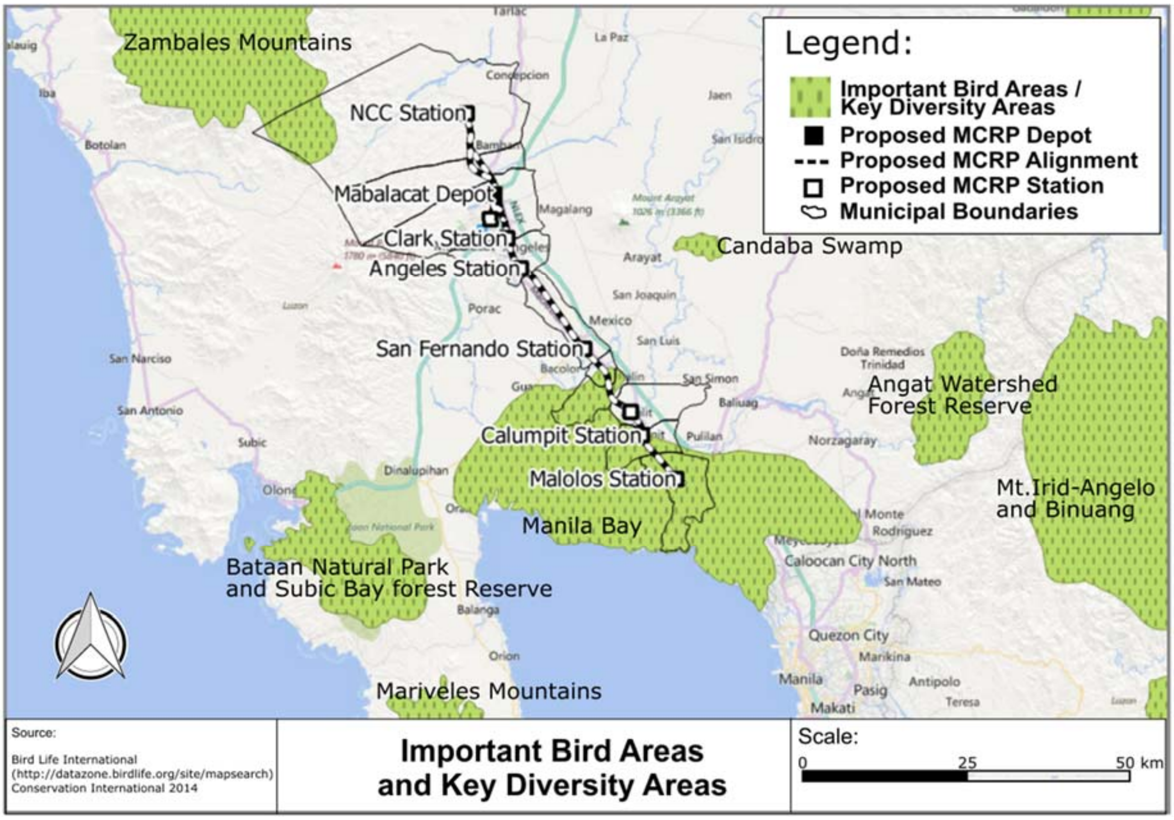
Figure 3.1.12 Protected Area under NIPAS

3) Important Bird Areas and Key Biodiversity Areas

195. The Important Bird Areas Program (IBAs) is a global effort to identify and conserve areas that are vital to birds and other biodiversity coordinated by the Bird Life International. In 2006, DENR defensed the terrestrial Key Biodiversity Areas (KBAs) using data from IBAs, the 2004

IUCN Red List, as well as point locality data from published literature, experts and scientists, and museum collections.

196. The proposed alignment of the MCRP will traverse Manila Bay which is designated as IBA and KBA in Malolos, Minalin and Sto. Tomas and is 15 km away from Candaba Swamp. Many migrating birds are observed in Manila Bay during the migration season and winter. Some vulnerable species are also recorded. The location map is shown in **Figure 3.1.13**.



Source: 1) Bird Life International (http://datazone.birdlife.org/site/mapsearch) 2) Conservation International 2014

Figure 3.1.13 IBA and KBA Location Map

(2) Areas Set Aside as Aesthetic, Potential Tourist Spots

197. The areas set aside as aesthetic or potential tourist spots that will be encroached by the proposed MCRP are the old PNR Stations, Gov. Macario Arnedo Park and Death March Marker in San Fernando, Pampanga and the Grotto of Our Lady of Lourdes in Bamban, Tarlac.

198. The Death March Marker, with National Historical Commission of the Philippines (NHCP) Level II Marker, is a historical site commemorating the infamous Death March of World War II, while the old PNR San Fernando Station has been converted by San Fernando into a museum. The old station is where the Filipino-American prisoners-of-war were herded into railway boxcars on their way to Capas, Tarlac. Not only the listed, San Fernando has many other tourist destinations.

199. The Grotto of Our Lady of Lourdes in Brgy. Anupul, Bamban is a religious pilgrimage area for Christian Filipinos which not only offers a quiet retreat place for meditation (especially during Holy Week) but also for local tourists as well.

(3) Areas of Unique Historic, Archaeological, or Scientific Interests

200. In the Philippines, NHCP declares the heritage in accordance with NHCP Guideline on the Identification, Classification, and Recognition of Historic Sites and Structures in the Philippines (2011) under RA 10066 (2009). Structures and site with 1) possess demonstrable historical significance, 2) be at least 50-year old, and 3) 70% authentic are qualified for consideration. There are ten (10) historical and cultural heritage declared by NHCP located in close proximity to the proposed MCRP, as presented in **Table 3.4.14**. Three (3) of these historical sites are located within about 100m from the MCRP alignment. These include Himpilang Daang Bakal ng San Fernando, Death March in San Fernando City and Bayan ng Kalumpit in Calumpit.

201. Within the project area, twelve (12) 50-year old PNR stations and Railway Bridges were dotted along the proposed MCRP alignment and these are listed **Table 3.4.15**. These structures may need preservation and DOtr will consult NHCP and PNR for the qualification of these structures for the provision of necessary protection measures during construction.

(4) Areas which are Traditionally Occupied by Cultural Communities or Tribes

202. Between the proposed Depot in Mabalacat and the NCC Station in Capas are areas with existing ancestral domain titles and ancestral domain claims by Aeta tribes. These are found within the boundary of Pampanga and Tarlac and some upland areas in Tarlac. Since increasing urban development may threaten the communities' customs, traditions and livelihood, there is a need to prioritize their rights. Republic Act 8371 and its implementing rules and regulations recognizes and promotes the rights of such indigenous cultural communities/indigenous peoples of the Philippines.

(5) Areas Frequently Visited and or Hard Hit by Natural Calamities

203. The proposed MRCP falls within an area with High Risk to typhoon passage. In terms of flooding, the segments from San Fernando Station to Malolos Station have high susceptibility. The proposed Depot is located within the embankment of Sacobia River in Mabalacat where bank protection wall was built by DPWH after the Mount Pinatubo erruption.

204. On the other hand, the proposed MCRP is not susceptible to ground rupture due to their significant distance from the major earthquake generators. Moreover, based on the volcanic hazard assessment issued by PHIVOLCS for the MCRP Project, the railway route is outside the permanent danger zone of the volcano. The MCRP route falls under Zone 4, which has been considered safe from lahars.

(6) Areas Classified as Prime Agricultural Lands

205. Prime agricultural land refers to the land that can be used for various or specific agricultural activities and can provide optimum and suitable yield with minimum inputs and development costs as determined by the Department of Agriculture (DAR AO No. 01 Series of 2002). The segment of the proposed MCRP passes through agricultural areas in Bamban and Capas, Tarlac.

206. There are fishponds or aquaculture areas located in Apalit, Minalin and Sto. Tomas where proposed alignment will traverse through approximately 4 km. These areas will not be encroached by the proposed MCRP since it will utilize the existing ROW of the PNR, except for a portion in Minalin, 0.9 km due to the required curvature for the alignment.

(7) Water Bodies

207. The proposed MCRP will be intersected by rivers and streams at 43 locations. These include San Fernando River, Pampanga River, Angat River, and their respective tributaries. However, none of these rivers are used for domestic purposes as most of them are already heavily polluted as a result of domestic and industrial activities.

208. There are fishponds or aquaculture areas located in Apalit, Minalin and Sto. Tomas. However, these areas will not be encroached by the proposed MCRP since it will utilize the existing ROW of the PNR.

Table 3.1.6 Assessment of ECA at the Proposed MCRP Site

Environmentally Critical Areas	Malolos	Calumpit	Apalit	Minalin	Sto. Tomas	San Fernando	Angeles	Mabalacat	Bamban	Capas
All areas declared by law as national parks, watershed reserves, wildlife preserves and sanctuaries	Yes	None	None	Yes	Yes	None	None	None	None	None
Areas set aside as aesthetic, potential tourist spots	None	None	None	None	None	Yes	None	None	Yes	None
Areas which constitute the habitat for any endangered or threatened species of Indigenous Philippine wildlife (Flora and Fauna)	None	None	None	None	None	None	None	None	None	None
Areas of unique historic, archaeological, geological, or scientific interests	Yes	Yes	Yes	Yes	Yes	Yes	Yes	None	None	None
Areas which are traditionally occupied by cultural communities or tribes	None	None	None	None	None	None	None	None	None	None
Areas frequently visited and or hard hit by natural calamities	-	-	-	-	-	-	-	-	-	-
- geologic hazard and volcanic activity	None	None	None	None	None	None	None	None	None	None
- floods	Yes	Yes	Yes	Yes	Yes	Yes	None	None	None	None
- typhoons	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Areas with critical slope: All lands with slope of 50% or more classified as geohazard by MGB	None	None	None	None	None	None	None	None	None	None
Areas classified as prime agricultural lands	None	None	None	None	None	None	None	None	Yes	None
Recharge areas of aquifers	None	None	None	None	None	None	None	None	None	None
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.	None	None	None	None	None	None	None	None	None	None
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.	None	None	None	None	None	None	None	None	None	None
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 breakwater of coastlines.	None	None	None	None	None	None	None	None	None	None

3.1.1.3 Land Tenure Issue

(1) BCDA

210. The BCDA currently runs several infrastructure projects in the north, such as the NCC in Tarlac and CIA airport expansion. The alignment goes through some areas within BCDA jurisdiction in Pampanga and Tarlac. The MCRP railway stations in Clark and in NCC, viaduct columns, underground, service access, drainage facilities and tunnels in Bamban are within the BCDA property, including the Mabalacat depot. In this case, agreement will be made with the BCDA on the use of these areas.

211. NCC is a planned community to be developed and located in Capas, Tarlac covering an area of approximately 7,500 hectares and managed by the BCDA. It will host the National Government Administrative Center and is designed to be the country's first smart, green, disaster-resilient city where nature, lifestyle business, and industries converge. NCC is envisioned to be at par with modern cities in the world. Some project components such as the New Govt. Center and the stadium/sports center have already started construction, while the SCTEX to NCC road project will start construction by late 2018.

212. The proposed Mabalacat Depot site is owned by BCDA, however being beside the bank protection wall of Prince Balagtas Ave., close coordination with the DPWH will be required.

(2) CIA

213. The railway station in CIA is inside the airport premises and operated by the Clark International Airport Corporation (CIAC). Agreements will be made with the airport management and operator on how best to develop and maintain the station, viaduct columns, drainage and related railway facilities. The airport terminal is planned to be expanded to cater to increasing future demand and provide an upgraded logistical hub.

(3) Private Land owners

214. The MCRP will affect an estimated total of 200 legal landowners for the section that alignment will run outside of PNR ROW and BCDA property, where the project will require land acquisition.

(4) Informal Settlers

215. PNR ROW has been proliferated by around 1,200 Informal Settler Families (ISFs) disregarding the hazard of living along the PNR ROW. Majority of the alignment from Malolos to Sto. Tomas has already been cleared (in preparation for the NSCR Project). However, ISFs have established houses along some segments of the alignment, in particular those close to the town proper. The old PNR stations in Apalit and Dau have been the residence of informal settlers. This is also true for the alignment along San Fernando and Angeles, which are heavily built-up areas, comprising a mix of residential, commercial and institutional land uses. A large number of ISF will be affected by the construction of the railway station in San Fernando. The same is true in Angeles, specifically those ISF's residing within the old PNR station where their access roads are affected by the alignment. As the ISFs will be affected by the project, they will be resettled/relocated in pre-identified locations and provided with such other assistance possible under the project.

(5) Access Lane

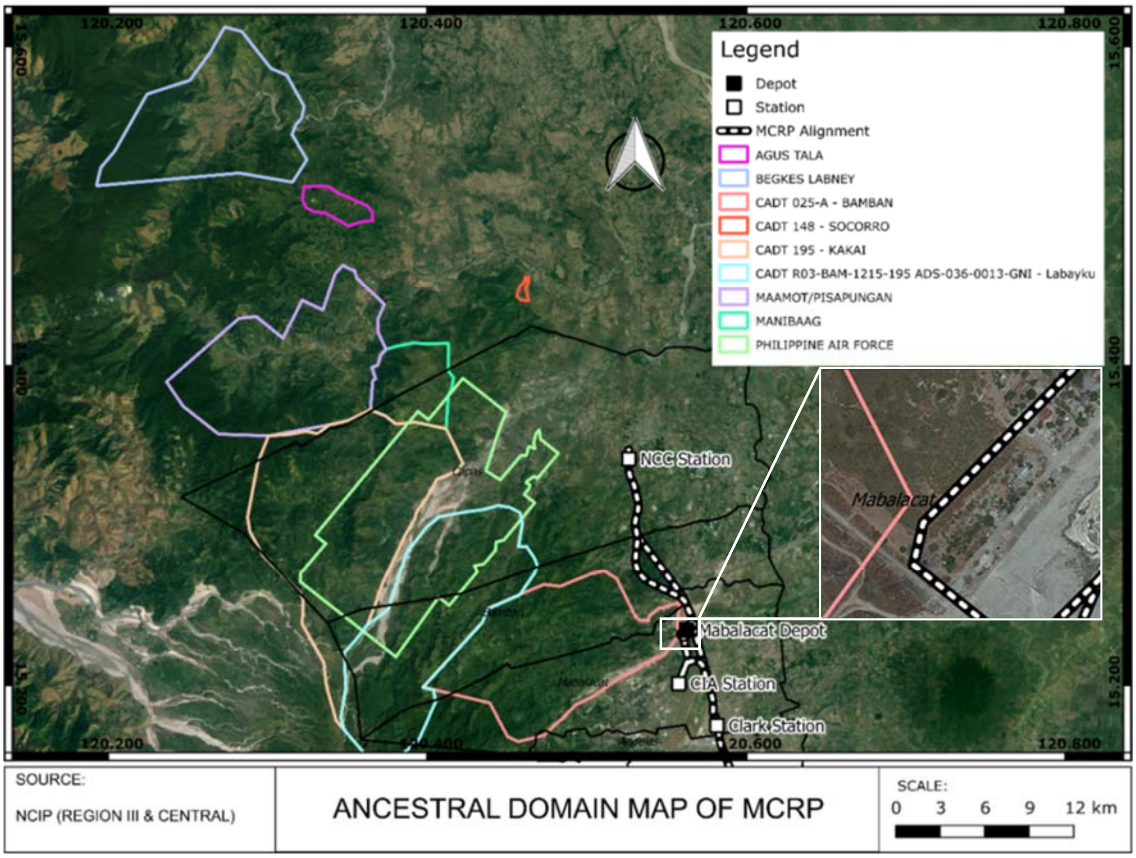
216. The proposed MCRP running through the PNR ROW will eventually go through a number of road/street crossings, both national and provincial/local roads and numerous river and creek

crossings as well. However, since it is designed as a viaduct, the roads/streets will be taken into consideration in the location of the viaduct columns. The same will hold true for the bridges, although the major rivers systems in the area are not usually navigational lanes for watercraft, except for some rivers/creeks in Sto. Tomas, Minalin and Apalit where fishermen navigate the rivers to access their fishponds.

(6) Ancestral Domain

217. Republic Act No. 8371, otherwise known as the Indigenous People Rights Act of 1997 (IPRA) recognizes and promote the rights of Indigenous Cultural Communities/Indigenous Peoples (ICCs/IPs) and the law recognized the rights of IPs of their ancestral domains and provided for a process of titling of lands through the issuance of CADT or Certificate of Ancestral Land Title (CALT).

218. In 1980, a location known as the SACOBIA property was designated as part of the U.S. Military Reservation (Clark Air Base) within the CSEZ subject to management of the CDC. On December 16, 1997, the NCIP issued a Certificate of Ancestral Domain Claim (CADC) No. R03-CADC-107, covering the area of approximately 5,515 hectares of the SACOBIA property in favor of the Aeta tribes. In 2006, a CADT 025 was issued by the NCIP covering the portions of Mabalacat and parts of Bamban. To address this issue, BCDA entered a Joint Management Agreement (JMA) also known as the Kasunduan Para sa Sama-Samang Pamamahala on December 6, 2007, with the CDC, NCIP and the Aeta tribes in the area, namely the Samahang Tribung Aeta ng CADT 025, Bamban Aeta Tribal Association (BATA), and the Mabalacat Aeta Tribal Association (MATA). Adjacent to CADT 025 are the approved CADTs of the Labayku and Kakai. **Figure 3.1.14** presents the location of the Ancestral Domain areas near the proposed MCRP.



Source: NCIP Region 3

Figure 3.1.14 Location of Ancestral Domain Areas Near the Proposed MCRP

3.1.1.4 Visual Aesthetics

219. The majority of landscape along the MCRP is agricultural land and residential. The noteworthy landscape significance in the vicinity is the landscape of Manila Bay and Mount Pinatubo.

(1) Wetland of Manila Bay (Apalit, Minalin, and Sto. Tomas)

220. The vast expanse and surrounding areas of Manila Bay Area offer historical, cultural and economic significance for Filipinos, of which, wetlands cover about 4,600 ha including mudflats, sandflats, swamps, beaches and rocky shores. About 53 % percent of the mudflats are found in Bulacan, 29 % in Pampanga and 17% in Bataan. The area where the project will traverse this part of Manila bay which is low and flat inland has distinctive landscape characteristics, of which mostly have been converted to fishponds. The proposed alignment will traverse through the middle of fishpond landscape. During the migratory season, the land and sea attributes of the fishponds may provide a recreation and tour destinations to bird watchers, aside from other uses.

(2) Mount Pinatubo and surrounding area

221. Mount Pinatubo is located approximately 25 kilometers west of the proposed MCRP. It is an active stratovolcano in the Zambales Mountains that erupted on July 16, 1991 and was considered as the century's biggest volcanic eruption. Located northeast of Mt. Pinatubo, are ancestral domain areas, where indigenous Aetas reside, and a Philippine Air Force military reservation. On its west, located are portions of the Zambales Mountains going towards West Philippine Sea. On its south, located are marks of lahar flow due to the 1991 eruption. Further south, located is Mapanuepe Lake which is near a mining site.

222. Despite the hazards it poses, Mt. Pinatubo is fast-becoming a tourist attraction due to its natural landscape and it also serves as the gateway to the historic town of Capas in the province of Tarlac. The economic growth, particularly in the tourism sector, is expected to boost with accessibility and connectivity created by the proposed MCRP. An increase in land value is expected in non-hazard prone areas surrounding Mt. Pinatubo.

3.1.1.5 Existing Solid Waste Management and Related Land Management Scheme of the Host LGUs

223. The solid waste management systems and other related land management schemes/programs of the host LGUs are discussed below. The existing programs of local governments which do not conform to RA 9003, the national legislation on ecological solid waste management, such as improper waste disposal, improper siting of disposal sites etc. will present problems on land management schemes. Improper management of disposal sites (such as the presence of open and uncontrolled burning) will create not only pollution potential but also affect aesthetic visuals.

<u>Malolos</u>

224. Based on the CLUP (1996-2000) of Malolos, the waste materials within the barangays of Malolos especially in the commercial area are being collected by a garbage truck owned by the LGU. A sanitary landfill is used as a dumping site by the city. Households in other barangays burn their waste in their backyards or thrown them down to a ready-made dugout.

<u>Calumpit</u>

225. Based on the CLUP (2007-2020) of Calumpit, the closure of the Sapang Bayan dumpsite was imminent due to the implementation of RA 9003 or the Ecological Solid Waste Management Act. Moreover, the establishment of a solid waste facility, with its own Materials Recovery

Facility (MRF), as final disposal site for residual and/or wastes that can no longer be processed in barangay was given a priority. The solid waste disposal facility will be strictly regulated and monitored to prevent scavenging and squatting in the disposal site. Installation of functional and operational MRFs in all of the 19 barangays were also considered to take care of the solid wastes problems of residents/households.

Apalit

226. Based on the CLUP (2016-2025) of Apalit, the municipality has a Municipal Solid Waste Management Board (MSWMB) headed by its Chairman, Mayor Pedro C. Nucom and its members through an Executive Order No. 07 Series of 2013, which strives for an ecologically-balanced and environmental friendly community. It encourages the participation of its citizens through Sustainable Ecological Solid Waste Management and effectively planning for the proper management of solid waste generated on urban and rural barangays, institutional and commercial establishments.

227. The “3Rs” - Reduce, Reuse, and Recycle are strategies for dealing with generated waste to reduce the volume. The biodegradable waste materials collected are processed into charcoal briquetting and composting as soil conditioner for crop-farming activities.

228. Seven (7) out of the twelve (12) barangays of Apalit have a Barangay MRF and one (1) MRF for segregation of solid wastes. Metro Clark Waste Management Corporation after segregation takes care of the collected garbage for disposal at the sanitary landfill at Sitio Kalangitan, Capas, and Tarlac. As of 2015, fourteen (14) units of dump trucks are being utilized for the collection of generated waste, two for the MRF and twelve (12) for the Barangay MRF. An acquisition of other equipment and tools is being plan for the improvement of the waste management system including additional personnel and staff.

Minalin

229. Two (2) out of the fifteen (15) barangays of Minalin have a barangay MRF for re-use, recyling and composting of wastes. The LGU’s final disposal of wastes is at Metro Clark Sanitary Landfill at CSEZ.

Sto. Tomas

230. Based on the CLUP (2016-2025) of Sto. Tomas, the municipality has two (2) dump trucks used for collecting segregated wastes among households and dumped in the controlled dumpsite located at Barangay San Matias. The same barangay has an MRF where wastes are segregated into biodegradable and non-biodegradable. Moreover, in order to facilitate and finance the crafting of its Solid Waste Management Plan (SWMP), the local leaders of Sto. Tomas initiated and availed of a loan through Landbank of the Philippines Apalit Branch. The said loan will be utilized to purchase a lot with an area of 5.6906 hectares located at Mesalipit Road, San Vicente wherein an MRF will be constructed. The MRF will service the municipality for sorting and segregation of biodegradable/compostable and non-biodegradable municipal waste. The LGU’s final disposal is at Metro Clark Sanitary Landfill at CSEZ.

231. In the conduct of formulating the SWMP, the municipal government is continuous in addressing the concerns on the increasing volume of solid waste. One of these actions is the Waste Analysis Characterization Study (WACS) conducted on October 2014. The main objective of the WACS is to determine the type and amount of materials discarded in the waste stream of Sto. Tomas. The study was useful in the formulation of strategies to address the irrational generation of wastes. This also serves as the baseline data in designing the MRF to determine the alternative methods for recycling and re-using of materials and in determining the quality of composting drums to be utilized by the biodegradables.

San Fernando

232. Based on the CLUP (2012-2021) of San Fernando, The City Solid Waste Management Board is currently updating the City's Ten-Year Solid Waste Management Plan for 2012-2022. The Barangay Solid Waste Management Committees are also in the process of re-organization. As of February 21, 2011, the City's controlled dumpsite has been closed. Presently, the City is operating the City Transfer Station, wherein only residual wastes are accepted for final sorting and transportation to Metro Clark Waste Management Corporation's Sanitary Landfill.

Angeles

233. Based on the CLUP (2012-2020) of Angeles, the City's daily production of waste is estimated to range from 100-150 metric tons that is equal to 33, 500-54, 750 MT per year. The city has already closed its open dump site facility several years back and it has since used the Metro Clark Sanitary Landfill.

234. The city may establish its own sanitary landfill within its territory due to the increase of tipping fee in Metro Clark Sanitary Landfill. It can also jointly develop a solid waste management facility with neighboring areas. It can also expand its existing material recovery facilities to reduce the volume of waste at the same time create livelihood. It can dump the remaining non-recoverable wastes in the Metro Clark Sanitary Landfill.

Mabalacat

235. Based on the CLUP of Mabalacat, the city has two (2) materials recovery facilities located at barangays Duquit and Sapang Balen. The Duquit MRF collects garbage from barangays Dau, Duquit and Lakandula while the central MRF in Sapang Balen collects wastes from all other barangays.

Bamban

236. Based on the Socio-Economic Profile (2016) of Bamban, the garbage generated by the municipality are collected and transported by the private and public Garbage Haulers to Metro Clark Sanitary Landfill at CSEZ for final disposal. Moreover, the municipality has a Garbage Truck Monitoring Station, a checkpoint established at the entrance of the Anupul–Pag-asa-Dapdap (Phase 1) Road wherein all garbage-loaded vehicles bound for Metro Clark Sanitary Landfill are inspected and issued bill ticket.

Capas

237. Based on the CLUP (2011-2020) of Capas, the waste materials within the barangays are being disposed in the Metro Clark Sanitary Landfill in Sitio Kalangitan, Barangay Cutcut II, which spans approximately 100 hectares.

3.1.1.6 Impact Identification, Prediction, Assessment and Mitigation

(1) Pre-Construction and Construction

1) Impact in terms of Compatibility with Existing Land Use

238. Along the PNR ROW from Malolos Station to Clark Station, the impact of the proposed MCRP on the land use is not significant during the pre-construction and construction phases. However, the MCRP alignment from Clark Station to NCC Station which will be located outside the existing PNR ROW to avoid the heavy built-up areas will have significant impact on the existing land use which is predominantly agricultural. The land use of about 18.2 km x 30 m (54.6 ha) private land in Bamban and existing arterial road of BCDA in Capas will be permanently changed for the ROW of MCRP thereby, resulting to a permanent loss of agricultural produce in these areas to give way for the MCRP. Similalry, the existing land use of the 40 ha depot in

Mabalacat and the area for the 30 m extension at seven (7) stations will be changed permanently from its existing land use for utilization by MCRP.

239. The direct impact on land use and development would be a function of the plans, zoning ordinances, and economic development programs of the affected LGUs and national government agencies with similar road and infrastructure projects in the vicinity of the alignment. Overall, the proposed MCRP is compatible with local government plans that support rail systems and transit-oriented development. Existing land use policies and zoning ordinances support the development of the proposed MCRP.

240. Information on the proposed MCRP will be shared with the affected LGUs from time to time. The affected municipalities/cities will have to adopt the proposed MCRP to their CLUPs to its implementation. The DOTr will communicate with said LGUs to ensure that the proposed MCRP is in accordance with the future land use plan. The DOTr will cooperate with local planners of LGUs in the identification of the best use of land in the surrounding areas and in the promotion of transit-oriented developments. The DOTr will also consider the recommendations of the LGUs relative to the location of the stations.

2) Impact on Compatibility with Classification as an ECA

241. Impacts on compatibility with ECA are expected to be less significant as DOTr will plan, design and construct the MCRP in consideration to the ECA such as areas of unique historic, archeological, or scientific interest and areas set aside as ECAs that may affect the project or may be affected by the project: 1) aesthetic potential tourist spots; 2) areas of unique historic, archaeological, geological of scientific interest; 3) areas frequently visited by and/or hard-hit by natural calamities (geologic hazards, floods and typhoons); and 4) areas classified as prime agricultural lands; 4) Areas which are traditionally occupied by cultural communities or tribes; and 5) areas declared by law as national parks, watershed reserves, wildlife reserves, sanctuaries.

242. As stated, DOTr will plan the site, construction yards, access roads, and construction activities and will design the foundation and structures in consideration of the ECA.

a. Areas of unique historic, archeological, geological or scientific interest

243. The MCRP is expected to enhance the existing ten (10) structures declared by the NHCP as historical and cultural heritage that are located close to the proposed MCRP. Most of these structures are located in San Fernando, Pampanga and one each is located in Calumpit, Apalit and Mabalacat. These sites of historical and cultural value which are proximate to the proposed MCRP have tourism potential. Other aesthetic or potential tourist spots close to the project are Gov. Macario Arnedo Park and Death March Marker in San Fernando, Pampanga and the Grotto of Our Lady of Lourdes in Bamban, Tarlac. With the proposed MCRP, the potential for tourism in the host LGUs will be enhanced.

244. Within the project area, old PNR structures of over 50 years of age were identified. The DOTr is in close coordination with the NHCP, NM, NCCA, PNR and LGUs in qualifying these structures as historical sites. The DOTr, together with the PNR, will prepare protection and conservation plans to maintain the structures within the project area and provide necessary protection measures during the phases of construction and operation.

b. Areas frequently visited by and/or hardhit by natural calamities

245. The impacts of natural and geologic hazards such as volcanic hazards (deposition of ash, sediment laden stream flow, lahar flow) landslides, flooding, and liquefaction to the MCRP will be addressed by the following: a) Typhoon impacts may be mitigated through regular coordination with PAGASA and adjustment of construction schedules in relation to bulletins issued by the said weather agency; b) Drainage systems will be constructed in accordance with the results of

comprehensive hydrological studies to address flooding. The project will be designed in compliance with the National Building and Structural Codes of the Philippines, and internationally accepted guideline; and c) Emergency Response Plan for construction phase will be prepared and implemented.

c. Areas classified as prime agricultural lands

246. The impact of the MCRP to the loss of agricultural land in Bamban, Capas and Mabalacat is considered significant. This pertains to areas outside the PNR ROW and Depot Site in Mabalacat. The DOTr has been coordinating with the BCDA, LGUs, lot owners and other concerned stakeholders for its intent of just compensation in acquiring the affected land and/or securing the ROW.

d. Areas which are traditionally occupied by cultural communities or tribes

247. The proposed MCRP alignment will not impact the Ancestral Domain areas for according to the letter from NCIP-Tarlac Provincial Office dated April 24, 2018, the MCRP alignment is outside the Ancestral Domain areas. However, futher investigation will be needed on the location of the proposed Mabalacat Depot due to its close proximity to CADT 025-A. DOTr is currently coordinating with the NCIP for the conduct of FBI to determine whether or not the location of the proposed Mabalacat Depot overlaps with, or affects an Ancestral Domain area. If indigenous community related issues will be raised during construction, NCIP will be consulted.

e. Areas declared by law as national parks, watershed reserves, wildlife reserves, sanctuaries

248. Although the MCRP will utilize the existing PNR ROW in Malolos, Minalin and Sto. Tomas which traverses the Manila Bay Wet Lands for IBA and KBA, internationally recognized by the BirdLife and IUCN the DOTr will implement measures so as not to further encroach the natural habitats in these areas. The area is significant for the conservation of flora and fauna as they are characterized by fishponds, marshes, rivers and swamps near human habitation. After consulting with the Biodiversity Management Bureau (BMB) that the area the alignment traverses was man-made fishponds, BMB confirmed that the significance to the ecology is low.

3) Impact in the Existing Land Tenure Issue/s

249. The impact of the proposed MCRP to the existing land tenure is significant in areas outside the PNR ROW from Malolos to Clark and at the Depot Site. However, the DOTr as previously mentioned, has been coordinating with the NCIP, BCDA, LGUs, lot owners, indigenous community, and other concerned stakeholders on its intent for a just compensation in acquiring the land and/or securing ROW.

250. The utilization of the proposed 40ha Depot Site at Mabalacat which is currently within the bank protection wall will need coordination with DPWH for the use of a portion of the BCDA for the alignment and depot. There are portions that still have encroachments by informal settlement, and these will be addressed in the Resettlement Action Plan for land acquisition and relocation of informal settlers.

4) Impairment of Visual Aesthetics

251. The impact of the MCRP construction to the existing surrounding visual landscape will be significant in wetlands in Pampanga and in at Tarlac area where the proposed vertical structures are located. These, however, will be temporary and structures will be designed in consideration of size, shape and color to mitigate the visual impact from local community and viewpoints. In addition, tree planting along the alignment will mitigate the visual impact of the hard structure in the natural setting in area such as Minalin and Sto. Tomas.

252. During construction, improper handling and disposal of construction and domestic wastes may result in visual pollution and will have an aesthetic impact on the landscape. In order to reduce and eliminate the environmental impacts of the solid wastes, the construction plans, operating instructions and solid waste management plan will be strictly implemented during construction. DOTr will ensure that the contractor will maintain cleanliness in the construction site and temporary screen/walls are provided to minimize visual clatter. During the demobilization of construction activities, construction yard will be rehabilitated to its previous condition.

5) Devaluation of Land Value as a Result of Improper Solid Waste Management and Other Related Impacts

253. Generation of waste and improper waste disposal during pre-construction and construction phases may affect the soil quality, which will result to the devaluation of land value. The proposed MCRP will generate domestic wastes such as papers, cartons, plastics, bottles, food leftovers, etc. Some hazardous solid wastes that will be generated include busted fluorescent lamps and spent batteries. Assuming a per capita waste generation of 0.6kg/day, the proposed MCRP will generate an estimated of 7.2 tons of waste per day during construction for a total of 12,000 workers. Residual construction materials such as aggregates, sand, cement, steel materials, timber, precast components, among others will be procured according to the schedule of the construction progress. Since the proposed MCRP requires huge quantity of materials, therefore, it is expected that residual construction materials may inevitably be left over. Permeation of lime or cement into the ground with water will result in soil hardening, higher pH value and groundwater pollution and in the end the polluted land will lose productivity and the valuable land resources will be wasted.

254. The DOTr will formulate and implement a Solid and Hazardous Wastes Management Plan which include the following: (1) Acquisition of adequate quantities of construction materials to avoid wastage; (2) Reuse of excess consrruction materials for road and other infrastructure projects of the host LGUs; (3) provision of adequately sized waste bins for recyclables, biodegradable and hazardous waste; (4) strict implementation of waste segregation by the construction personnel; (5) coordination with the LGUs for the regular monitoring of project generated waste for eventual disposal to the LGU designated disposal facility. Hazardous wastes will be stored properly and will be treated and disposed of by the DENR Accredited Transporter and Treater in accordance with RA 6969. Regular soil monitoring will also be conducted at the established sampling stations to maintain the current soil quality throughout the construction phase.

255. Emergency Preparedness and Response Plan and a Health and Safety Management Plan will be implemented in case of accidental spills. Also, regular training of workers on environment management and management of working environment will be provided.

(2) Operation

1) Impact in Terms of Compatibility with Existing Land Use

256. The proposed MCRP will have no impact on the compatibility with the land use during the operation phase. Affected LGUs will adopt the proposed MCRP in their CLUPs. Moreover, the proposed MCRP is anticipated to provide a more efficient and safer transportation facility due to reduced travel time, reduced traffic congestion, improved traveler safety, and reduced energy consumption. As a result of this improvement, land development is expected to increase along or near the corridor through conversion of low density residential areas to higher density residential and commercial uses.

2) Impact in Terms of Compatibility with Classification as an Environmental Critical Area

257. During operation phase, typhoon impacts may be mitigated through regular coordination with PAGASA and adjustment of train schedules in relation to bulletins issued by the said weather

agency. Drainage systems will be properly inspected and maintained to address flooding. An Emergency Preparedness and Response Plan for the operation phase will be prepared and implemented.

258. Although only low ground shaking impact is expected of the project, maintaining close coordination with the Philippine Institute of Volcanology and Seismology (PHIVOLCS) during earthquake events to make necessary adjustments on its operation will be required, as the project will be connected to a network of transit developments. DOTr will also coordinate with NHCP, PNR, LGU and relevant authorities for the continuous conservation of identified old PNR structures.

3) Impact in the Existing Land Tenure Issue

259. The proposed MCRP will have no impact on the existing land tenure issue during operation phase.

4) Impairment of Visual Aesthetics

260. The proposed MCRP will have no impact on the visual aesthetic, yet it will be different from the occurring landscape along the alignment. The structures (viaducts and stations) will be well designed (size, shape and colour). The architecture of the structures will be complimentary to the urban landscape and will not be unpleasing to the visual aesthetics of the natural rural landscape.

261. Continuous tree planting activities and maintenance within the ROW, depot and around the stations will minimize the visual impact by the project and harmonize with the surrounding environments to create green corridors. This will be also beneficial to the local community and will contribute to the reduction of GHG emissions.

5) Devaluation of Land Value as a Result of Improper Solid Waste Management and Other Related Impacts

262. The proposed MCRP will generate domestic wastes such as papers, cartons, plastics, bottles, food leftovers, etc. Assuming a per capita waste generation of 0.6 kg per day, the proposed project will generate an estimated of 0.84 ton of solid waste per day during operation for a total workfore of 1,400. Some hazardous wastes that will also be generated include busted fluorescent lamps, spent batteries, used oils, etc. Improper disposal of generated solid and hazardous wastes particularly at the stations and depot could pose health and sanitation hazards to the operations personnel and railway passengers and may affect the soil quality at the area which will result to the devaluation of land value.

263. A Solid Waste Management Plan will be implemented in accordance with RA 9003 at the stations and depot of the proposed MCRP. This includes waste minimization, segregation, and proper disposal. Properly sized bins will be provided for recyclable, biodegradable and hazardous wastes. The MCRP Management will coordinate with the host LGUs for the regular collection of the wastes and their disposal to the DENR designated site. Bulk hazardous wastes will be stored in impermeable area and with appropriate secondary containment. Hazardous wastes will be stored properly and will be transported, treated and disposed of by a DENR Accredited Transporter and Treater in accordance with RA 6969. Regular soil monitoring will also be conducted at the established sampling stations when necessary.

264. An Emergency Preparedness and Response Plan and a Health and Safety Management Plan will be implemented in case of accidental spills. Regular training to employee will also be provided to keep workplace and surrounding environment in good condition.

3.1.2 Geology/Geomorphology

265. Primary geologic data were gathered and analyzed through inspection of the stations and key segments of the MCRP route. The field surveys and analysis were guided through the use of Google images, topographic maps and Shuttle Radar Topography Mission (SRTM) digital elevation data of the Central Luzon.

266. Topographic, geologic and seismologic data were accessed from the National Mapping and Resource Information Authority (NAMRIA), Mines and Geosciences Bureau (MGB) and Philippine Institute of Volcanology and Seismology (PHIVOLCS). **Table 3.1.7** presents the data accessed and gathered from these agencies.

Table 3.1.7 Secondary Data Gathered from NAMRIA, MGB and PHIVOLCS

Data Source	Nature of Data
National Mapping and Resource Information Authority	1:50,000 scale topographic maps
Mines and Geosciences Bureau	2010 edition of the Geologic and Tectonic Map of the Philippines
	1980 and 2010 editions of the Geology and Mineral Resources of the Philippines
	Landslide and Flood Susceptibility Map of Parts of Region 3
Philippine Institute of Volcanology and Seismology	Earthquake Data
	Map of Major Earthquake Generators
	Liquefaction Potential Map
	Map of Active and Potentially Active Volcanoes
	Ground Rupture Hazard Map
Philippine Institute of Volcanology and Seismology and US Geological Survey	Peak Ground Acceleration Maps

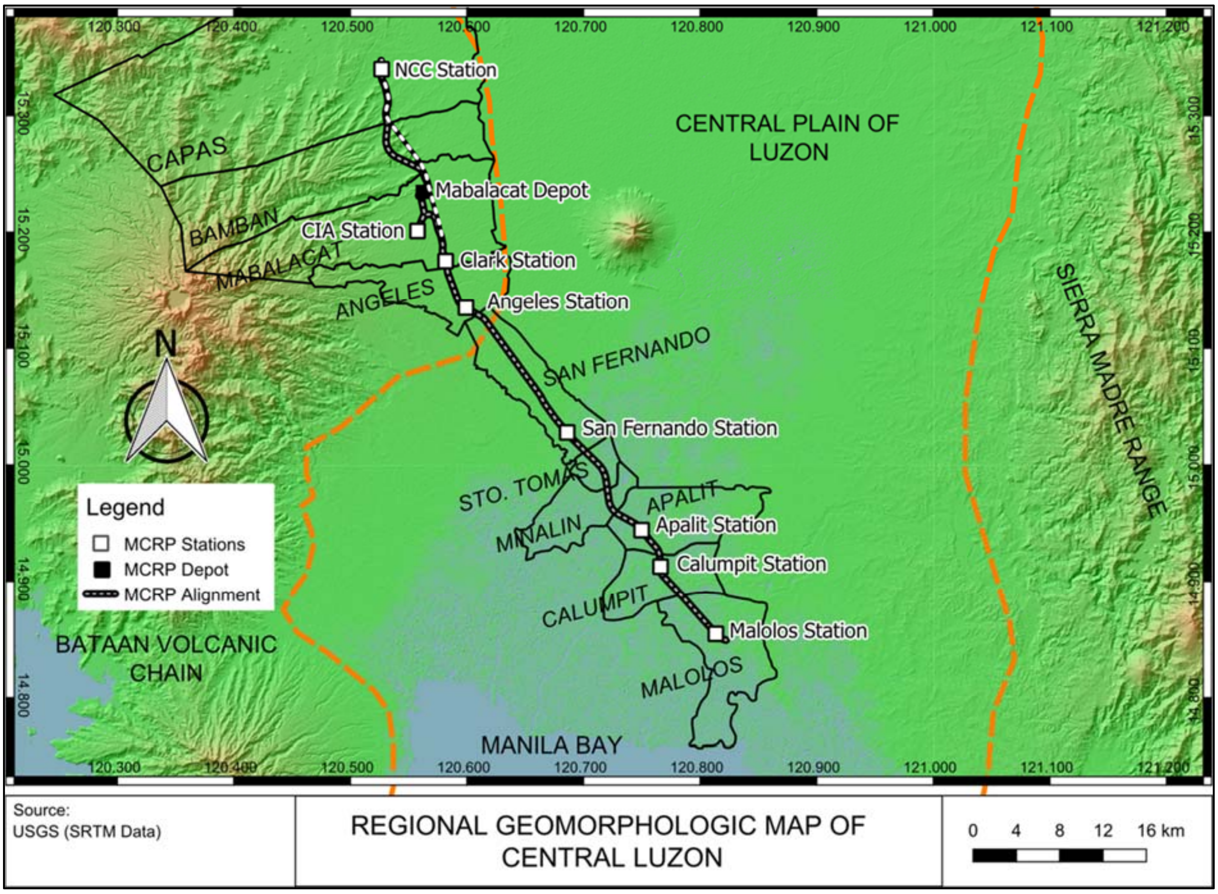
Source: GEOSPHERE, 2018

3.1.2.1 Surface Landform/Geomorphology/Topography/Terrain/Slope

267. The proposed MCRP traverses the foot slopes of the Bataan Volcanic Chain and the Central Plain of Luzon (CPL). The Sierra Madre Range corresponds to a long mountain chain, which extends from Cagayan in the north to the Bicol in south. It is characterized by steep and dissected slopes with foothills on the west, which abuts against the CPL. The steep slopes favor erosion and dissection by west flowing rivers and streams which flow towards CPL. The eroded sediments are subsequently deposited into the adjacent plain.

268. The Bataan Volcanic Chain corresponds to a line of volcanoes, which include Mt. Mariveles, Mt. Natib and the active Mt. Pinatubo. It serves as the western boundary of the CPL. The terrain is characterized radial drainage system, which discharges to CPL.

269. The CPL corresponds to a long natural depression, which extends from Lingayen in the north to Manila Bay in the south. It is bounded on the west and east by the Bataan Volcanic Chain and Sierra Madre Range, respectively. It received eroded sediments from the Bataan Volcanic Chain and Sierra Madre Range. **Figure 3.1.15** shows the regional geomorphologic map of Central Luzon and the location of the proposed MCRP with respect to the mapped terrain units. **Figure 3.1.15** also enumerates the features of the intersected terrain units and links the geology, hydrology, and hazards prevailing within the individual or combination of the route segments.



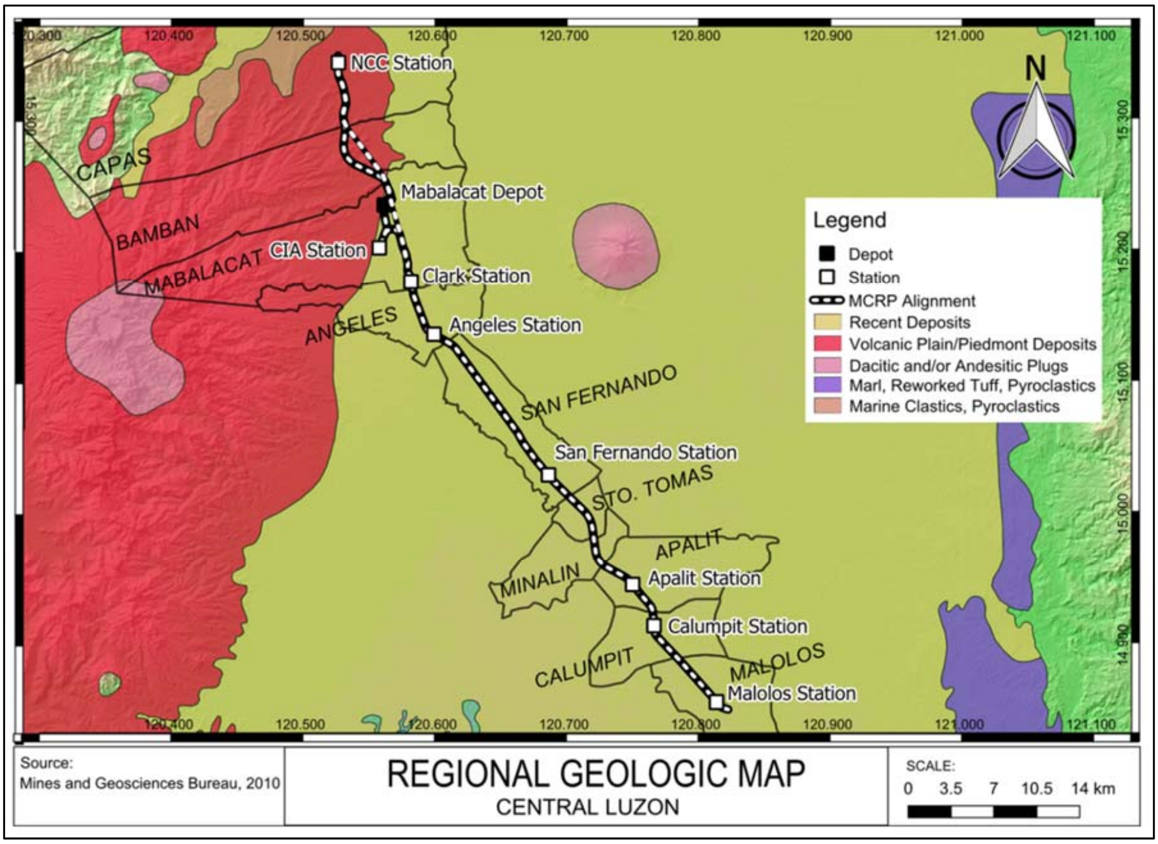
Source: USGS (SRTM Data)

Figure 3.1.15 Regional Geomorphologic Map of Central Luzon

3.1.2.2 Subsurface Geology/Underground Condition

(1) Lithology and Stratigraphy

270. The geologic formations within a 10 km corridor which could potentially affect the proposed MCRP were identified and delineated using available geologic and topographic maps (**Figure 3.1.16**). Within this corridor, two (2) geologic formations were identified namely the Recent Deposits (Qh) and the Quaternary Volcanic Pyroclastics (QVP). Qh is also referred to as Quarternary Alluvium while the QVP traversed by the MCRP route is referred to as Bamban Formation.



Source: Mines and Geosciences Bureau, 2010

Figure 3.1.16 Regional Geologic Map of Central Luzon showing the Proposed MCRP Alignment

271. Qh refers to the heterogeneous mixture of sands, clays, silts and gravels of varying degrees of consolidation. The composition of this sediment varies in proportion to proximity to their sources. The segments from Angeles Station to Mabalacat Depot are dominated by lahar components. Farther south and east towards the Malolos Station, Qh is predominantly of alluvial origin. This represents deposits of San Fernando River, Pampanga River and Angat River and their tributaries. The segment from San Fernando to Apalit is dominated by the clayey fraction of the Qh as indicated by the swampy condition of this area. Where the proposed MCRP alignment passes through built up areas, the Qh is locally covered by pavements, embankments or partially consolidated fill.

272. QVP includes pyroclastics and tuffaceuous sedimentary rocks. This material and its weathered derivatives underlie the segment after the Mabalacat River crossing up to the NCC Station. **Table 3.1.8** shows the stratigraphic succession along the route traversed by the proposed MCRP including the general lithologic descriptions and their distribution within the route traversed by the proposed MCRP.

Table 3.1.8 Stratigraphy of the Proposed MCRP

Epoch	Geologic Formation	Formation Name	General Lithology	Distribution
Holocene	Recent Deposits (Qh)	Quarternary Alluvium	Unconsolidated, heterogeneous aggregate of gravels, boulders, sands, silts and clays with lahars at the lower slopes of Mt. Pinatubo	Mabalacat Depot to Malolos Station
Pliocene - Holocene	Quaternary Volcanic Pyroclastics (QVP)	Bamban Formation	Gently dipping layers of tuff, agglomerate, pyroclastic flows and tuffaceuous sedimentary rocks	Immediate north of Mabalacat to NCC Station

(2) Regional Tectonic Setting

273. The Philippines is located in a tectonically active region near the boundary between the Philippine Sea Plate and the southeastern edge of the Eurasian Plate. The active zone of deformation between these two (2) plates is referred to as the Philippine Mobile Belt (Gervasio, 1966) and is characterized by a complex system of subduction zones, collision zones and marginal sea basin openings (Geology of the Philippines, 2002). The island of Luzon where the proposed MCRP is to be located occupies the northern section of the Philippine Mobile Belt.

274. The major earthquake generators relevant to the proposed MCRP include the Philippine Trench, the Philippine Fault, West Marikina Valley Fault, and the Manila Trench (**Figure 3.1.17**).

Philippine Trench

275. The Philippine Trench corresponds to the morphological expression of the subduction of the Philippine Sea Plate beneath the eastern Philippine Arc (Geology of the Philippines, 2002; Cardwell and others, 1980; Fitch, 1970; Hamburger and others, 1983). The trace of the trench is about 412 km east of the Malolos Station.

Manila Trench

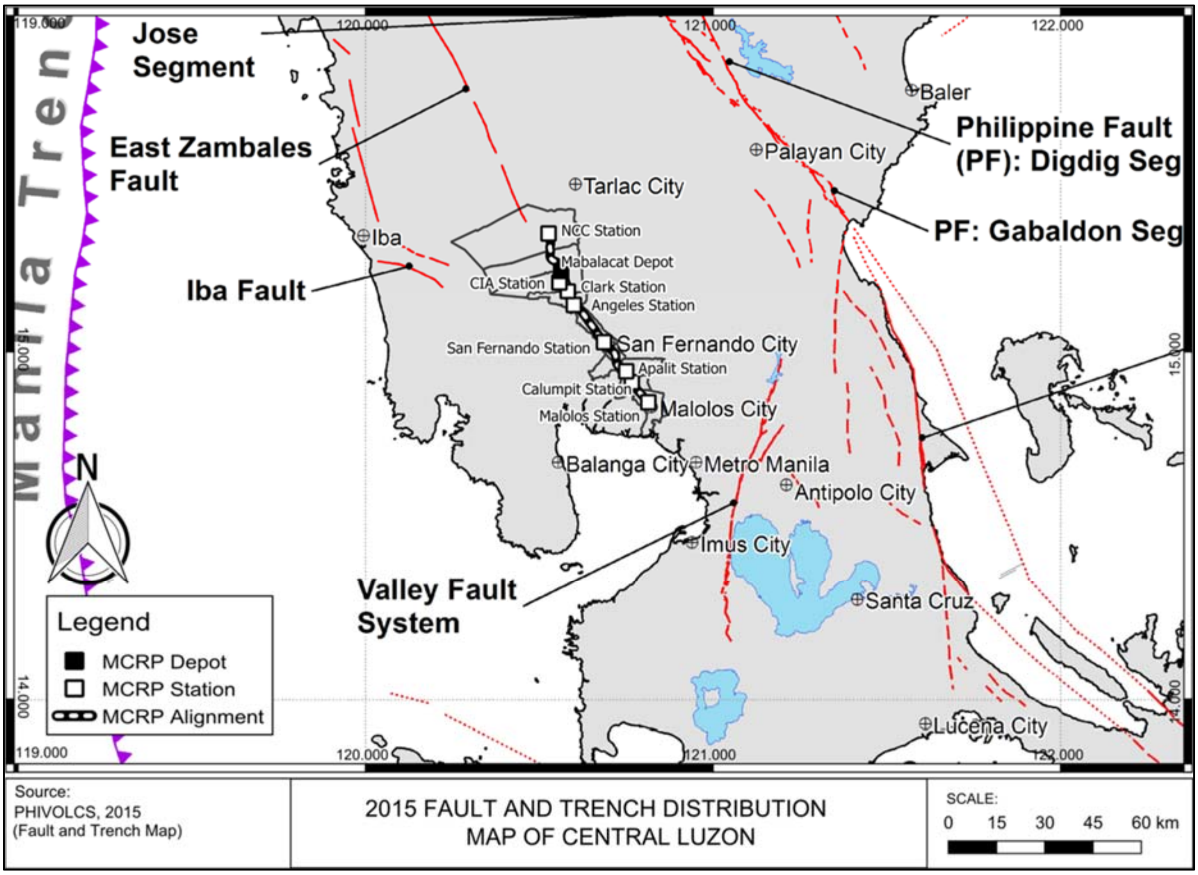
276. The Manila Trench is a broadly arcuate geological structure located west of the island of Luzon and spans the length from 13^o north to 22^o north latitude. This earthquake generator is located approximately 160 km west of the NCC Station.

Philippine Fault

277. The Philippine Fault is a left lateral fault, which transects the Philippine Mobile Belt from Luzon though the Visayas to Mindanao over a length of more than 1,200 kilometers. PHIVOLCS attributed the occurrence of earthquakes in Ragay (1973, M 7.0), Northern Luzon (1990, M 7.7) and Masbate (2003, M6.2) to movement along segments of the Philippine Fault. The projected trace of the fault in Luzon in Dingalan, Quezon is approximately 85 km northeast of the Angeles Station.

West Marikina Valley Fault

278. The West Marikina Valley Fault is a right lateral geological structure which traverses a distance of about 135 km from Bulacan in the north to as far south as Tagaytay area. Its trace is located 34 km southeast of the Malolos Station of the MCRP.



Source: Philippine Institute of Volcanology and Seismology, 2015

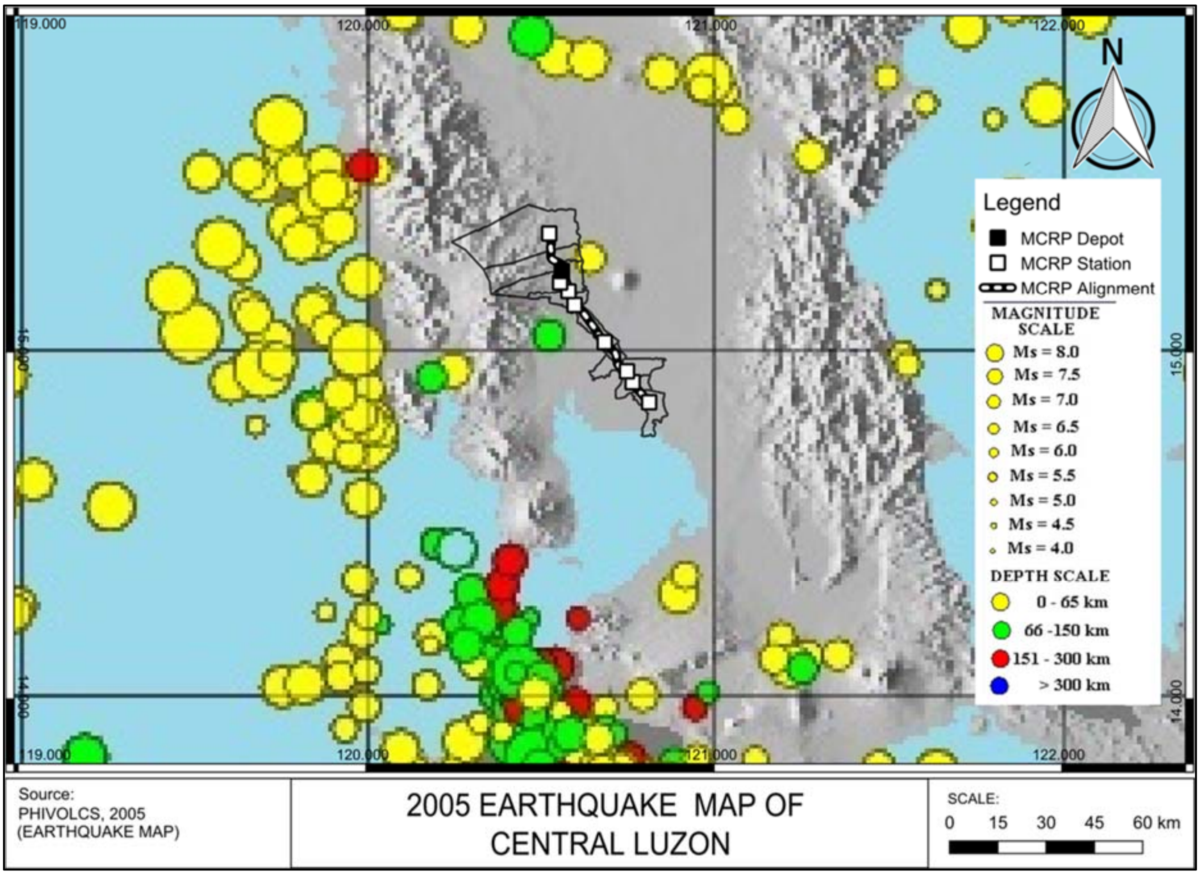
Figure 3.1.17 The Proposed MCRP Alignment as Plotted on the Map of Major Earthquake Generators

3.1.2.3 Geologic and other Natural Hazard

279. The hazards which can potentially affect the MCRP include flooding, landslides and earthquake related hazards. The seismic related hazards include ground rupture, ground shaking, and liquefaction. The proposed MCRP route has been assessed by PHILVOLCS Earthquake and Volcanic Hazard Assessment for Ground Rupture, Liquefaction, Landslide, Tsunami, nearest volcano, and pyroclastic flow/ base surge.

(1) Seismicity

280. **Figure 3.1.18** shows the plot of earthquakes with magnitude's greater than five (5) within a 300-kilometer radius from the center of the proposed MCRP in Angeles Station. The clusters of earthquakes are found at the northeast offshore of Baler, Quezon and southwest offshore between Mindoro and Batangas. **Table 3.1.9** lists the major seismic events (M ≥ 6.5) within 100 kilometers from the center of the proposed MCRP from 1907 to 2013. The strongest recorded quake corresponds to a Magnitude 7.8 event, which was recorded on July 16, 1990, north east of the alignment. Any strong seismic events within the area of the Clark station to the CIA station will create an impact to the underground structures and railway operations of this segment of the alignment. Duration of strong-motion shaking during earthquakes may cause fatigue failure and, therefore, large deformations in underground structures. Damage at these underground structures may be significant due to slope instability. Generally, seismic events will cause abrupt changes in structural integrity/stability and ground conditions.



Source: Philippine Institute of Volcanology and Seismology, 2005

Figure 3.1.18 Plot of Earthquakes within 100 km from the Proposed MCRP

Table 3.1.9. Major Seismic Events within 100 km from MRCP Line

Year	Month	Day	Hour	Min	Sec	North	East	Depth	Ml	Mb	Ms	Distance from the Nearest Alignment (km)	Direction from MCRP
1990	7	16	7	26	34.6	15.68	121.17	25		6.5	7.8	79	NE
1959	7	18	19	54	57.0	15.50	120.50	150			6.6	29	NW
1940	3	28	15	48	50.0	14.20	120.60	160			6.8	75	SW
1933	3	3	2	19	38.0	15.50	120.10	120			6.5	58	NW

Source: Philippine Institute of Volcanology and Seismology

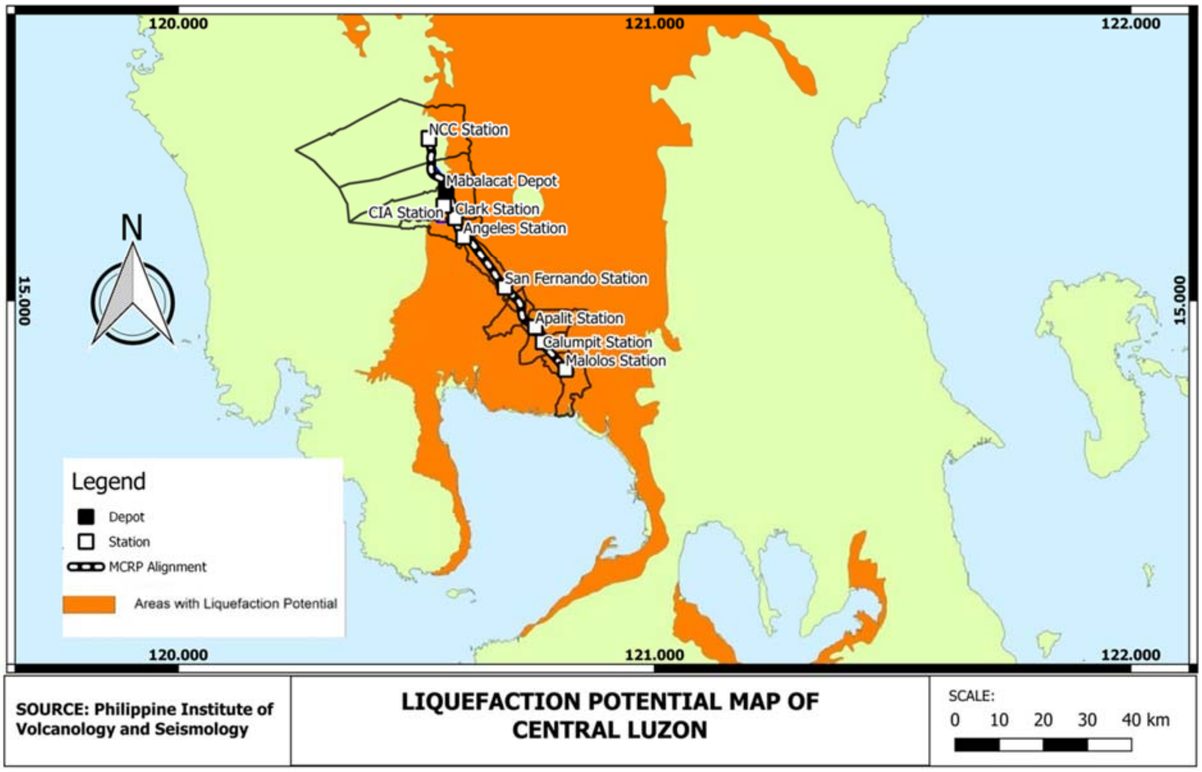
(2) Ground Subsidence and Settlement

281. Settlement due to loading of the proposed engineering structures such as stations and equipment depot can potentially take place on sections of the proposed MCRP which will traverse the area underlain by Qh. This assessment will depend on the design load at the structure sites and the geotechnical properties of the foundation materials. Such properties can only be determined during the design stage when drilling, in-situ tests and laboratory tests will be conducted.

282. Subsidence usually takes place in areas underlain by limestone and compressible materials like peat or clays. It can also take place when groundwater is excessively extracted from an area. In the case of the proposed MCRP, there are no limestone formations beneath the alignment. The presence of significant deposits of clay notably at the location of stations in the areas underlain by Qh will be confirmed during the design of the foundation for these structures. Accordingly, the assessment for subsidence cannot be made at this stage of the project. Reports of subsidence due to excessive groundwater extraction are currently not available.

(3) Liquefaction

283. The areas underlain by the Qh where groundwater is deemed shallow are potentially vulnerable to liquefaction in the event of a major earthquake occurrence. The segments from Mabalacat to Malolos fall under such classification (**Figure 3.1.19**). A geotechnical investigation is currently being conducted to further assess the properties of soil and rocks at the project area, particularly at the locations of the train stations and depot. The investigation includes drilling with Standard Penetration Tests (SPT), water level measurements, grain size analysis of recovered soil samples and calculation of liquefaction potential.

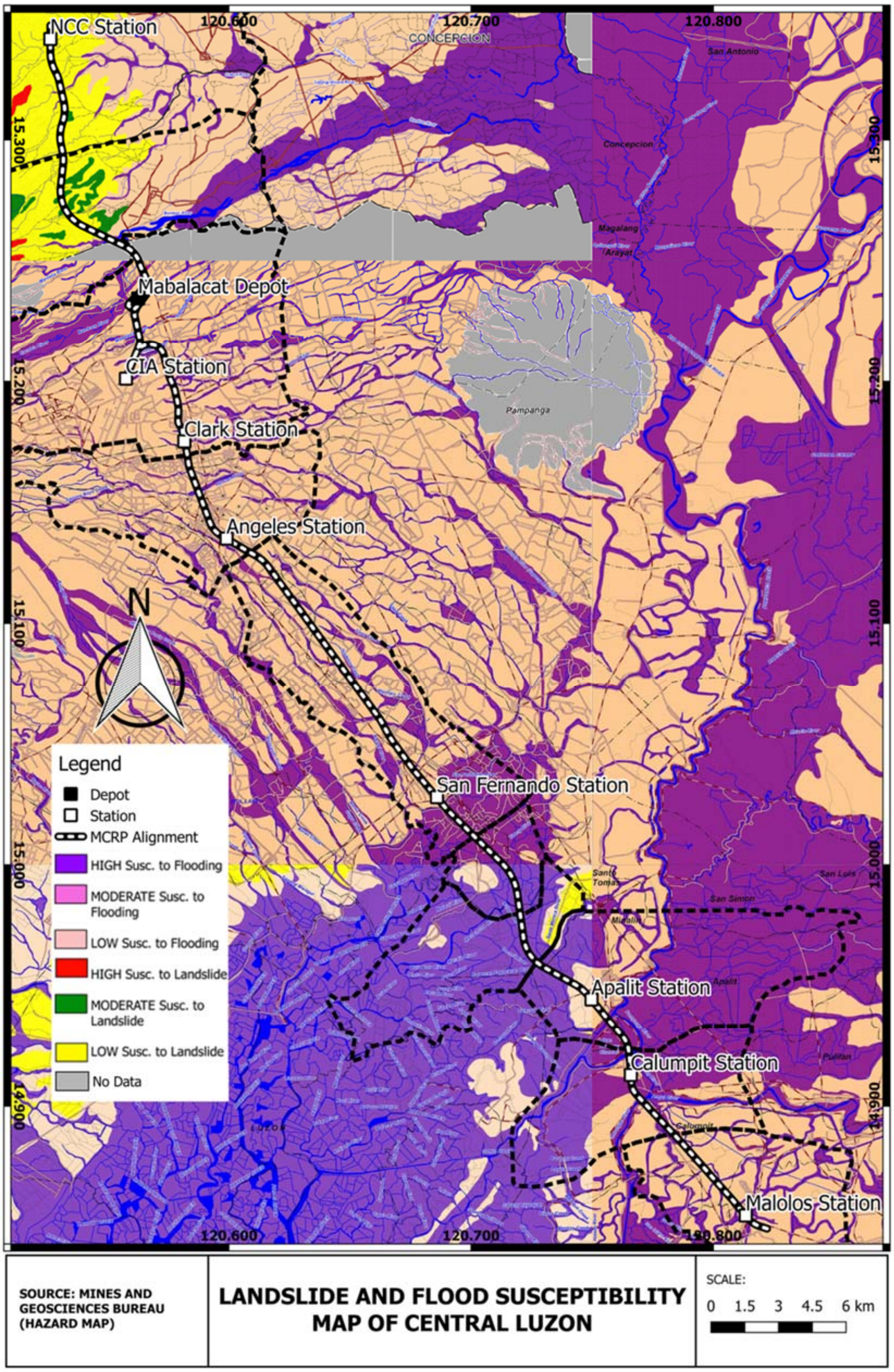


Source: Philippine Institute of Volcanology and Seismology

Figure 3.1.19 The MCRP Alignment Plotted on the Liquefaction Potential Map

(4) Landslides

284. The gently sloping to hilly sections of the segment from Mabalacat Depot to NCC Station has low to moderate susceptibility to landslides based on the 1:50,000 scale map prepared by the MGB (**Figure 3.1.20**). Depending on the proposed development, this segment will be subjected to semi-detailed engineering geologic mapping to determine the likely behavior of the cut slopes vis-à-vis the route of the railway or tunnel. The portals of the tunnel if applicable need to be subjected to geotechnical investigation and stability analysis.



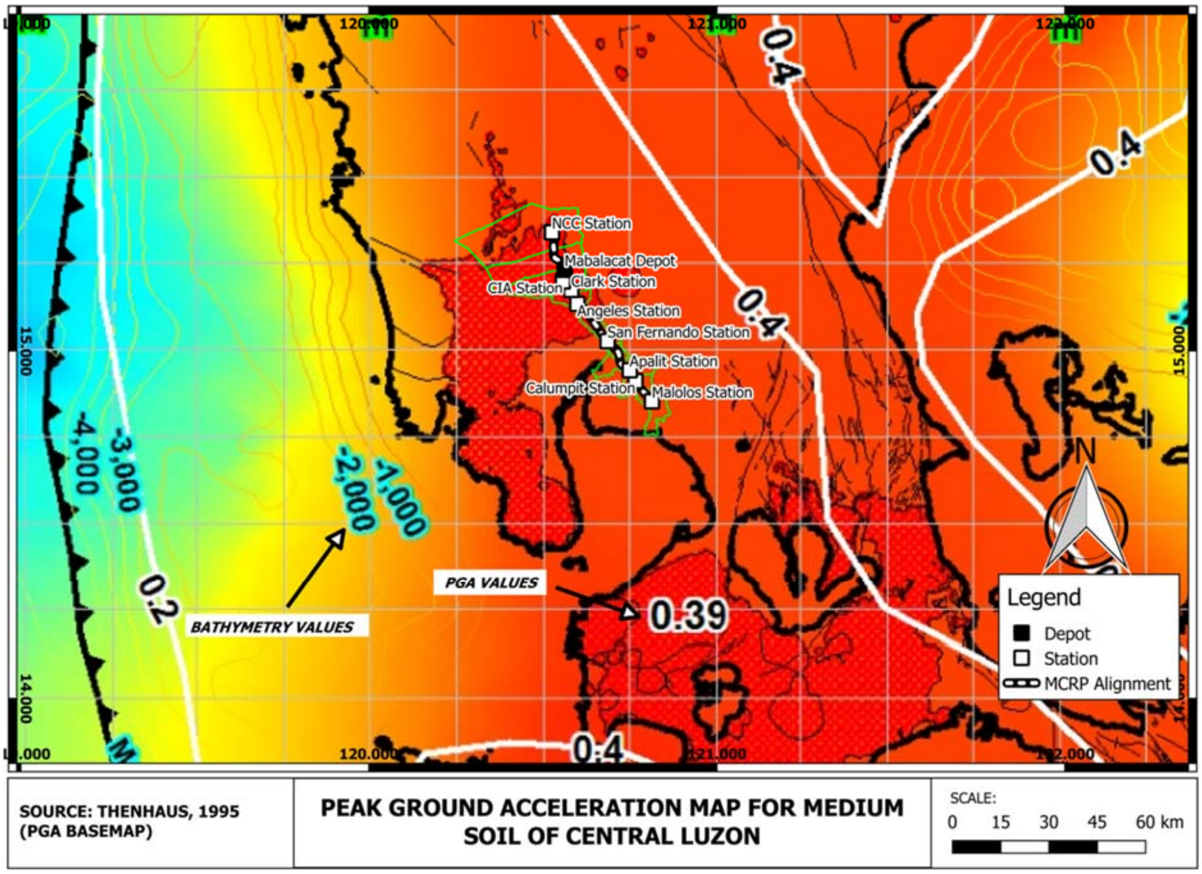
Source: Landslide and Flood Susceptibility Map of Parts of Region 3, Mines and Geosciences Bureau

Figure 3.1.20 Landslide Susceptibility Map

(5) Ground Shaking

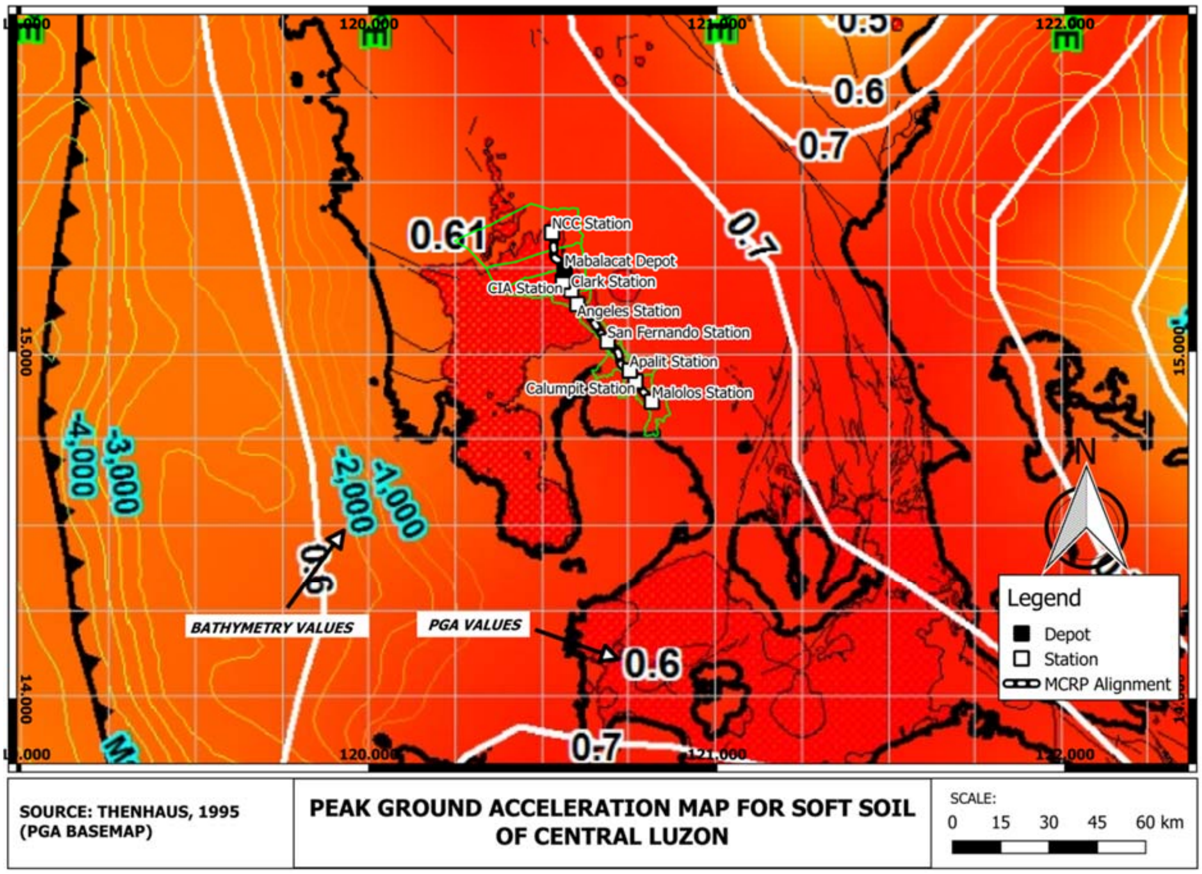
285. Earthquakes that can be generated by the major geological and tectonic structures in the region could bring about ground shaking which could affect the stability of railway line and its

stations. A study conducted by Thenhaus, Hanson and Algermissen of the United States Geological Survey and the Philippine Institute of Volcanology and Seismology (1995) estimated peak ground horizontal accelerations that have a 10% probability of being exceeded in 50 years for rock conditions, medium soil and soft soil conditions in the Philippines. In the case of the MCRP Line, the rocks underlying the segments from Mabalacat to Capas are underlain by consolidated volcanic deposits deemed to fall under medium soil category (**Figure 3.1.21**). The segments from Mabalacat Depot to the Malolos Station are underlain by unconsolidated sediments which are deemed to fall under the soft soil category (**Figure 3.1.22**). Accordingly, the peak ground accelerations correspond to 0.4 ***g*** and 0.7 ***g***, respectively. These regional values though need to be validated through more detailed seismological studies at the railway stations and depot.



Source: Thenhaus, 1995

Figure 3.1.21 PGA Map for Medium Soils of MCRP Line



Source: Thenhaus, 1995

Figure 3.1.22 PGA Map for Soft Soils of MCRP Line

(6) Ground Rupture

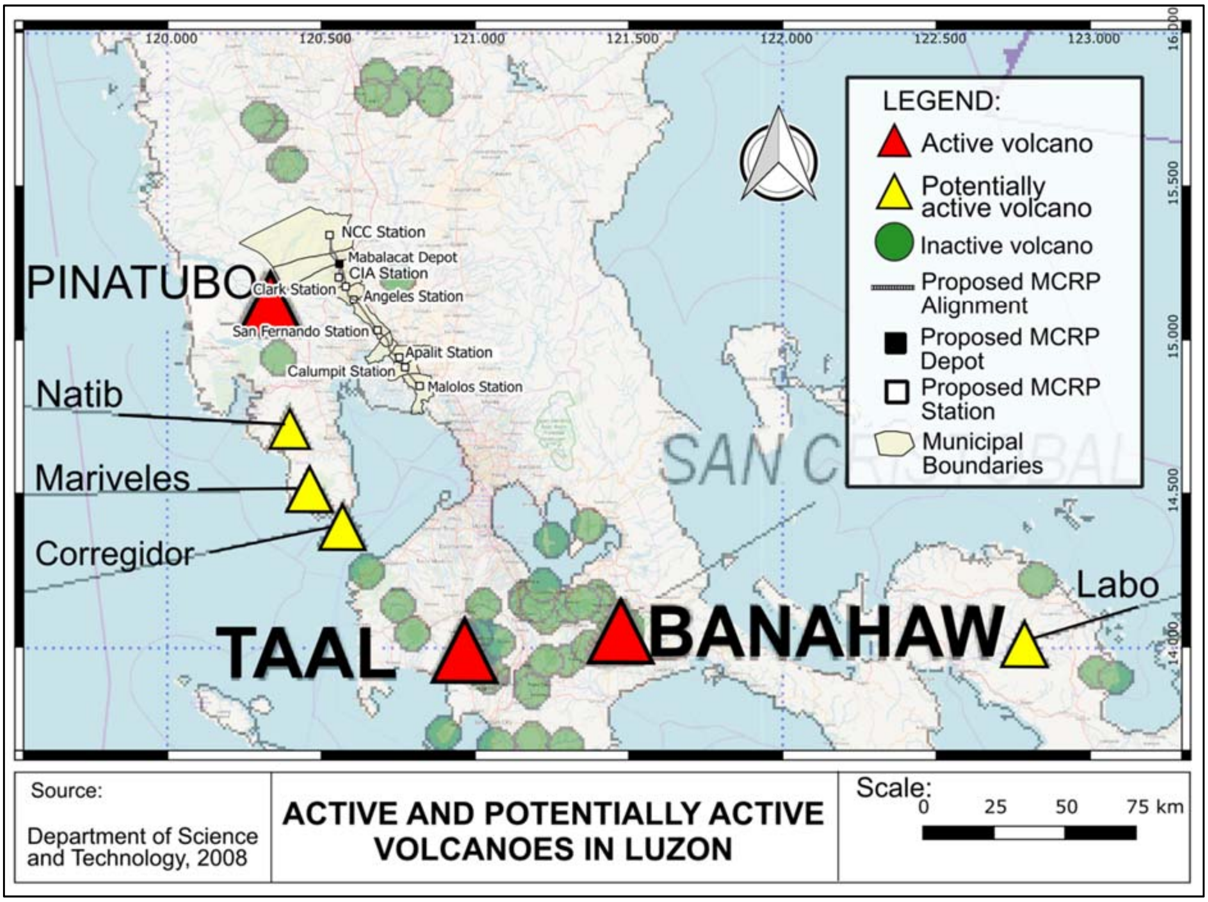
286. Ground rupture occurs when a new rupture is created or when renewed movement of old fractures takes place (Punongbayan, 1994). PHIVOLCS is recommending a buffer zone at least 5m on both sides of a fault trace or from the edge of deformation zone. The nearest active fault to the proposed MCPR route is the West Valley Fault, which is about 34 km southeast of the Malolos Station (**Figure 3.1.17**). Based on the earthquake hazard assessment conducted by PHIVOLCS, the proposed MCRP route is safe in terms of ground rupture hazard.

(7) Volcanic Hazards

287. Volcanic hazards will include pyroclastic flows, ash fall and lahar flow. As shown in **Figure 3.1.23**, the nearest active volcano from the proposed MCRP is Mt. Pinatubo. The crater of this volcano is approximately 25 km west of the proposed MCRP. During the 1991 eruption of Mt. Pinatubo, the pyroclastic flows extended down to the upstream sections of Sacobia and Abacan Rivers but did not affect the area to be traversed by the proposed MCRP. However, the ash generated by Mt. Pinatubo covered the entire MCRP route.

288. The sections of the proposed MCRP, which traverse the lower slopes of Mt. Pinatubo are underlain by lahar which represents remobilized volcanic deposits from the 1991 eruption. Based on the volcanic hazard assessment issued by PHIVOLCS (**Annex 3-1**), the proposed MCRP falls under Zone 4 which has been considered safe from lahars. The route may be affected by sediment laden stream flows during heavy rains and can potentially affect the Mabalacat Depot area and the major railway crossings at Mabalacat River and Abacan River.

289. In the event of another major eruption, lahar could again be formed and affect the segments of MCRP which cross major rivers and streams. Moreover, the proposed MCRP will be susceptible to the deposition of ash.



Source: Philippine Institute of Volcanology and Seismology

Figure 3.1.23 Distribution of Volcanoes in the Philippines

3.1.2.4 Impact Identification, Prediction, Assessment and Mitigation

(1) Pre-construction and Construction Phase

1) Change in Surface Landform/Geomorphology/Topography/Terrain/Slope

290. Pre-construction activities for the proposed MCRP would not entail significant terrain alteration. These will only involve surveys, foundation/geotechnical exploration and detailed engineering design, most of which will involve minimal land alternation, clearing and removal of vegetation cover at the selected sections of the railway route.

291. Permanent and major modification of the terrain will take place at the segments through Clark to CIA and the hilly areas from Mabalacat Depot to the NCC Station. These activities can potentially destabilize the slopes in these segments.

292. Construction of the elevated section will change the present topographic condition, but it will be negligible as the total length of elevated section is only 54.7 km. The underground/Tunnel construction of proposed 4.1 km may lead to the land subsidence as well as building collapse.

293. The anticipated destabilization of the slopes in Clark to CIA and Mabalacat to Capas segments is deemed as short-term and the magnitude will depend on the final layout and design, which will be quantified through the conduct of geotechnical investigations.

294. The hilly portion of the alignment will be subjected to geological and geotechnical investigations during the DED stage to identify and evaluate the potentially unstable slopes for the formulation of appropriate engineering measures for the protection of slopes and banks, and soil improvements to prevent or minimize slope failure during construction. An experienced team composed of an engineering geologist and geotechnical engineer will monitor all earthmoving activities at these structure sites.

295. The terrain of the alignment in the Bamban-Capas area is drained by rivers emanating from the slopes of Mt. Pinatubo, whose lower slopes are mantled by lahar deposits, unconsolidated and deemed permeable. The immediate banks of the main rivers (Sacobia and Bamban) are vulnerable to flooding and the lower to middle slopes traversed by the project vary from gently sloping to steep with low to moderate susceptibility to landslides. The upper slopes to the far west of the MCRP line are steep to very steep and have high susceptibility to landslides.

296. On the other hand, the area from Malolos to San Fernando covers a vast plain, flat and largely agricultural and traversed by rivers originating from the Cordillera Mountains to the North, and Sierra Madre to the East. The area is underlain by unconsolidated formation and is vulnerable to flooding.

2) Change in Subsurface Geology/Underground Condition

297. The MCRP is expected to cause changes in subsurface geology and underground conditions from Clark-CIA and Depot-Bamban. Similalrly, the construction of elevated structures in Malolos-Clark and Bamban-NCC will also entail the excavation of necessary overburden or weathered rocks to facilitate the placement of required engineering structures for elevated sections. However, the extent of this impact may only be determined during the Detailed Engineering Design Phase.

3) Inducement of Subsidence, Liquefaction, Landslide, Mud/Debris Flow, etc.

298. The natural hazards which can potentially affect the proposed MCRP include landslides, volcanic hazards and earthquake related hazards. The seismic related hazards include ground shaking and liquefaction. The proposed MCRP is deemed not susceptible to ground rupture due to its significant distance from the major earthquake generators.

299. The natural hazards, which are present within the entire route or selected segments of the proposed MCRP pose a threat not only to the stability of the tracks and stations but more importantly on the construction workers. These hazards can damage or destroy the tracks and/or stations or cause stoppage of construction.

300. During the construction phase, there will be possibilities of ground subsidence due to the tunnel boring activities at the underground. Ground subsidence may lead to the building collapse in the urban area. The geological survey is still being conducted which includes the assessment for potential subsidence. Proper method implementation and mitigation measure is required to minimize the land subsidence during construction.

301. Landslides and lahar flows will be further investigated through the conduct of engineering geological, geotechnical study and hydrologic study of the rivers draining the upper slopes of Mt. Pinatubo notably Abacan River, Mabalacat River and Bamban River. The results of this can be the basis for institution of mitigating measures or rerouting of threatened segments.

302. The design and construction of the structures and foundation of the proposed MCRP will comply with the provisions of the National Building Code and the Structural Code of the Philippines, and international standards based on the geotechnical and seismicity studies to eliminate/minimize impacts of liquefaction, ground shaking and ground rupture hazards.

303. Coordination with the PHIVOLCS during earthquake events will be made in order to make adjustments including assessment of possible damages to the structures being constructed. Sufficient protection measures such as soil improvements will be provided during excavation works. In case of the emergency, emergency escape route, early warning system, as well as emergency power supplies for the MCRP are also advised to be installed to ensure continued operation of vital services during emergencies. Earthquake drills will also be conducted annually. Emergency Response Plan is also established and implemented.

304. It is also strongly advised that the site is regularly inspected for structures constructed and under construction to detect any defects to minimise the potential accidents incurred by natural hazard. In addition, appropriate materials handling program or a site protection and rehabilitation program will be implemented.

(2) Operation phase

1) Change in Surface Landform/Geomorphology/Topography/Terrain/Slope

305. The operation of the proposed MCRP will not bring about changes in topography and geomorphology.

2) Change in Subsurface Geology/Underground Condition

306. Changes in subsurface geology and underground condition are not expected during the operation of the proposed MCRP.

3) Inducement of Subsidence, Liquefaction, Landslide, Mud/Debris Flow, etc.

307. The natural hazards, which are present within the entire route or selected segments of the proposed MCRP pose a threat not only to the stability of the tracks and stations but more importantly on the passengers. These hazards can damage or destroy the tracks and/or stations or cause stoppage of operations.

308. Landslide and lahar flows can block the railway route or hit the moving train and damage the railway cars. Ash fall can reduce visibility and cause stoppage of operations. Ground shaking can bring about liquefaction and settlement of the track and stations foundation and can also damage bridge crossings. The basic mitigation measure for the hazards that can potentially affect the proposed MCRP is to undertake the appropriate studies, which will generate information that can be used for designing structures that can reduce the identified impacts.

309. Impacts of ground shaking can be mitigated through appropriate foundation design based on a combination of geotechnical and seismicity studies. Coordination with the PHIVOLCS regarding impending or actual eruption of Mt. Pinatubo will be made so that the operational adjustments can be instituted. Earthquake resistance of the MCRP will rely on the constructed protective measures and its maintenance.

310. Proper inspection and prompt maintenance checks are very important to every single installed structure and facility. Upgrades or installation of new technological advances when available are also encouraged for the continued operation of MCRP. Regular earthquake drills are also advised to be put in place to prevent loss of life and possibly the trains themselves.

3.1.3 Pedology

3.1.3.1 Soil Types

311. The proposed MCRP will traverse at eight (8) types of soil namely: (1) Bigaa Clay Loam, (2) Quingua Silt Loam, (3) San Fernando Clay, (4) Lapaz Fine Sand, (5) Angeles Fine Sand, (6) Angeles Coarse Sand, (7) Angeles Sandly Loam and (8) Tarlac Loam.

Bigaa Clay Loam

312. Bigaa Clay Loam covers 17,550 ha of land in Bulacan and 8,959 ha in Pampanga. Bigaa Clay Loam belongs to the Bigaa Soil Series which is generally montmorillonitic. This type of soil is generally expansive due to its characteristic of being montmorillonitic. The parent material of this type of soil is Recent Alluvium. General thickness is found to be ranging from 100-150 cm. It has a general fertility of moderate to very high.

Quingua Silt Loam

313. Quingua Silt Loam covers 20,850 ha of land in Bulacan and 21,569 ha in Pampanga. The mineralogy of this type of soil is generally mixed. The parent materials are Recent Alluvium and Recent Coastal Deposits. Soil thickness is found to be ranging from 100-150 cm. Fertility ranges from moderate to very high fertility.

San Fernando Clay

314. San Fernando Clay covers about 2,527 ha of land in Pampanga. This type of soil can be found on broad alluvial plains. The mineralogy is fine and mixed. Parent material for this type of soil is recent alluvium. The drainage ranges from poor to very poorly drain. Fertility ranges from moderate to very high.

Lapaz Fine Sand

315. Lapaz Fine Sand belongs to the Lapaz Soil Series, which can be found on level to slightly rolling topography. The permeability of the soil is characterized to be moderate to rapid. The stoniness of the soil is considered to be none. The flooding condition for this type of soil is none to seasonal and erosion is none.

Angeles Fine Sand

316. Angeles Fine Sand, Angeles Coarse Sand, and Angeles Sandy Loam are from the Angeles Soil Series which can be found on nearly level to gently undulating landscape. Angeles Fine Sand covers 32,279 ha and 4,685 ha of the land in Pampanga and Tarlac, respectively.

Angeles Coarse Sand

317. Angeles Coarse Sand covers 8,161 ha and 5,377 ha of land in Pampanga and Tarlac, respectively.

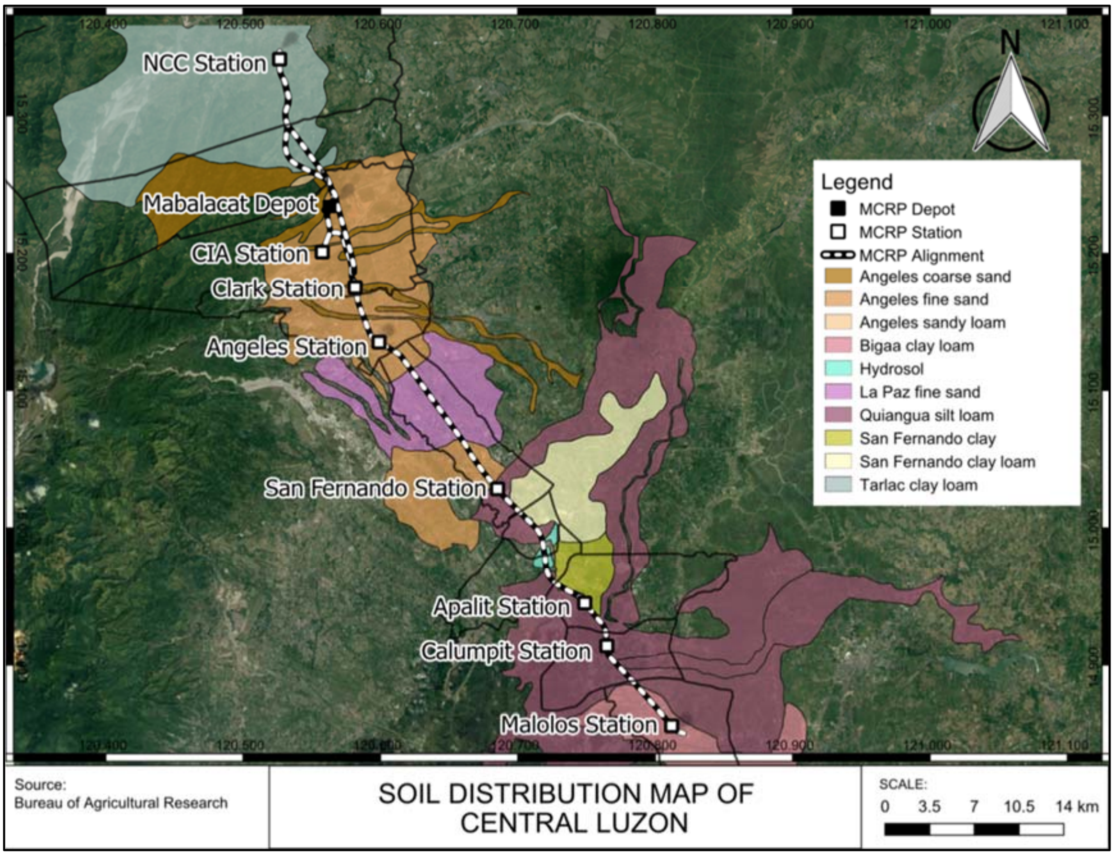
Angeles Sandy Loam

318. Angeles Sandy Loam covers 86,699 ha of land in and Tarlac. The general use for these types of soil in the soil series is for agriculture. This means that the soil is generally fertile. The parent material for this type of soil is Recent Alluvial deposits. The general stratum is generally grayish in color.

Tarlac Clay Loam

319. Tarlac Clay Loam is dark-gray to black in color and is fine granular to gritty clay loam. The length of the soil ranges from 50 to 80 cm. B horizon is defined by calcium carbonate

accumulation. The parent material is tuff or tuffaceous sandstones. The distribution of the soil types can be seen in **Figure 3.1.24**.



Source: Bureau of Agricultural Research

Figure 3.1.24 Soil Map showing the Soil Types along the MCRP Alignment

3.1.3.2 Soil Erodibility

320. The erodibility of the soils along the alignment is generally little to no erosion due to land cover and water content of the soil. For the Mabalacat area, some of the land surface has little land cover. The baseline condition for erodibility for this area can be considered vulnerable to erosion. The topography also plays a part on the erodibility of the soils in the area. Since the area is generally flat, the erodibility of the soils would also be lesser. The river bank stability for the soils along the alignment is generally stable because the soil types are mixed with clay particles. The clay particles will add stability of the riverbanks through flocculation.

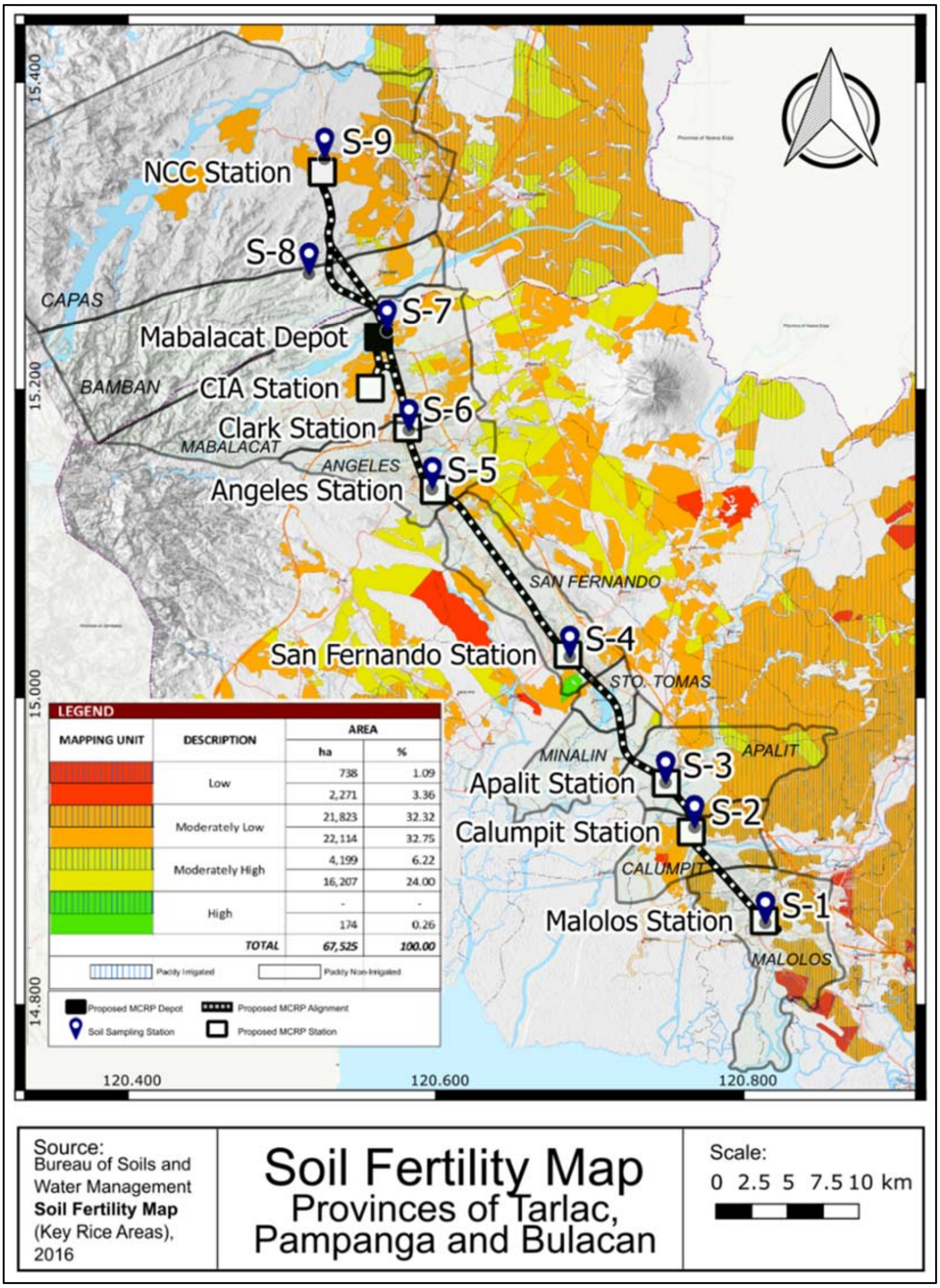
3.1.3.3 Soil Quality

321. The soil quality within the project site is indicated by the presence and level of heavy metals and pesticide residues. The extent of agricultural activity and the major products of the Central Luzon show that there is good soil quality in the area. This is complemented by the practice of some farmers on the use of organic fertilizers being encouraged by agricultural officials. However, there are still areas where application of chemical fertilizers and pesticides are common and these causes a deterioration of soil quality conditions.

(1) Soil Fertility

322. Soil fertility is the capacity of the soil to supply nutrients to the plants in proper amounts and proportions. Bigaa Clay Loam in Malolos has a general fertility of moderate to very high.

Quingua Silt Loam in Calumpit, Minalin and San Fernando has a fertility ranges from moderate to very high fertility. San Fernando Clay in Apalit, Sto. Tomas and San Fernando have fertility ranges from moderate to very high. Lapaz Fine Sand in San Fernando has low fertility. Angeles Series such as Angeles Fine Sand, Angeles Coarse Sand and Angeles Sandy Loam in Angeles, Mabalacat and Bamban has low fertility. Tarlac Clay Loam in Bamban and Capas has high fertility. Moreover, based on the Soil Fertility Map of BSWM presented in **Figure 3.1.25**, the soil fertility of the key rice areas within and adjacent to the proposed MCRP in Bulacan, Pampanga and Tarlac are moderately low except at some areas in the southern portion of San Fernando with high fertility.



Source: Soil Fertility Map (Key Rice Areas), 2016, Bureau of Soils and Water Management

Figure 3.1.25 Soil Fertility Map of Bulacan, Pampanga, and Tarlac

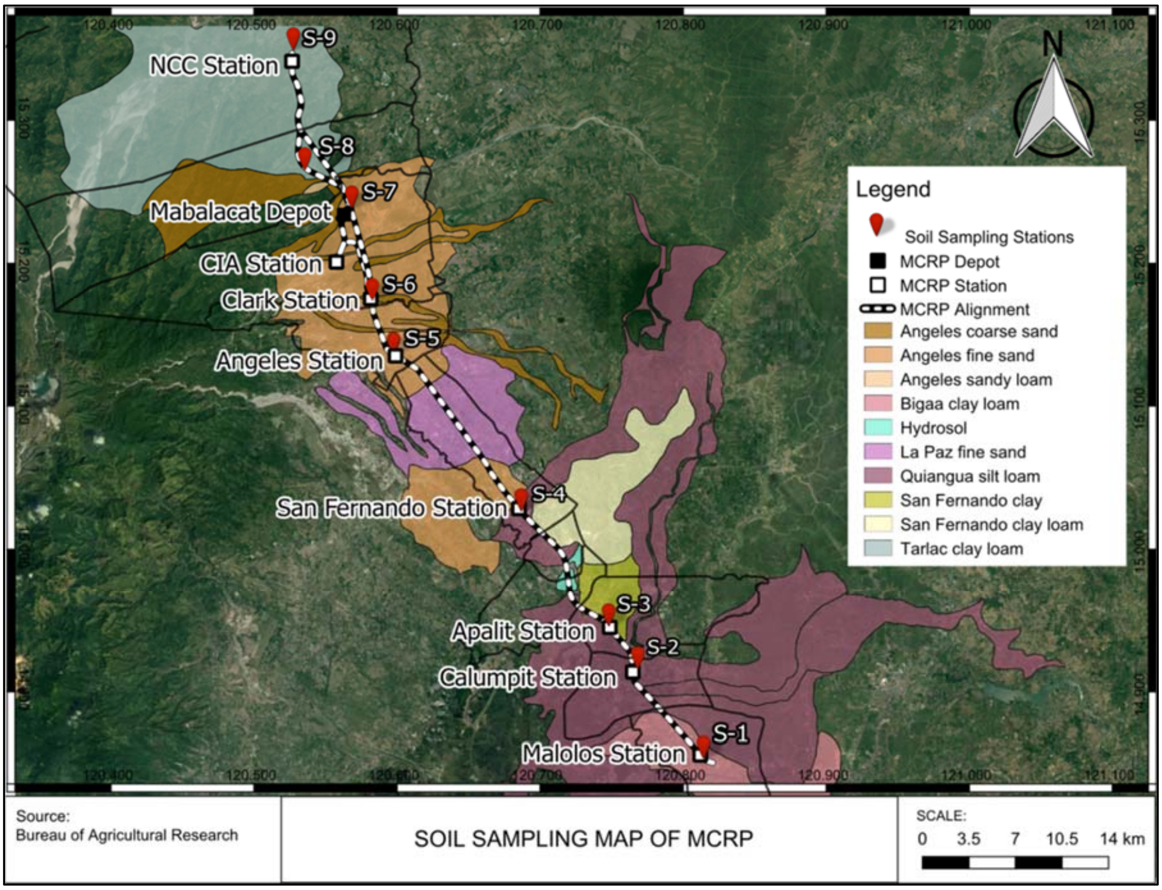
1) Field Survey

323. Soil samples were collected at nine (9) established sampling stations (**Table 3.1.10** and **Figure 3.1.26**) for physicochemical analyses such as such as pH, N, P, K, micronutrients and heavy metals. Soil samples were collected from two (2) horizons per sampling station. Surface/disturbed soil samples were taken at 0-25 cm depth using soil auger and were analyzed for pH, N, P, K, and micronutrients. The subsurface/undisturbed soil samples were taken at 25-50 cm and were analyzed for heavy metals.

324. The limits used for assessment of trace metals are the Target and Intervention Values of Dutch Standards. USEPA 2010 Standard and Leeper, 1978 were used as reference for the assessment of parameters that are not found in the Dutch Standards. The Dutch Standards are environmental pollutant reference values used in environmental remediation, investigation, and clean-up.

Table 3.1.10 Sampling Stations for Soil Quality Testing

Station Number	Description	Date of Sampling
S-1	Malolos Station Coordinates: 14°51'13.15"N, 120°48'50.91"E	January 28, 2018
S-2	Calumpit Station Coordinates: 14°54'57.72"N, 120°46'5.10"E	January 29, 2018
S-3	Apalit Station Coordinates: 15°1'35.40"N, 120°41'13.10"E	January 31, 2018
S-4	San Fernando Station Coordinates: 15° 1'36.00"N, 120°41'12.00"E	February 1, 2018
S-5	Angeles Station (Near La Pieta Memorial Cemetery) Coordinates: 15° 8'9.00"N, 120°35'51.00"E	February 2, 2018
S-6	Clark Station (Brgy. Lakandula) Coordinates: 15°10'26.00"N, 120°34'57.00"E,	February 3, 2018
S-7	Depot Site (Brgy. Dolores) Coordinates: 15°14'18.54"N, 120°34'5.61"E	February 5, 2018
S-8	Dapdap Resettlement Site, Brgy. San Roque, Bamban Coordinates: 15°16'32.76"N, 120°31'3.47"E	February 6, 2018
S-9	NCC Station Coordinates: 15°20'56.31"N, 120°31'38.48"E	February 7, 2018



Source: Bureau of Agricultural Research and GEOSPHERE, 2018

Figure 3.1.26 Soil Quality Sampling Stations

2) Applied Standard

325. The Adequate Values for parameters such pH, Organic Matter, primary nutrients (Phosphorus, Potassium), secondary nutrient (Magnesium), micronutrients (Iron, Copper, Manganese, and Zinc), as set the General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy, which were adopted by BSWM, were used to determine the fertility of the collected soil samples. Dutch Target and Intervention Values (2000) were adopted for trace metals such as Lead, Arsenic, Mercury, Cadmium, and Chromium Hexavalent.

3) Results and Analysis

326. The results of the soil quality analysis presented in **Table 3.1.11** showed that the levels of pH, Organic Matter, Phosphorus, Potassium, Magnesium and macronutrients (available Iron, Copper, Manganese and Zinc) in all sampling stations are adequate based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy except for the pH in Stations S-1 and S-2 and Organic Matter in Stations S-1, S-3, S-4 and S-9. The lowest level of nitrogen was recorded in Stations S-3 and S-7 at 240 mg/k while the highest level of nitrogen was recorded in Stations S-9 at 2,000 mg/kg. The lowest level of calcium was recorded in Station S-8 at 1.38 cmol/kg while the highest level was recorded in Station S-2 at 310.76 cmol/kg.

327. The levels of Lead in Stations S-2 and S-3 exceed the Target Value of the Dutch Standard but way below the Intervention Value. On the other hand, the levels of Lead in Stations S-1 and S-4 to S-9 are way below the Target Value of the Dutch Standard. The levels of Mercury in Stations

S-1 and S-5 to S9 are below the detectable limits of the analysis. The levels of Mercury in Stations S-2 to S-4 are way below the Target Value of the Dutch Standard. The level of Cadmium in Station S-4 is within the Target Value of the Dutch Standard. Levels of Cadmium in Stations S-1 and S-6 are below the Target Value. In Stations S-2, S-3, S-5, S-7, S-8 and S-9, the levels of Cadmium exceed the exceeds the Target Value but way below the Intervention Value of the Dutch Standard except for Station S-3, which is closer to the Intervention Value. The levels of Arsenic in Stations S-2 to S-9 are way below the Target Value of the Dutch Standard. The level of Arsenic in Station S-1 exceeds the Target Value but way below the Intervention Value of the Dutch Standard. The levels of Chromium Hexavalent in Stations S-3, S-5, S-6, and S-9 are within the Target Value of the Dutch Standard.

a. Results by Sampling Stations

Station S-1 (Malolos Station)

328. The soil sample collected at Station S-1 (Malolos Station) is classified as Bigaa Clay Loam. The levels of Phosphorus, Potassium, Magnesium, and macronutrients (available Iron, Copper, Manganese and Zinc) in the soil sample are adequate based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. On the other hand, the level of pH in the soil sample is high and the level of Organic Matter is low. The level of Nitrogen is 1,400 mg/kg while level of Calcium is 145.82 cmol/kg.

329. The levels of Lead and Cadmium in Stations S-1 are way below the Target Value of the Dutch Standard. The levels of Mercury and Chromium Hexavalent are below the detectable limits of the analysis. Level of Arsenic exceeds the Target Value but way below the Intervention Value of the Dutch Standard.

Station S-2 (Calumpit Station)

330. The soil sample collected at Station S-2 (Calumpit Station) is classified as Quingua Silt Loam. The levels of pH, Organic Matter, Phosphorus, Potassium, Magnesium, and macronutrients (available Iron, Copper, Manganese, and Zinc) in the soil sample are adequate based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. The level of Nitrogen is 250 mg/kg while level of Calcium is 310.76 cmol/kg.

331. The levels of Mercury, Arsenic, and Chromium Hexavalent in Stations S-2 are way below the Target Value of the Dutch Standard. On the other hand, the levels of Lead and Cadmium exceed the Target Value but way below the Intervention Value of the Dutch Standard.

Station S-3 (Apalit Station)

332. The soil sample collected at Station S-3 (Apalit Station) is classified as San Fernando Clay. The levels of Phosphorus, Potassium, Magnesium, and macronutrients (available Iron, Copper, Manganese, and Zinc) in the soil sample are adequate based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. On the other hand, the level of pH in the soil sample is high and the level of Organic Matter is very low. The level of Nitrogen is 240 mg/kg while level of Calcium is 73.35 cmol/kg.

333. The levels of Mercury and Arsenic in Stations S-3 are way below the Target Value of the Dutch Standard. The level of Chromium Hexavalent is below the detectable limits of the analysis. The levels of Lead and Cadmium exceed the Target Value but below the Intervention Value of the Dutch Standard.

Station S-4 (San Fernando Station)

334. The soil sample collected at Station S-4 (San Fernando Station) is classified as Quingua Silt Loam. The levels of pH, Phosphorus, Potassium, Magnesium, and macronutrients (available Iron, Copper, Manganese, and Zinc) in the soil sample are adequate based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. On the other hand, the level of Organic Matter is very low. The level of Nitrogen is 260 mg/kg while level of Calcium is 14.40 cmol/kg.

335. The levels of Lead, Mercury, Arsenic, and Chromium Hexavalent in Stations S-4 are way below the Target Value of the Dutch Standard. The level of Cadmium is within the Target Value of the Dutch Standard.

Station S-5 (Angeles Station, Near La Pieta Memorial Cemetery)

336. The soil sample collected at Station S-5 (Angeles Station, Near La Pieta Memorial Cemetery) is classified as Angeles Coarse Sand. The levels of pH, Organic Matter, Phosphorus, Potassium, Magnesium, and macronutrients (available Iron, Copper, Manganese, and Zinc) in the soil sample are adequate based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. The level of Nitrogen is 250 mg/kg while level of Calcium is 2.73 cmol/kg.

337. The levels of Lead, Arsenic, and Chromium Hexavalent in Stations S-5 are way below the Target Value of the Dutch Standard. The level of Mercury is below the detectable limits of the analysis. The level of Cadmium exceeds the Target Value but way below the Intervention Value of the Dutch Standard.

Station S-6 (Clark Station, Brgy. Lakandula)

338. The soil sample collected at Station S-6 (Clark Station, Brgy. Lakandula) is classified as Angeles Fine Sand. The levels of pH, Organic Matter, Phosphorus, Potassium, Magnesium, and macronutrients (available Iron, Copper, Manganese, and Zinc) in the soil sample are adequate based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. The level of Nitrogen is 280 mg/kg while level of Calcium is 18.85 cmol/kg.

339. The levels of Lead, Arsenic, Cadmium and Chromium Hexavalent in Stations S-6 are way below the Target Value of the Dutch Standard. The level of Mercury is below the detectable limits of the analysis.

Station S-7 (Depot Site, Brgy. Dolores)

340. The soil sample collected at Station S-7 (Depot Site, Brgy. Dolores) is classified as Angeles Fine Sand. The levels of pH, Organic Matter, Phosphorus, Potassium, Magnesium, and macronutrients (available Iron, Copper, Manganese, and Zinc) in the soil sample are adequate based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. The level of Nitrogen is 240 mg/kg while level of Calcium is 10.11 cmol/kg.

341. The levels of Lead, Arsenic, and Chromium Hexavalent in Stations S-7 are way below the Target Value of the Dutch Standard. The level of Mercury is below the detectable limits of the analysis. The level of Cadmium exceeds the Target Value but way below the Intervention Value of the Dutch Standard.

Station S-8 (Dapdap Resettlement Site, Brgy. San Roque, Bamban)

342. The soil sample collected at Station S-8 (Dapdap Resettlement Site, Brgy. San Roque, Bamban) is classified as Tarlac Loam. The levels of pH, Organic Matter, Phosphorus, Potassium, Magnesium, and macronutrients (available Iron, Copper, Manganese, and Zinc) in the soil sample are adequate based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. The level of Nitrogen is 250 mg/kg while level of Calcium is 1.38 cmol/kg.

343. The levels of Lead and Arsenic in Stations S-8 are way below the Target Value of the Dutch Standard. The levels of Mercury and Chromium Hexavalent are below the detectable limits of the analysis. The level of Cadmium exceeds the Target Value but way below the Intervention Value of the Dutch Standard.

Station S-9 (NCC Station)

344. The soil sample collected at Station S-9 (NCC Station) is classified as Tarlac Loam. The levels of pH, Phosphorus, Potassium, Magnesium, and macronutrients (available Iron, Copper, Manganese, and Zinc) in the soil sample are adequate based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. On the other hand, the level of Organic Matter is very low. The level of Nitrogen is 2,000 mg/kg while level of Calcium is 3.35 cmol/kg.

345. The levels of Lead and Chromium Hexavalent in Stations S-9 are way below the Target Value of the Dutch Standard. The levels of Mercury and Arsenic are below the detectable limits of the analysis. The level of Cadmium exceeds the Target Value but way below the Intervention Value of the Dutch Standard.

Table 3.1.11 Results of Soil Analysis Pertaining to Soil Fertility

Parameters	Sampling Stations									Adequate Values[1]	
	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9		
Soil Type	Bigaa Clay Loam	Quingua Silt Loam	San Fernando Clay	Quingua Silt Loam	Angeles Fine Sand	Angeles Coarse Sand	Angeles Fine Sand	Tarlac Loam	Tarlac Loam	-	
pH	9.1	8.34	8.82	8.29	7.24	6.78	7.81	8.34	8.35	5.5-8.5	
Organic Matter, %	0.99	1.7	0.36	0.58	1.06	2.18	2.17	2.15	0.89	1-8; >3**	
Primary Nutrients											
Total Kjeldahl Nitrogen, mg/kg	1,400	250	240	260	250	280	240	250	2,000		
Phosphorus, mg/kg	436	349	398	93	43	126	75	395	192	>10 >20**	
Potassium, cmol/kg	1,460	2,194	1,951	525	494	348	513	118	107	>0.25	
Secondary Nutrients											
Calcium, cmol/kg	145.82	310.76	73.35	14.40	2.73	18.85	10.11	1.38	3.35	-	
Magnesium, cmol/kg	83.13	102.63	65.80	20.87	14.94	10.53	20.47	5.68	6.82	>0.50	
Micronutrients											
Available Iron, mg/kg	37,014	50,424	51,801	8,706	7,486	16,721	4,811	3,895	22,830	>4.5	
Available Copper, mg/kg	68.1	115	582	45	20	28	37	15	26	>0.2	
Available Manganese, mg/kg	922	941	2,756	212	477	296	192	126	621	>1.0	
Available Zinc, mg/kg	673	502	1,187	259	50	1,615	14	71	54	>1.5; >1.0**	
Trace Metals										Dutch Standards[2]	
										Target Values	Intervention Values
Lead, mg/kg	23	103	476	41.8	19.9	35	18.1	20.4	27.8	85	530
Mercury, mg/kg	<0.05	0.07	0.17	0.08	<0.05	<0.05	<0.05	<0.05	<0.05	0.3	10
Cadmium, mg/kg	0.7	2.17	11.2	0.8	1.37	0.620	1.99	1.97	1.96	0.8	12
Arsenic, mg/kg	32	2.17	1.95	2.32	0.660	0.790	1.33	0.885	<0.4	29	55
Chromium Hexavalent, mg/kg	<0.2	0.35	<0.2	5.5	12	12	3.0	<0.2	10	100	380

Note: ** Limits applicable to dry land crops
Target Values of Dutch Standard– indicates the level at which there is a sustainable soil quality;
Intervention Values of Dutch Standard– representative of the level of contamination above which there is a serious case of soil contamination;

Source: 1Adequate Values based on General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy (Adopted by BSWM); 2 Dutch Target and Intervention Values (2000);

b. Results by Parameters

346. Results of analysis for each parameter were graphed showing its relative concentration levels at nine (9) sampling stations. Brief discussions were made comparing the results across the sampling stations and against relevant General Guidelines for the Fertility Rating of Soils and Dutch Target and Intervention Values.

pH Level

347. **Figure 3.1.27** shows that the pH levels in all sampling stations are adequate except in Stations S-1 (Malolos Station) and S-3 (Apalit Station) which exceeded the maximum guideline value of pH set in the General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. The lowest pH level was recorded in Station S-6 (Clark Station) at 6.78.

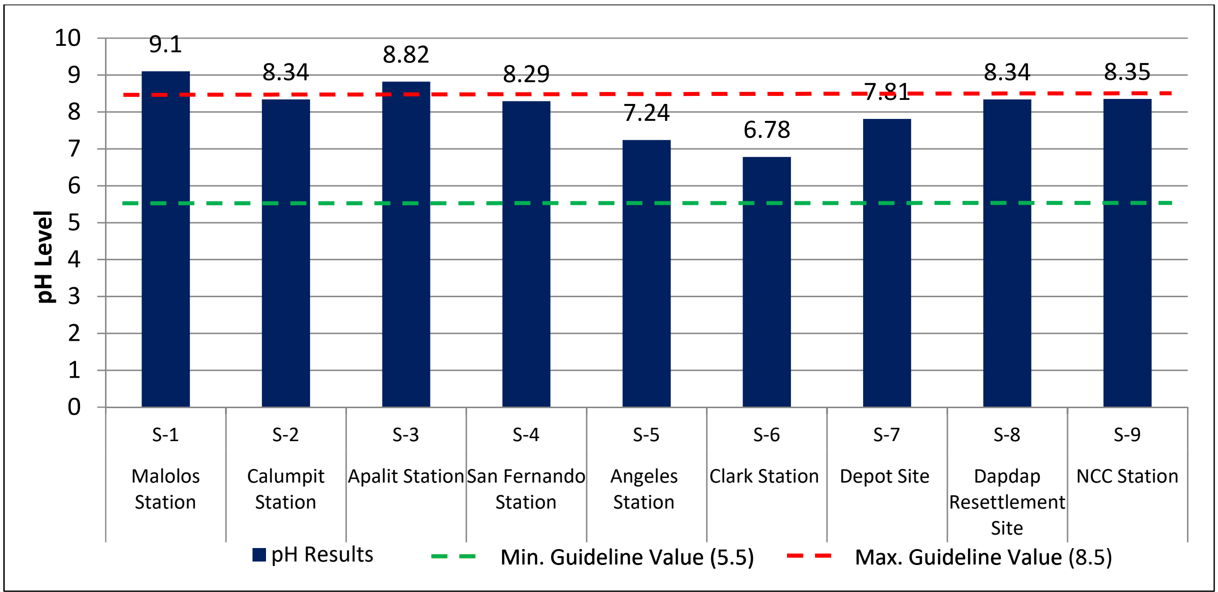


Figure 3.1.27 Results of pH Measurement of Soil Samples

Organic Matter

348. **Figure 3.1.28** shows that the levels of Organic Matter in all sampling stations are adequate except in Stations S-1 (Malolos Station), S-3 (Apalit Station), S-4 (San Fernando Station), and S-9 (NCC Station) which are below the minimum guideline value set in the General Guidelines for the Fertility Rating of Soils. The highest level of organic matter was recorded in Station S-6 (Clark Station) at 2.18%.

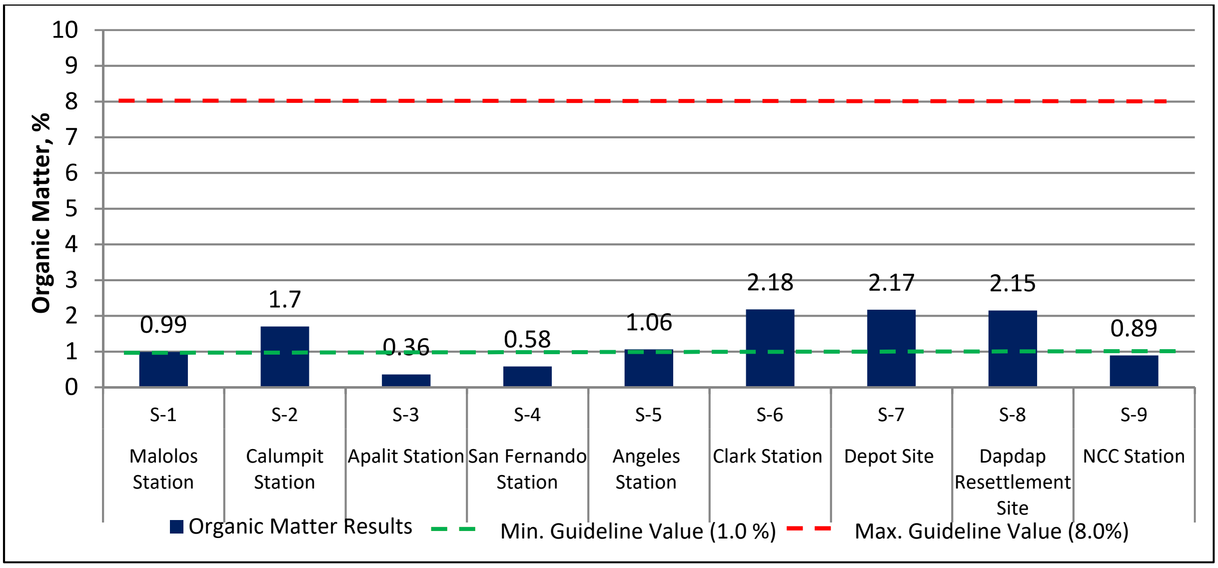


Figure 3.1.28 Results of Organic Matter Measurement of Soil Samples

Total Kjeldahl Nitrogen

349. **Figure 3.1.29** shows that the highest level of Total Kjeldahl Nitrogen was recorded in Station S-9 (NCC Station) at 2,000 mg/kg while the lowest nitrogen level was recorded in Stations S-3 (Apalit Station) and S-7 (Depot Site) at 240 mg/kg.

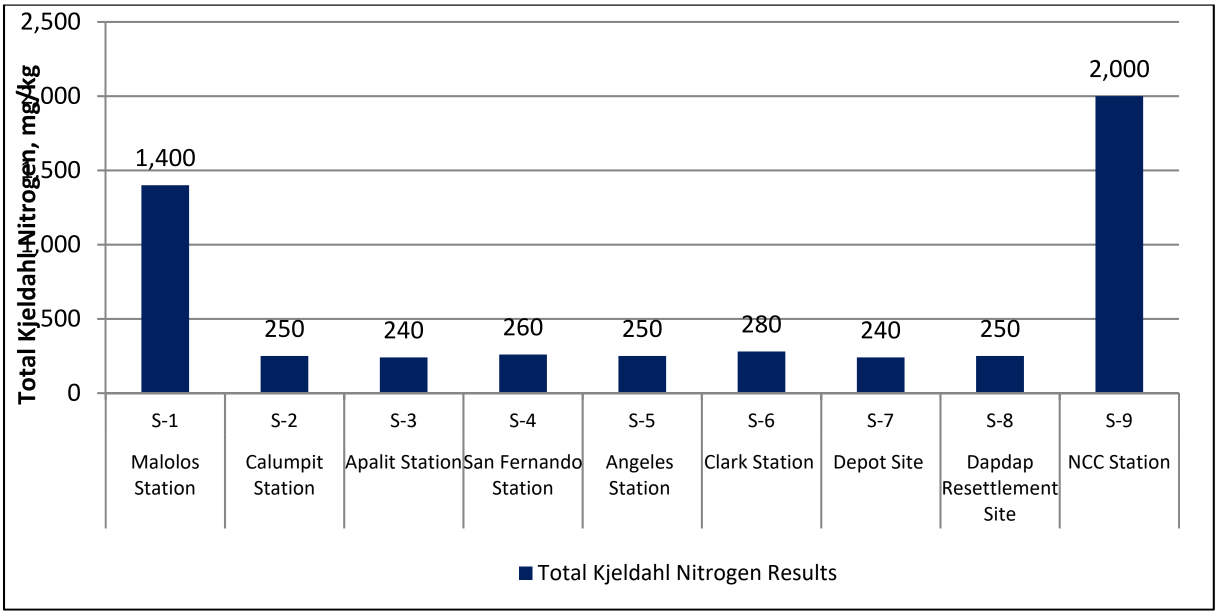


Figure 3.1.29 Results of Total Kjeldahl Nitrogen Measurement of Soil Samples

Phosphorus

350. **Figure 3.1.30** shows that the levels of Phosphorus in all station are adequate (>10.0 mg/kg). The highest level of phosphorus was recorded in Station S-1 (Malolos Station) at 436 mg/kg while the lowest phosphorus level was recorded in Station S-5 (Angeles Station) at 43 mg/kg.

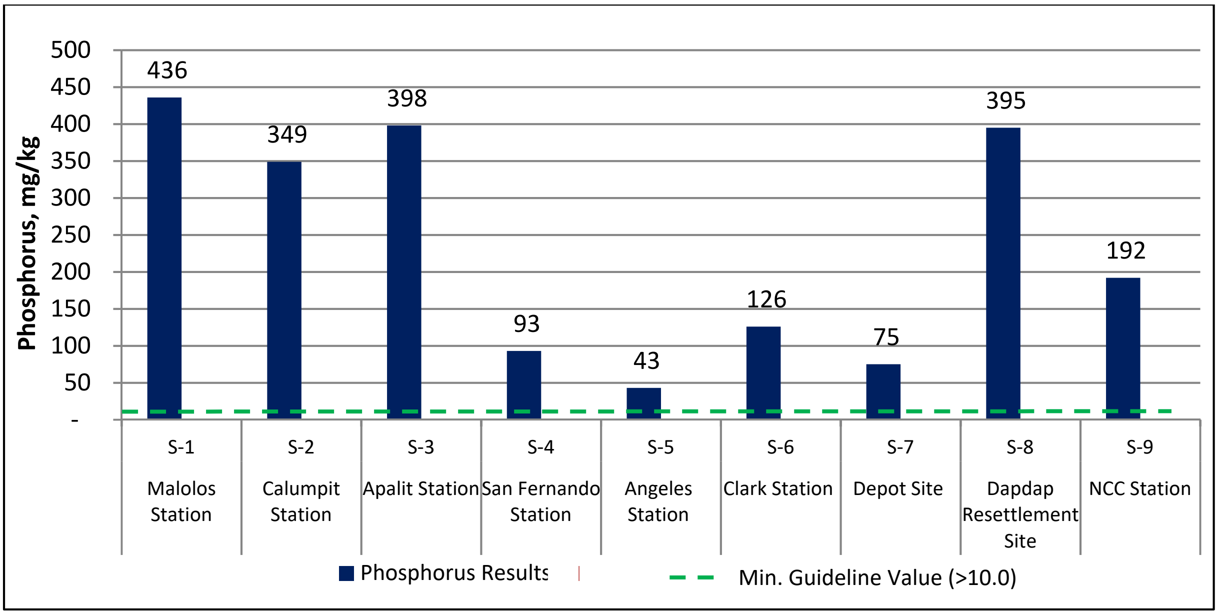


Figure 3.1.30 Results of Phosphorus Measurement of Soil Samples

Potassium

351. **Figure 3.1.31** shows that the levels of Potassium in all sampling stations are adequate. The highest level of potassium was recorded in Station S-2 (Calumpit Station) at 2,194 cmol/kg while the lowest level was recorded in Station S-9 (NCC Station) at 107 cmol/kg.

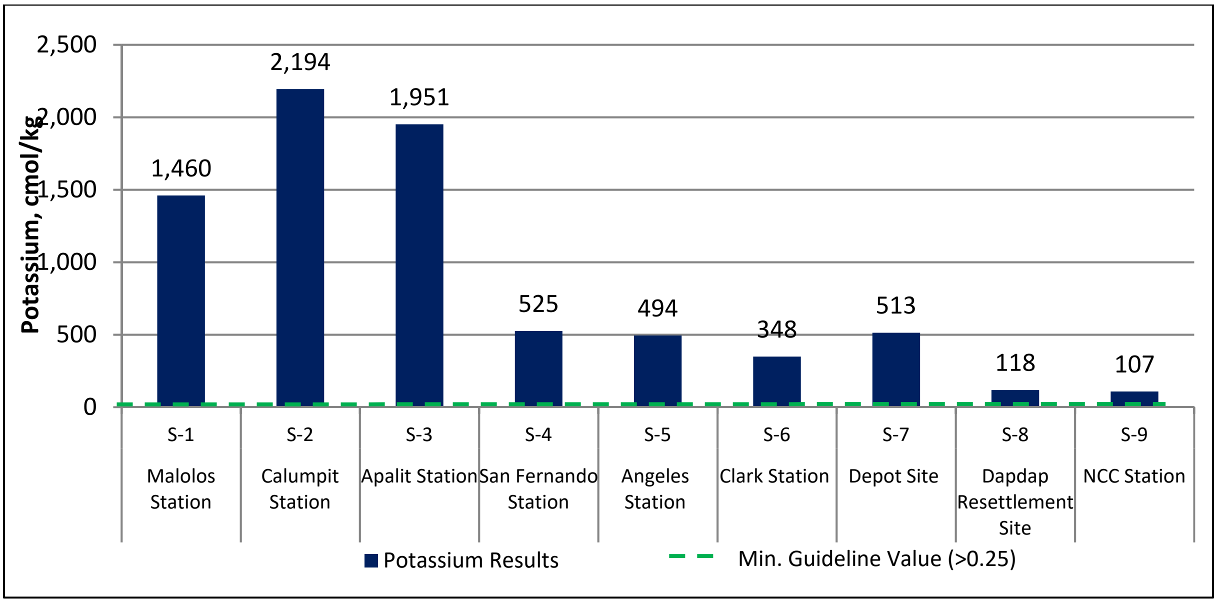


Figure 3.1.31 Results of Potassium Measurement of Soil Samples

Calcium

352. **Figure 3.1.32** shows the highest level of Calcium was recorded in Station S-2 (Calumpit Station) at 310.76 cmol/kg while the lowest level was recorded in Station S-8 (Dapdap Resettlement Site) at 1.38 cmol/kg.

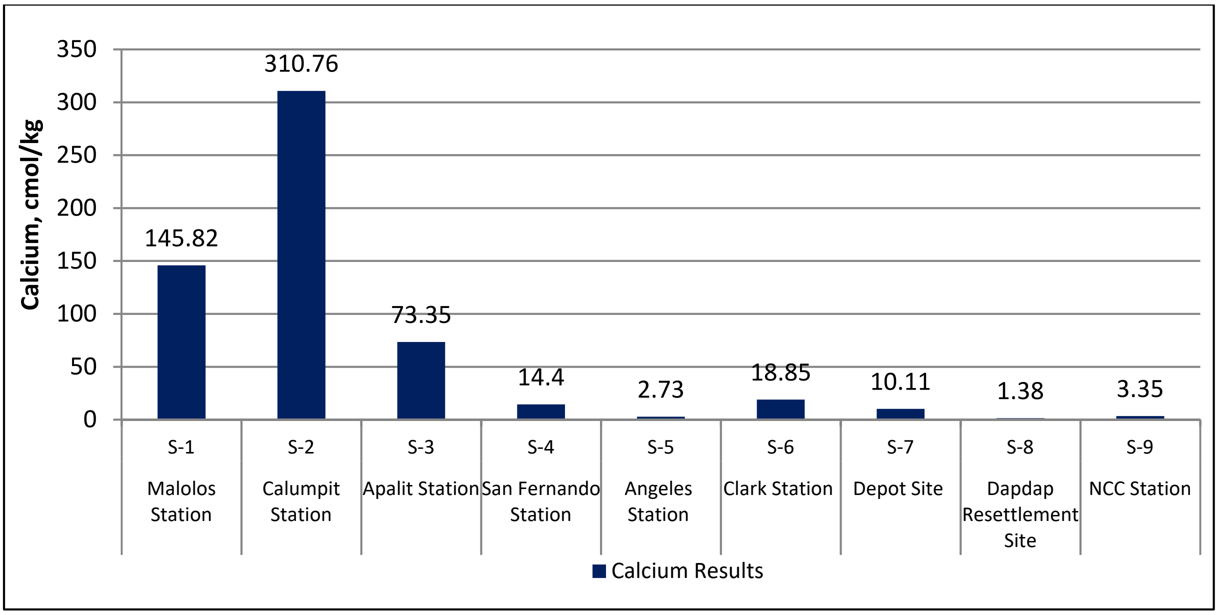


Figure 3.1.32 Results of Calcium Measurement of Soil Samples

Magnesium

353. **Figure 3.1.33** shows that the levels of Magnesium in all sampling stations are adequate (>0.50 cmol/kg). The highest level of magnesium was recorded in Station S-2 (Calumpit Station) at 102.63 cmol/kg while the lowest level was recorded in Station S-8 (Dapdap Resettlement Site) at 5.68 cmol/kg.

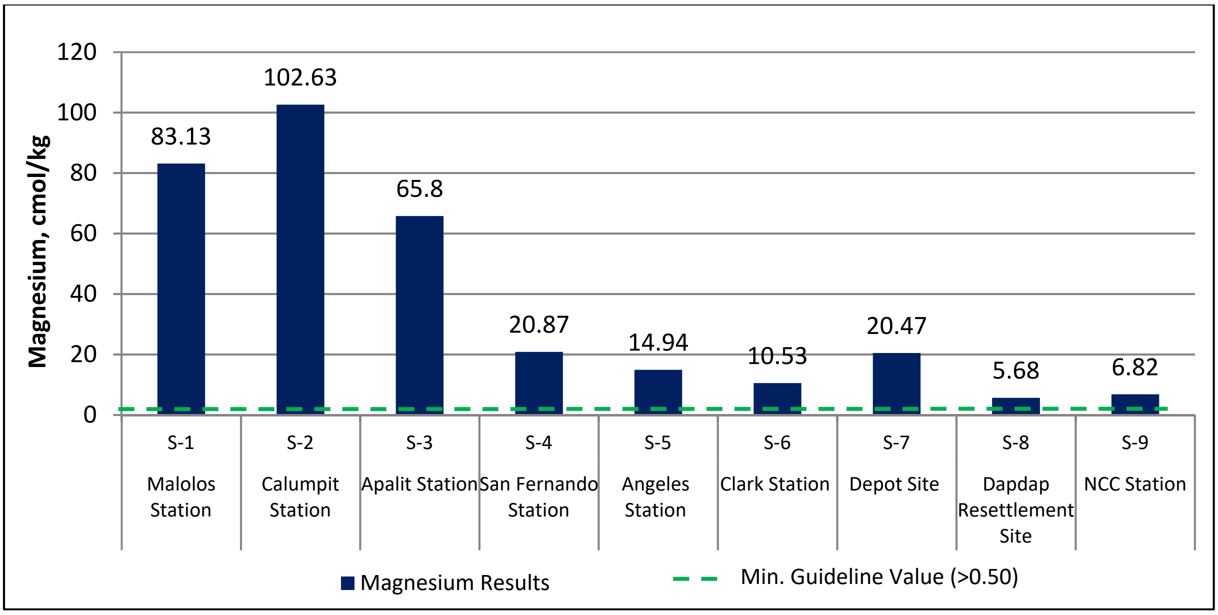


Figure 3.1.33 Results of Magnesium Measurement of Soil Samples

Available Iron

354. **Figure 3.1.34** shows that the levels of available iron in all stations are adequate (>4.5 mg/kg). The highest level of available iron was recorded in Station S-3 (Apalit Station) at 51,801 mg/kg while the lowest level was recorded in Station S-8 (Dapdap Resettlement Site) at 3,895 mg/kg.

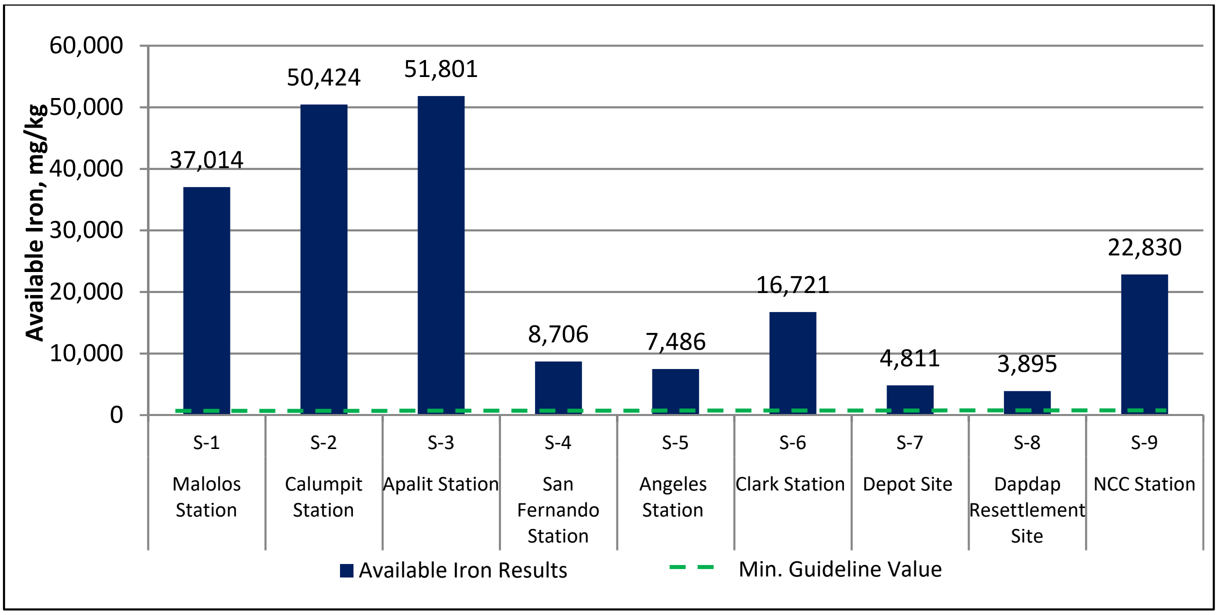


Figure 3.1.34 Results of Iron Measurement of Soil Samples

Available Copper

355. **Figure 3.1.35** shows that the levels of available copper in all stations are adequate (>0.2 mg/kg). The highest level of available copper was recorded in Station S-3 (Apalit Station) at 582 mg/kg while the lowest level recorded in Station S-8 (Dapdap Resettlement Site) at 15 mg/kg.

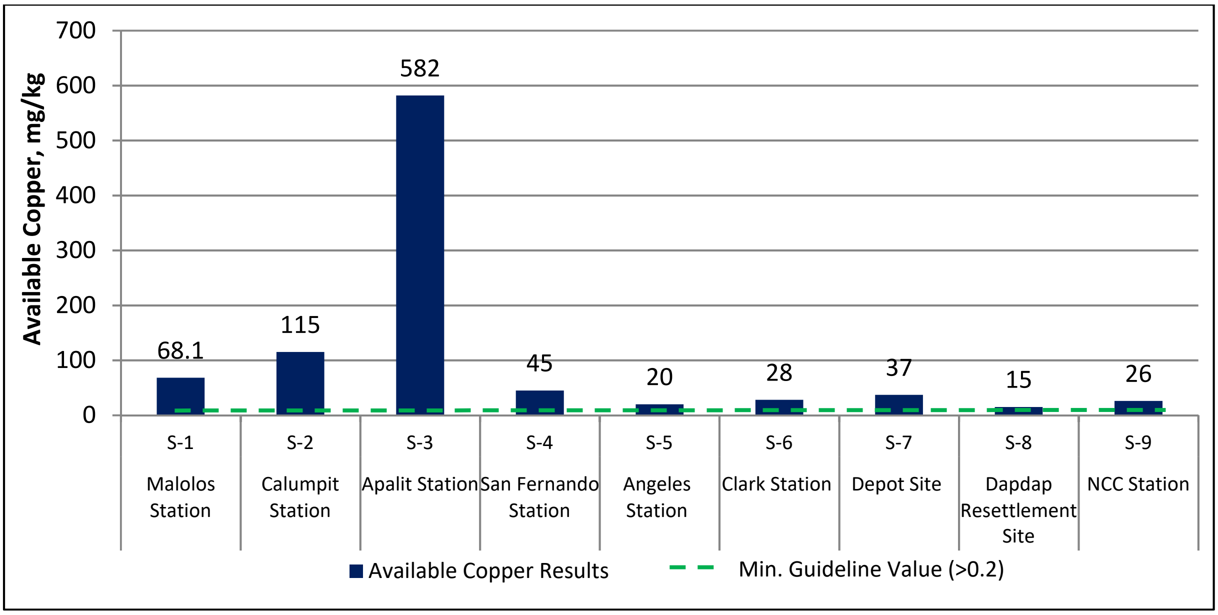


Figure 3.1.35 Results of Copper Measurement of Soil Samples

Available Manganese

356. **Figure 3.1.36** shows that the levels of available manganese in all stations are adequate (>10 mg/kg). The highest level of available manganese was recorded in Station S-3 (Apalit Station) at 2,756 mg/kg while the lowest available manganese was recorded in Station S-8 (Dapdap Resettlement Site) at 126 mg/kg.

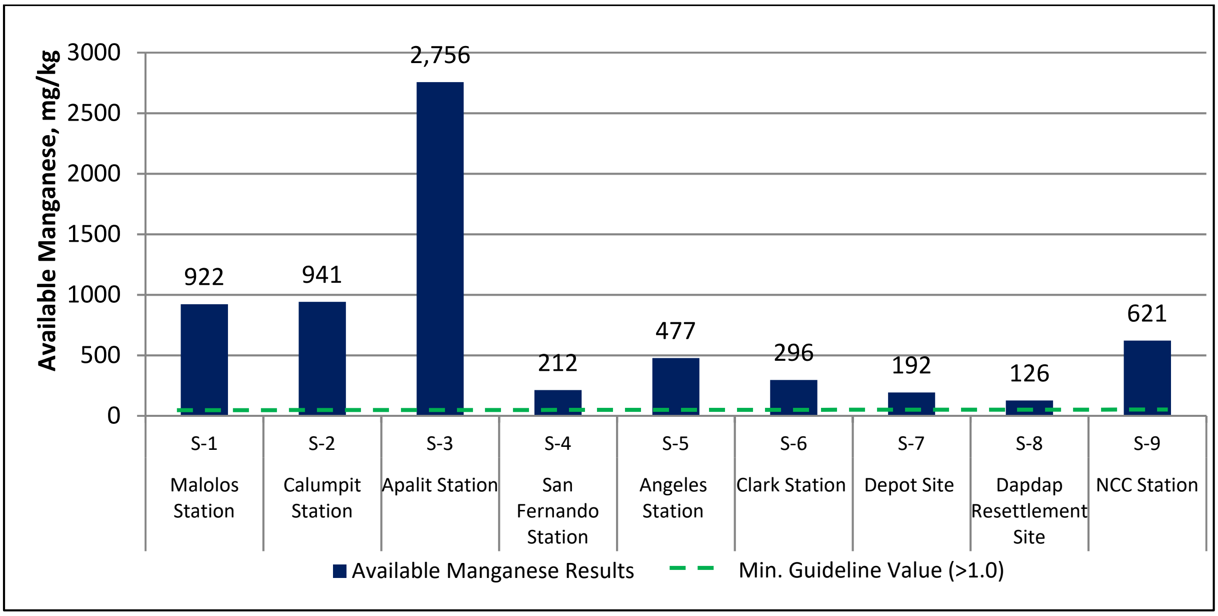


Figure 3.1.36 Results of Manganese Measurement of Soil Samples

Available Zinc

357. **Figure 3.1.37** shows that the levels of available zinc in all stations are adequate (>1.5 mg/kg). The highest level of available zinc was recorded in Station S-6 (Clark Station) at 1,615 mg/kg while the lowest level was recorded in Station S-7 (Depot Site) at 14 mg/kg.

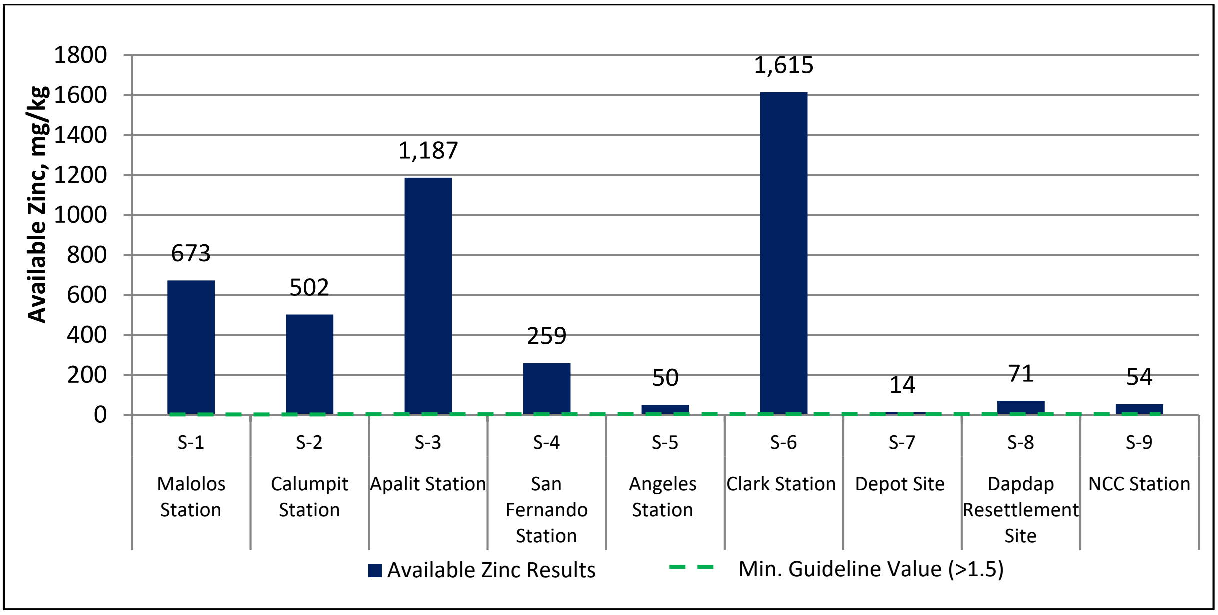


Figure 3.1.37 Results of Zinc Measurement of Soil Samples

Lead

358. **Figure 3.1.38** shows that the levels of Lead in Stations S-2 and S-3 exceed the Target Value of the Dutch Standard but way below the Intervention Value. On the other hand, the levels of Lead in Stations S-1 and S-4 to S-9 are way below the Target Value of the Dutch Standard. The highest level of Lead was recorded in Station S-3 (Apalit Station) at 476 mg/kg while the lowest level was recorded in Station S-7 (Depot Site) at 18.1 mg/kg.

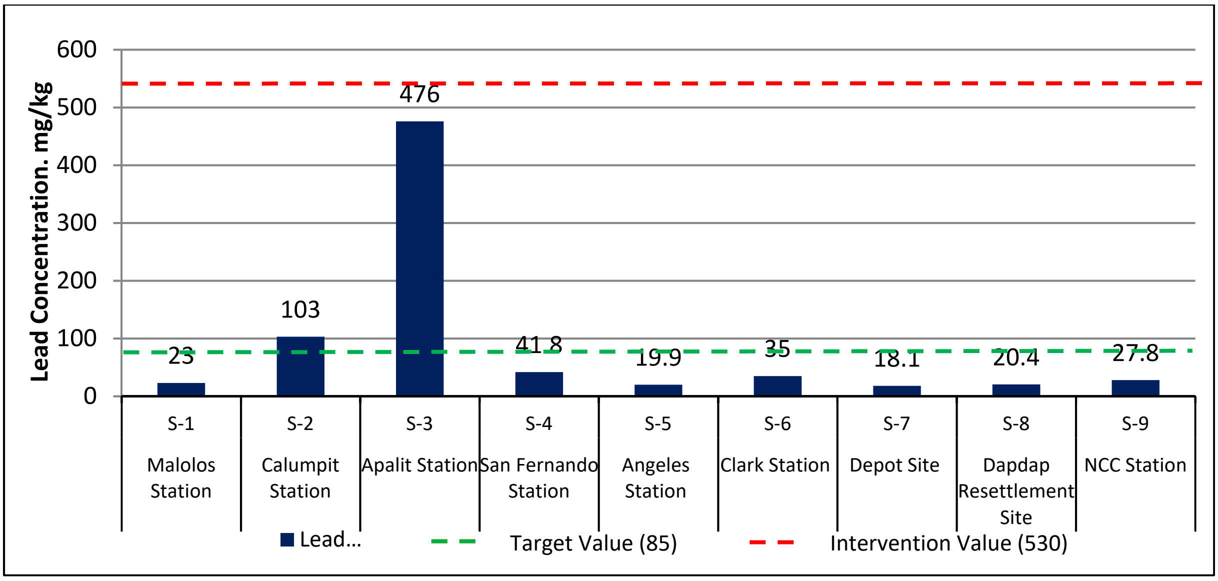


Figure 3.1.38 Results of Lead Measurement of Soil Samples

Mercury

359. **Figure 3.1.39** shows that the levels of Mercury in Stations S-1 and S-5 to S9 are below the detectable limit of the analysis. The levels of Mercury in Stations S-2 to S-4 are way below the Target Value of the Dutch Standard. The highest level of Mercury was recorded in Station S-3 (Apalit Station) at 0.17 mg/kg.

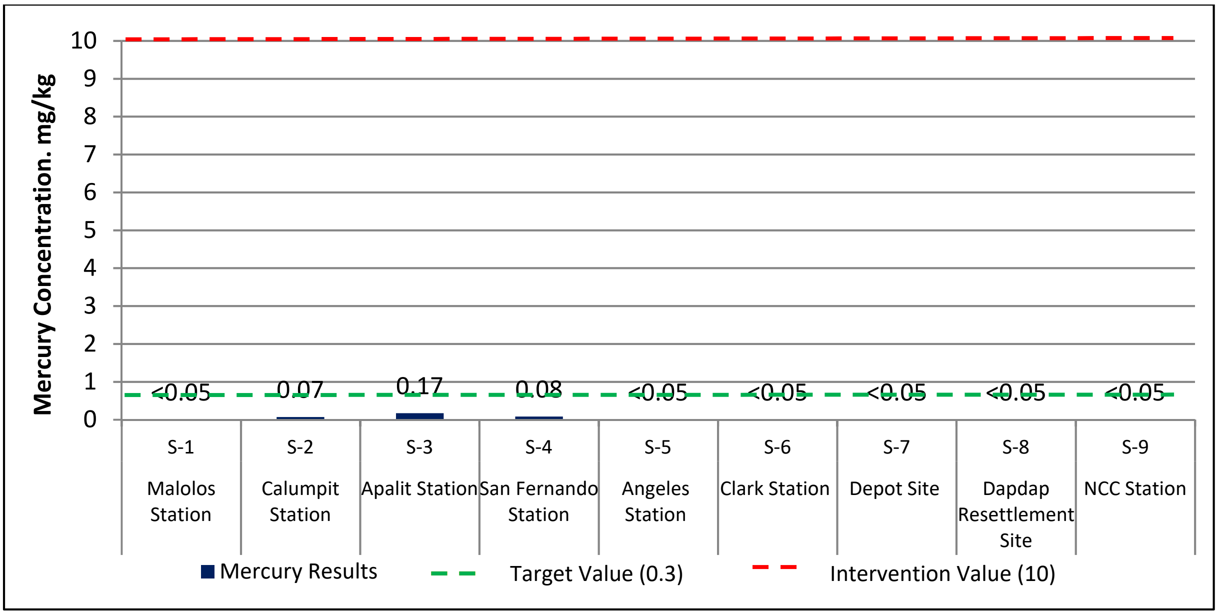


Figure 3.1.39 Results of Mercury Measurement of Soil Samples

Cadmium

360. **Figure 3.1.40** shows that the level of Cadmium in Station S-4 is within the Target Value of the Dutch Standard. Levels of Cadmium in Stations S-1 and S-6 are below the Target Value. In Stations S-2, S-3, S-5, S-7, S-8 and S-9, the levels of Cadmium exceed the exceeds the Target Value but way below the Intervention Value of the Dutch Standard except for Station S-3, which is closer to the Intervention Value.

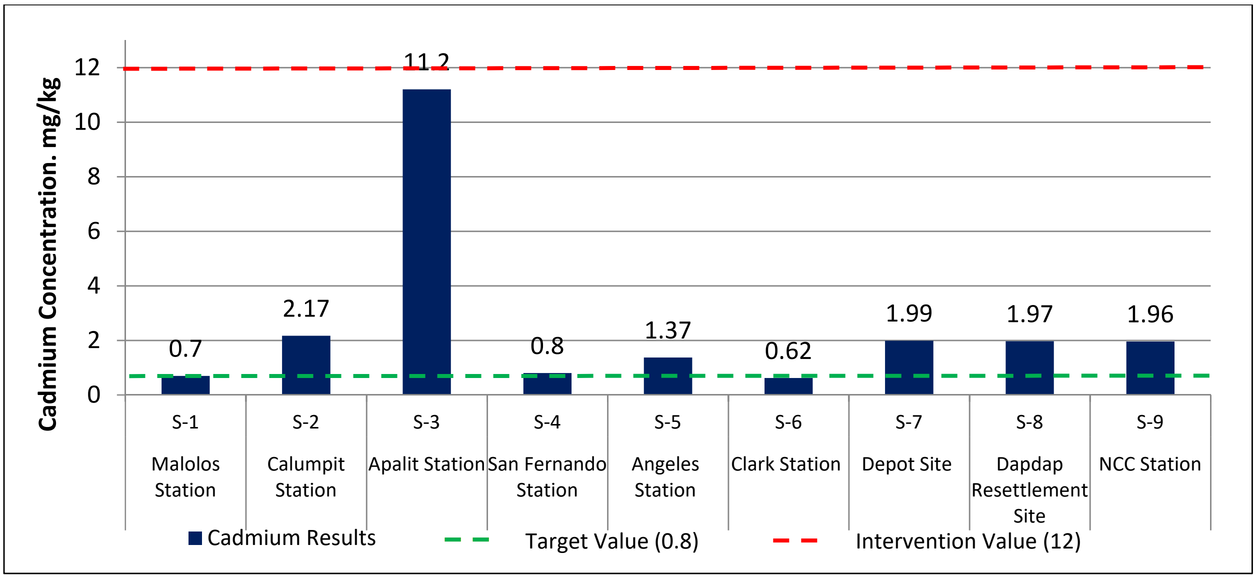


Figure 3.1.40 Results of Cadmium Measurement of Soil Samples

Arsenic

361. **Figure 3.1.41** shows that the levels of Arsenic in Stations S-2 to S-8 are way below the Target Value of the Dutch Standard. The level of Arsenic in Station S-1 exceeds the Target Value but way below the Intervention Value of the Dutch Standard. Arsenic in Station S9 is below the detectable limit of the analysis.

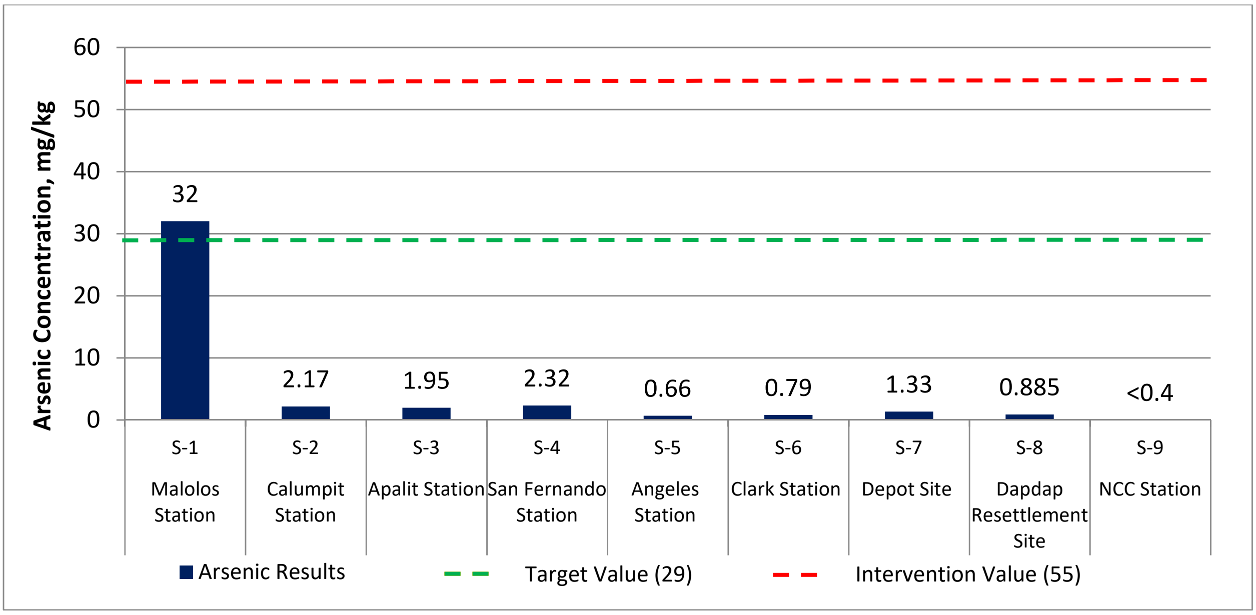


Figure 3.1.41 Results of Arsenic Measurement of Soil Samples

Chromium Hexavalent

362. **Figure 3.1.42** shows that the levels of Chromium Hexavalent in Stations S-3, S-5, S-6, and S-9 are below the Target Value of the Dutch Standard. The levels of Chromium Hexavalent in Stations S-1, S-3 and S-8 are below the detectable limit of the analysis. The highest level of chromium hexavalent were detected in Stations S-5 and S-6 (Angeles Station and Clark Station) at 12 mg/kg.

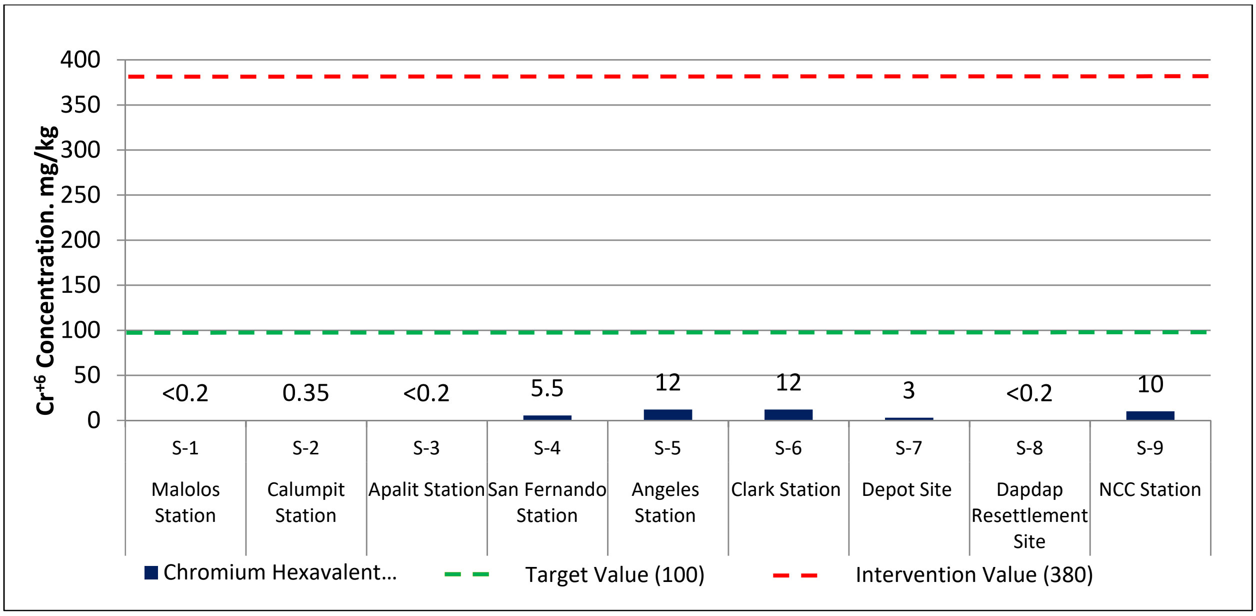


Figure 3.1.42 Results of Chromium Hexavalent Measurement of Soil Samples

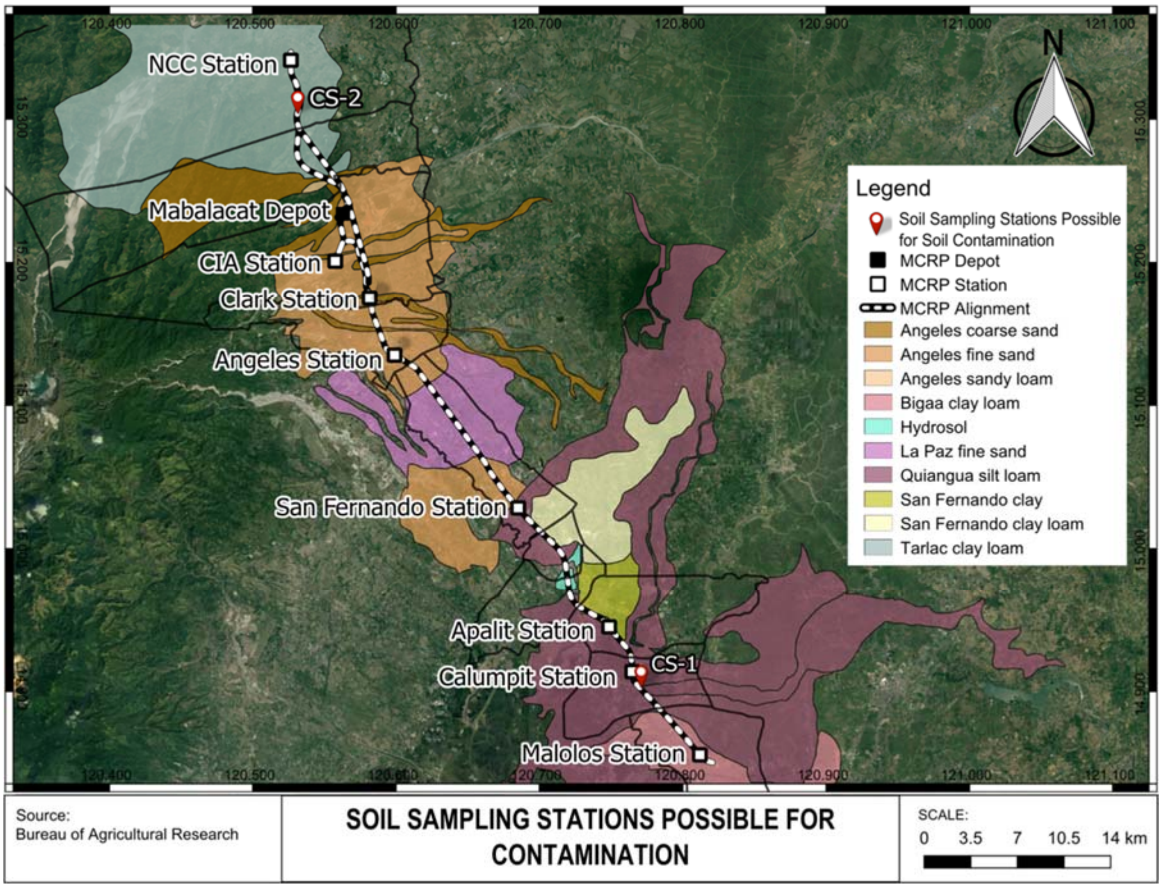
(2) Soil Contamination

1) Field Survey

363. Soil samples were collected at the North Rail Temporary Covered Dumpsite in Calumpit and at the Metro Clark Sanitary Landfill in Capas (**Table 3.1.12** and **Figure 3.1.43**) using composite sampling to determine if the area is contaminated. The collected soil samples were submitted to Mach Union Laboratory, Inc. for the analysis of pH, Arsenic (As), Barium (Ba), Copper (Cu), Zinc (Zn), Iron (Fe), Cadmium (Cd), Chromium (Cr), Lead (Pb), Manganese (Mn), Mercury (Hg), Selenium (Se), Nickel (Ni), Oil and Grease (O&G) and Cyanide (CN) using Toxicity Characteristic Leaching Procedure (TCLP) analysis.

Table 3.1.12 Location of Soil Sampling Stations with Possible Contamination

Sampling Location		Date of Sampling
CS-1	Calumpit – North Rail Temporary Covered Dumpsite Coordinates: 14°54'15.58"N, 120°46'5.53"E	March 15, 2018
CS-2	Metro Clark Sanitary Landfill Coordinates: 15°18'20.38"N, 120°31'49.08"E	March 19, 2018



Source: Bureau of Agricultural Research and GEOSPHERE, 2018

Figure 3.1.43 Soil Sampling Stations with Possible Contamination

2) Applied Standard

364. The TCLP limits prescribed in Table 2.1 Classification of Hazardous Wastes of the DAO 2013-22, Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36) were adopted in determining whether the soil samples collected in Stations CS1 and CS2 are contaminated with Acid wastes, Alkali wastes, waste with Cyanide and/or waste with Inorganic Chemicals

3) Results and Analysis

365. **Table 3.1.13** shows the results of the TCLP analysis for the potentiallycontaminated soil samples.

Station CS-1 (Old Municipal Dumpsite (Covered))

366. Results of analysis for soil sample collected in Station SC-1 which is classified as Quingua Silt Loam showed that the pH of the soil sample is 3.7. This means that the soil samples are not contaminated with neither Acid wastes nor Alkali wastes. Arsenic, Barium, Mercury and Cyanide were not detected in the soil samples. Cadmium, Lead, and Selenium were detected but the levels are way below the TCLP limits. Copper, Zinc, Iron, Nickel, Manganese and Oil and Grease were also detected but there are no TCLP limits described in DAO 2013-22 for these parameters.

Station CS-2 (Metro Clark Sanitary Landfill)

367. Results of analysis of soil sample collected in Station CS-2 which is classified as Tarlac Clay Loam showed that the pH of the soil sample is 8.5. This means that the soil sample is not contaminated with neither Acid wastes nor Alkali wastes. Arsenic, Barium, Copper, Iron,

Cadmium, Chromium, Mercury, Selenium, and Nickel were not detected in the soil samples. Lead, and Cyanide were detected but the levels are way below the TCLP limits. Zinc, Manganese and Oil and Grease were also detected but there are no TCLP limits described in DAO 2013-22 for these parameters.

Table 3.1.13. Results of TCLP Analysis for Potentially Contaminated Soil Samples

Parameters	Sampling Station		TCLP Limits (based on Table 2.1 Classification of Hazardous Wastes of DAO 2013-22)
	CS-1	CS-2	
pH	3.7	8.5	<2 Acid >12.5 Alkali
Arsenic, mg/L	<0.001	<0.001	>1
Barium, mg/L	<0.04	<0.04	>70
Copper, mg/L	0.0629	<0.005	-
Zinc, mg/L	0.192	0.049	-
Iron, mg/L	0.116	<0.009	-
Cadmium, mg/L	0.0138	<0.002	>0.3
Chromium, mg/L	0.03	<0.03	>5
Lead, mg/L	0.0233	0.1232	>1
Manganese, mg/L	2.58	0.207	-
Mercury, mg/L	<0.0001	<0.0001	>0.1
Selenium, mg/L	0.001	<0.001	>1
Nickel, mg/L	0.077	<0.02	-
Oil and Grease, mg/L	8.57	2.3	-
Cyanide, mg/L	<0.001	0.00724	>70

Source: DAO 2013-22, Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36)

3.1.3.4 Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction Phase

1) Soil Erosion/Loss of Topsoil/Overburden

Soil Erosion

368. During construction, earthmoving activities will be carried out along the alignment, stations and depot. These areas will be subjected to clearing and removal of vegetation, stripping of soil cover, excavation of underlying rock, grading or construction of embankments. These activities will generate stockpiles of excavated materials within the project area. The stockpiles of excavated materials if not properly managed could be exposed to erosion especially during rains and will contribute to the siltation of nearby drainage systems or natural waterways.

369. Temporary siltation ponds with silt traps will be provided within the work areas so as not to contaminate the the water ways in the area. Also, care must be observed in the operation of heavy equipment for transporting and handling excavated materials from one area to another so as to avoid spills into drainage systems or nearby waterways.

370. As part of the detailed design stage, DOTr through its contractor will formulate designed measures to minimize if not prevent slope failure during construction. The measures will be based on the findings and recommendation of the geohazard assessment and geotechnical investigations.

371. The time scale for the erosion of exposed surfaces and materials stockpiles is deemed short-term as this process would likely take place only during the rainy season of the construction period.

372. The construction contractor will be required to submit and implement appropriate materials handling program or a site protection and rehabilitation program that will be monitored regularly by DOTr.

2) Change in Soil Quality

Degradation of Soil Fertility

373. The soil quality survey conducted at selected sampling sites shows that lead and cadmium does not conform to the international standards. Whenever possible, DOTr will collect soil samples prior to start of construction activities to validate the baseline levels preferably during the wet season.

374. Construction activities that will result in solid waste generation include the demolition of existing structures and clearing and securing of ROW. Recycling of wastes will be implemented, as much as possible, through sorting, stockpiling and containing recyclable wastes. If appropriate, leftover concrete and metals will be used for suitable alternative projects. If waste is inevitable, it will be sorted in the designated temporary storage area prior to disposal and temporary storage area will be designated. Non-recyclable wastes will be disposed of by a licensed contractor to a designated landfill.

375. During construction works, soils may become contaminated in the event leaks and accidental spills of fuels and lubricants from construction vehicles and machineries, as well as other hazardous chemicals like paints and solvents. These may result in relatively insignificant amount of contaminants in the soil. Hazardous Waste Management Plan will be strictly enforced and soil quality will be continuously monitored to maintain the quality and early detection contamination.

376. With proper spill prevention measures, this event would be less likely to cause negative adverse effects. To achieve this, the Contractors will be required to:

- Conduct proper inspection and maintenance of machines and equipment;
- Store bulk hazardous chemicals in impermeable areas and with appropriate secondary containment;
- Comply with environmental permitting requirements for the storage, transport, treatment and handling of hazardous substances and wastes in accordance with RA 6969;
- Implementation of manual for workers to prevent oil and chemical spills and also provide regular training to workers on environment management and working environment; and
- Implement an Emergency Response Plan and a Health and Safety Management Plan in case of spills.

377. The construction workforce, will likewise, generate solid wastes such as packaging materials from construction materials and general wastes from workers such as food scraps, putrescible wastes, toiletries and recyclable and non-recyclable packaging materials. If such wastes will not be handled properly, these would cause land and potential surface water contamination and negative impacts to aesthetics. Mitigation measures to address solid waste impacts include:
摧

- Submission and implementation of Solid Waste Management Plan as part of contractors' engagement in accordance to RA 9003.
- Placement of waste bins in strategic areas to avoid dispersal of litter and regular site maintenance duties.
- Regular collection, transportation, and disposal of wastes to minimize the attraction of vermin, insects and pests.

Excavated Soil Disposal

378. During construction phase, excess soil from earthwork activities such as excavation, backfilling, and embankment may be generated. If not managed properly, soil wastes may be discharged to water bodies through run-off and could cause increased sedimentation in nearby rivers. Based on the construction plan, a total of around 800 km^3 of soil will be for disposal as a

result of soil excavation and backfilling operations for the construction of stations, elevated structures, earthworks for construction workability, and drainage and box culvert at the Depot.

379. As a measure, as much as possible, excavated soil can be recycled and reused for utilization in the project or other project/s. For the handling of excavated soil, placement of excavated materials on appropriate disposal sites or spoils area and with adequate containment in accordance to RA 9003. In addition, implementation of construction plan and soil management plan will be strictly enforced.

Exposure to Contaminated Soil

380. The soil survey was conducted at the potentially contaminated area within and adjacent to the proposed MCRP. Results, however, shows that there were no traces of soil contamination.

381. During construction, there are potential construction activities such as site preparation, excavation work which will involve excavation of previously contaminated area. In case toxic substances are found within the project area and/or adjacent sites, site activities will be put on hold until Environmental Site Assessment is conducted and contaminated soil management plan is prepared to implement necessary remediation measures in consultation with the EMB-DENR. The site will be continuously monitored for toxic level to ensure that contaminant will not pose hazard.

382. Workers will be provided training on the handling of contaminated soil and provided with appropriate PPE. Implementation of an Emergency Preparedness and Response Plan and a Health and Safety Management Plan will be enforced in case of spills.

(2) Operation phase

1) Soil Erosion/Loss of Topsoil/Overburden

383. Since the railway will run on relatively flat terrain, soil erosion during operation of the proposed MCRP is not likely to occur.

2) Change in Soil Quality

Degradation of Soil Quality

384. The potential impact on soil quality degradation during operation phase of MCRP will be significant at the Depot particularly if handling of chemicals, fuel oil, lubricants, wastes and used oils is not properly implemented. Improper management of chemicals for the MCRP operation, solid wastes and wastewater may result to land contamination as well as aesthetic impacts. Management measures will include proper chemical storage and handling; segregation of wastes; provision of waste bins that will allow proper waste segregation; use of sealable waste bins to avoid attraction of vermin, insects and pests, regular collection and transportation of wastes for recycling or disposal at licensed facilities; and formulation and implementation of policies on solid waste minimization and solid waste management for patrons and staff.

385. Hazardous wastes to be generated, as part of general maintenance works, such as lead acid batteries, air filters, busted fluorescent, used oils, etc. will be disposed of in accordance with the provisions of R.A. 6969 "*The Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990* as well as R.A. 9003, *The Ecological Solid Waste Management Act*. Wastes of these kinds will be properly inventoried, labeled, and stored prior to proper disposal through DENR-Accredited Transporters and Treaters.

386. Soil contamination during operation phase could result from leaks of lubricants agents and used oil. Releases of such chemicals will be of more concern in the proposed depot stockyard, where train maintenance activities will take place:

- Provide proper inspection and maintain of machines and equipment;
- Implement manual for workers to prevent oil and chemical spills and provide regular training to workers on environment management and working environments;
- Implement an Emergency Response Plan and a Health and Safety Management Plan must be in place in case of spills; and
- Undertake continuous monitoring of toxic level to ensure that contaminant will not pose hazard. In case traces of contaminants are detected, consult with the DENR – EMB and develop a soil management plan.

Exposure of Contaminated Soil

387. Should contaminated soil be present, continuous monitoring of toxic level will be conducted at the pre-contaminated site and/ or in area vicinity to the contaminated site to ensure that contaminant will not pose hazard. In case traces of contaminants are detected, consult with the EMB-DENR and develop a soil management plan.

3.1.4 Terrestrial Ecology

388. The Philippines is one of the mega diversity countries due to its diverse habitats and high rates of endemism. However, on the other hand, it is also one of the world's hotspots, with a large number of endangered and threatened species.

389. The proposed alignment of MCRP, will traverse the agricultural area of Pampanga and Bulacan and Manila Bay. At Manila Bay, one can find the Philippine Duck (Anas luzonica) and Black-faced Spoonbill (Platalea Minor) which are endemic to the Philippines and classified as Vulnerable in the IUCN Red List of Threatened Species.

390. Millions of shorebirds rest and feed in wetlands of Manila Bay area when flying south from their breeding grounds in the arctic tundra during September to April, and returning North during the short northern hemisphere summer of May to August.

391. The project will conduct the terrestrial and fresh water ecology survey at wetland, agricultural land, mountainous area and those areas close to the designated areas.

3.1.4.1 Terrestrial Flora

392. Some of the most marked temporal fluctuations in species abundances are linked to seasons. In theory, multispecies assemblages can persist if species use shared resources at different times, thereby minimizing interspecific competition. Philippines has only two (2) seasons: the wet and dry season. The dry season starts in late November and ends in May while wet or rainy season starts in June and lasts till October.

393. For terrestrial flora, there is no actual or significant difference or bearing in terms of data gathering during dry or wet season. This is because species composition from plant diversity assessment does not solely rely on physical factors specifically climate or weather data, or does not arrest the fact that there is more diverse species during wet season only. For this study, the terrestrial flora survey was conducted during the dry season.

(1) Field Survey

394. The terrestrial flora survey was conducted on February 4-7, 2018 at five (5) established sampling stations (**Table 3.1.14**). The survey was conducted using transect and quadrant methods, interviews with the local residents and records of flora and fauna collection from scientific literature.

395. During terrestrial flora survey, modified belt transect method was utilized wherein nine (9) quadrats (20m x 20m) were laid out along a 2 km transect at every 250 m interval. Quadrat shape and size were adjusted as necessary to fit smaller or oddly shaped habitats (e.g. creek line, flow lines, etc.). Nested quadrat sampling technique was used to assess and characterize the structure and species composition of the different plant communities. For large woody plants inside the 20 m x 20 m quadrat with a diameter at breast height (dBh) of ≥10 cm, the merchantable height (MH), and total height (TH) were measured. The frequency of shrubs, poles and saplings inside the 5 m x 5 m quadrat was counted to account the intermediate species, while the percentage cover of understory species (grasses and other plants below 1 m in height) inside the 1 m x 1 m quadrat was determined.

396. Information gathered in the field were tabulated and analyzed to characterize floral composition within the study area. The relative density, relative dominance and relative frequency values for each tree species were determined to obtain their Importance Value (IV), which is the standard measurement in forest ecology to determine the rank relationships of species. Also, the relative frequency, relative density and relative dominance indicate different aspects of the species importance in a community. Importance values were determined using the following formula:

$$\text{Density} = \frac{\text{number of individuals}}{\text{area sampled}}$$

$$\text{Relative Density} = \frac{\text{density for a species}}{\text{total density for all species}} \times 100$$

$$\text{Frequency} = \frac{\text{number of plots in which species occur}}{\text{total number of plots sampled}}$$

$$\text{Relative Frequency} = \frac{\text{frequency value for a species}}{\text{total frequency for all species}} \times 100$$

$$\text{Dominance} = \frac{\text{basal area or volume for a species}}{\text{area sampled}}$$

$$\text{Relative Dominance} = \frac{\text{dominance for a species}}{\text{total dominance for all species}} \times 100$$

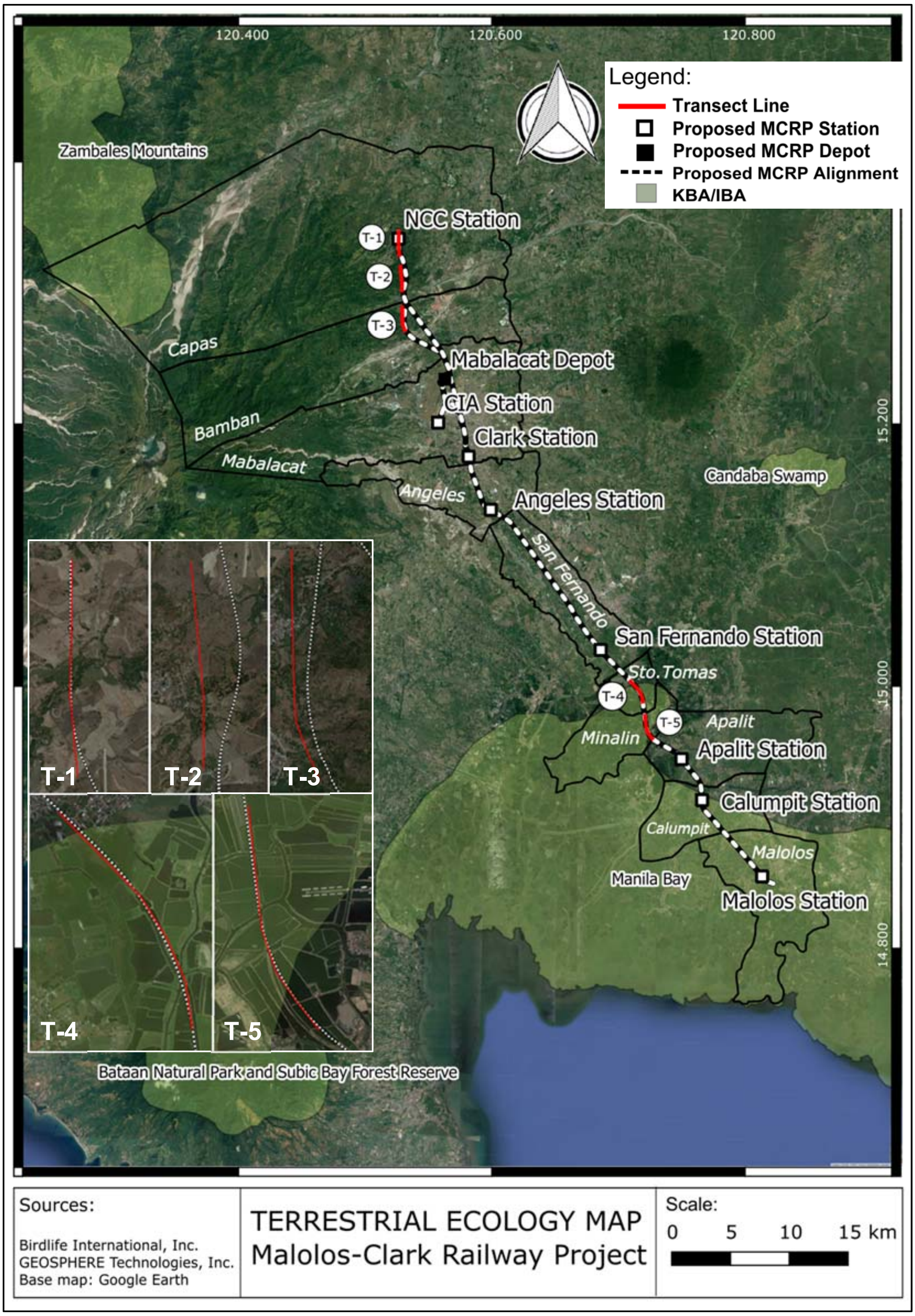
$$\text{Importance Value} = \text{Relative Density} + \text{Relative Frequency} + \text{Relative Dominance}$$

397. Diversity indices (Shannon, Simpson's and Evenness) for each sampling quadrats were generated using Paleontological Statistical software package for education and data analysis (PAST version 3.12). Moreover, endemism and ecological status of the different species were assessed to determine the ecological importance of the vegetation in the area. Plant classification followed the latest Angiosperm Phylogeny Group classification (APG IV, 2016) while the common names adapted that of Rojo (1998).

Table 3.1.14 Terrestrial Flora Sampling Station

Sampling Station	Coordinates	Profile/Dominant Species	Vegetation Type	Human Activity
Transect 1 – Barangay Aranguren, Capas, Tarlac	N 15°31'34.87" E120°20'19.77"	Shrub species: *Tithonia diversifolia* (Hemsl.) A. Gray, *Urena lobata*, *Chromolaena odorata* and *Stachytarpeta jamaicensis*, etc. Tree species: *Leucaena leucocephala*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg., *Ficus ulmifolia, Ficus odorata, Ficus nota*, *Ficus septica* Burm. f. *Melanolepis multiglandulosa*, *Mallotus philippinesis, Streblus asper, Gmelina arborea,* etc.	Rice farms; shrub and grasslands; Open wooded lands; Sparse vegetation	Planting, cultivation, Human settlement, pasture for carabao, Construction of road for the Green city project

Sampling Station	Coordinates	Profile/Dominant Species	Vegetation Type	Human Activity
		Herbaceous layer: *Mimosa pudica* L., *Mikania cordata* (Burm. f.) B.L. Rob., *Tridax procumbens, Alternanthera sessilis, Sorghum halopense, etc.*		
Transect 2 - Barangay Cutcut, Capas, Tarlac	N 10°18'39.92" E120°31'43.38"	Herbaceous layer: *Ipomoea triloba, Tridax procumbens, Mikania cordata* (Burm. f.) B.L. Rob., etc. Shrub species: *Lantana camara* L., *Chromolaena odorata*, *Bridelia stipularis, Sida acuta* and *Sida rhomboidifolia,* etc. Tree species: *Artocarpus altilis, Leucaena leucocephala*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg., *Ficus ulmifolia, Ficus nota*, *Ficus septica* Burm. f. *Melanolepis multiglandulosa*, *Chionanthus ramiflorus, Gmelina arborea, Canarium luzonicum,* etc.	Sugar cane plantation, open shrub and woodlands, grasslands with few scattered trees	Human settlement
Transect 3 – Bamban, Tarlac	N 15°16'46.32" E124°31'45.32"	Shrub species: *Lantana camara* L., *Chromolaena odorata*, *Solanum ferox, Ficus spp*., *Hedyotis sp., Borreira ocymoides*, etc. Tree species: *Artocarpus ovatus, Ficus psuedopalma*, *Leucaena leucocephala, Garuga floribunda, Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg., *Ficus septica* Burm. f., *M. multiglandulosa, Munitigia calabura, Artocarpus blancoi,* etc. Herbaceous layer: *Mimosa pudica* L., *Stachytarpeta jamaicensis, Mikania cordata* (Burm. f.) B.L. Rob., *Caesalpinia latisiliquum, Tridax procumbens,* etc.	Secondary growth of open wooded land with some portion of open shrub and grasslands; bamboo vegetation and Banana.	Human settlement, Kaingin, privately owned ranch(cow)
Transect 4 – Barangay San Matias, Sto. Tomas	N 15°59'51.47" E120°42'55.28"	Tree species: *Leucaena leucocephala, Samanea saman*, *Pithecelobium dulce*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg., *Ficus septica* Burm. f., *Gmelina arborea*, etc. Herbaceous layer: *Zehneria indica* (Lour.) Keraudren *Centrosema pubescens*, *Ipomoea triloba*, *Mikania cordata* (Burm. f.) B.L. Rob., *Passiflora foetida, Tridax procumbens,* etc. Grass species: *Thysanolaena latifolia*, *Sorghum halepense, Saccharum spontaenum*, etc.	Fishponds and wetlands that includes diverse floral species of ground, shrub and herbaceous layer. Sparse tree vegetation includes those located at trails and open spaces.	Human settlement
Transect 5 – Barangay Lourdes, Minalin	N 14°58'04.21" E120°43'19.31"	Shrub species: *Solanum torvum*, *Sida acuta*, *Chromolaena odorata*, etc. Tree species: *Gmelina arborea*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Morinda citrifolia* L., *Ficus septica* Burm. f. *Melanolepis multiglandulosa,* etc. Herbaceous layer: *Coccinea grandis* (L.) Voigt, *Centrosema pubescens*, *Passiflora foetida, Mikania cordata* (Burm. f.) B.L. Rob., *Caesalpinia latisiliquum, Tridax procumbens,* etc. Grass species: *Imperata cylindrica, Thysanolaena latifolia*, *Sorghum halepense, Saccharum spontaenum*, etc.	Same as T5, the area is heavily dominated by both active and abandoned fishponds as well as wetlands that includes diverse floral species of ground, shrub and herbaceous layer. Sparse tree vegetation includes those located at trails and open spaces.	Human settlement



Source: GEOSPHERE, 2018

Figure 3.1.44 Terrestrial Ecology Sampling Stations

(2) Results and Analysis

398. Varying plant communities were observed at different transects, which are dominated mostly with grassland to open wooded land ecosystem. There are also man-made ecosystem (e.g. agroforestry farms, rice farms, etc.) perpendicular to the alignment. Majority of these notable

vegetation along these areas are generally remnants and existing agroforestry farms, rice farms, fruit tree and sugar cane farms.

399. Most of the plant and tree species are pioneer species, which are the first to colonize previously disrupted or damaged ecosystems, beginning a chain of ecological succession that ultimately leads to a more diverse steady-state ecosystem. Dominant families include Cannabaceae, Fabaceae, Verbenaceae, Anacardiaceae, Lamiaceae, Asteraceae and Moraceae. Additionally, a number of both endemic and threatened tree species were encountered in the transect plots.

400. Recorded plant species are predominantly grasses, shrubs and followed by trees. Many of these plant species covers a large number of families. The vegetation types of high conservation significance within the proposed MCRP include those areas with the presence of noteworthy, endemic, threatened, or endangered plant and tree species.

1) Associated Vegetation/Significant Landscapes

401. Associate vegetation or landscapes are important in assessing terrestrial ecology assessment since these areas can serve as either viable alternative shelter or entrance site for new plant or animal species recruits from the main ecosystems or an area affected by any development or disturbance. Aside from the remaining dense vegetation, some tall trees and shaded portions of the site, there are still be some areas that can serve as viable habitat for birds and other wildlife species in the area. Among the plant communities documented, grasslands are the most dominant vegetation in the locations of the proposed MCRP.

Grasslands

402. These are natural, climax vegetation community comprising seasonally inundated grassland on flat, hard substrate such as boulder or rocky sediments. Impeded drainage and thin or absent soils result in an absence of woody plants and seasonally inundated grassland with a unique assemblage of species. Such habitats host specialized assemblages of herbs including some that are likely threatened species. Almost 40% of all transect plots are grasslands with similar dominating species of grasses and shrubs, including trees.

Open shrub and wooded lands.

403. Another notable vegetation community is the open woodland comprising an open stand of trees with crown canopies 8-10 m in height and at least 40% of the surface covered by native trees. Open woodlands are notable in the transect plots established in Transect 1, Transect 2 and Transect 3 in Barangays Aranguren, Cutcut and San Roque, respectively. Open woodland differs from forest such that canopy interlocking does not occur in woodland. Open woodland trees have thick, fire resistant bark and if burnt to the ground in severe fires, the trees have the ability to regrow from rootstocks. Example of these tree species are Binayuyu (*Antidesma ghaesambalia,* Alibangbang (*Bauhinia malabarica)* and Anabiong (*Trema orientalis*). These features are usually absent in forest tree species.

Man-made Wetlands (Including fishponds)

404. These are areas that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem along with privately owned fishponds. These areas are located in Transect 4 and Transect 5, which covers Barangay San Matias in Sto. Tomas and Barangay Lourdes Minalin. Diverse species of migratory birds are observed in the area feeding on fishes and other organisms during the survey. Floral species are generally low as these areas are well maintained and vegetation such as grasses and shrubs are not allowed to grow well except for some portions that are idle, wetlands and some government owned properties.

405. Moreover, regeneration of vegetation in these abandoned farms and areas is assessed to be very difficult or far from possible. The vegetation patches that could support the regeneration are

quite less or none at all to colonize these abandoned areas. From another point, the sizes of the abandoned areas are too large to be colonized by the adjacent patch of vegetation or sparse vegetation patches or even by the remnant vegetation of the slash and burn works. Furthermore, due to extensive cultivation, the soil conditions are already unsuitable for plant survival. In effect, only the pioneer species such as grasses that could withstand these conditions tend to colonize these abandoned farms and form the new set of regenerations. Large tracts of land in the project site have been opened and converted to agricultural farms through slash and burn. The slash and burn practice involves burning in the farm land preparation. Burning the vegetation will not only facilitate land clearing but will also fertilize the land by releasing the nutrients held in the biomass of the standing plants. More than 40% of the project site are classified as grassland and crop land areas. These areas, in most cases, are completely devoid of its original vegetation which are used for cultivating agricultural crops such as corn, rice, banana and sugar cane.

406. Small creek lines are also observed near the alignment that joins other minor creek lines runs nearby. The area between the proposed railway route and the creek lines in Transect 1 and Transect 2 is characterized with a plain relief going to a rolling slope, covered with frequent grass and is fragmentally bogged up, which is an indication that ground waters are rather high (~1.m). On the other hand, Transect 4 and Transect 5 are characterized by a shallow depth of ground water that quite wide wetlands are formed. The hydrogeological conditions of these site clearly indicate that the above-mentioned consideration about the possible pollution of the ground water is very likely to happen.

2) General Vegetation

407. Almost two thirds of the areas along the railway alignment are occupied by agricultural landscapes and settled areas. Therefore, natural vegetation is represented along the railway route as fragments of separate habitats of various sizes. Three (3) types of vegetation were defined for the proposed MCRP, representing few structural and floristic composition of general plant form such as trees, shrubs, grasses and herbaceous species. These are mainly comprised of the following:

- Grasslands of *Imperata, Thysanolaena Themeda, ThyPenissetum* and *Echinocloa* species with a variable shrub and tree understory on plains and hill slopes (dominating the majority of the project area from Transect 1 to Transect 3);
- Small to medium sized individuals of sparse trees of Is-Is (Ficus ulmifolia), Anabiong (Trema orientalis), Datiles (Muntigia calabura), Binunga (Macaranga tanarius), Gmelina (Gmelina arborea) and Acacia (Samanea saman) usually with an overstorey of Bambusa spp., and Hagonoy (Chromolaena odorata) in creek lines;
- Variable vegetation on remnants of Fruit tree vegetation, fishponds and wet areas (ranging from small open wooded lands of tree species with genus *Mangifera*, *Acacia, Leucaena, Bauhinia* and *Macaranga* trees).

408. The vegetation types of high conservation significance within the proposed MCRP include those areas with the presence of noteworthy, endemic, threatened, or endangered plant and tree species. The vegetation in the identified transect plots considered to be of the highest conservation significance within the rail alignment is Transect 3. Transect 3 has the characteristics of young secondary growth such that the vegetation in the area contains more native trees and endemic species such as *Streblus asper, Artocarpus ovatus, Mallotus philippinensis, Ficus psuedopalma, Ficus nota*, *Ficus ulmifolia* and *Litsea glutinosa,* among others. These species are native to the country and some exhibits high conservation status. The vegetation communities in other transect plots are generally remnants of previous land uses with the presence of residential houses including operational farms. Some of which are affected by slash and burn or intentional fires to clear lands for farming as observed within the transect plots. Based from the assessment survey, 40% of the vegetation communities are native composed of native plant and tree species which is represented by treelets, shrubs and diverse herbaceous layer. However, invasive plant species such as those opportunistic and light tolerant species smother most of the sections in the proposed

alignment. Open shrub to wooded lands are characterized by areas that are located in Transect 1 to Transect 3 which are cleared for rice farms. This section discusses the species composition and profile of the transect plots located in areas that are totally devoid of trees or has canopy cover of less than <5%. The surveyed plots are both previously used for slash and burn farming. All plots are abandoned at the time of the study in terms of farm lots, while the others are still operating. Thirteen (13) are introduced species while five are Philippine endemic. Furthermore, all endemic species are recorded from the regenerating plot (Transect 3), while most of the introduced species are listed from the newly abandoned kaingin area.

Note: (A, B) Transect 1 at Brgy. Aranguren, Capas, Tarlac showing remnants of idle rice farms; A small creek perpendicular to the proposed alignment with diverse plant species that includes pioneer S. cuneiformis, Streblus asper, Mallotus philippinensis and Ficus spp.; (C, D) Transect 2 at Brgy. Cutcut, showing sparse tree and grass vegetation transition to a shrub land Dominant tree species include genus of Bauhinia, Gmelina, Samanea, Chionanthus and Antidesma. (E, F) Transect 3 at Brgy. San Roque showing open wooded land with few individual trees and thick vegetation of grasses and banana. Slopes are characterized by rolling to undulating terrain with dominant grass species of Pennisetum sp. Tall grasses smother trails and hill slopes with dominant species Talahib (Saccharum spontaeneum).

Photo 3.1.1 Photographs of Transect 1, Transect 2, and Transect 3

Note: (G, H) Transect 4 at Brgy. San Matias, Sto. Tomas showing wetlands and abandoned fishponds dominated by Water hyacinth (*E. crassipes*) and few scattered tree species of *L. leucocephala*, *T. orientalis* and *S. saman.* Further inland, dense vegetation of Talahib (*S. spontaenum*) and some herbaceous vine species was observed. (I, J) Transect 5 at Brgy. Lourdes, Minalin showing irrigated and maintained operational fishponds with small creek line buffer dominated with grass species with diverse genera of *Echinocloa, Themeda, Saccharum* and *Phragmites*. Herbaceous species such as *Alternanthera sessilis*, *Passiflora foetida*, *Zehneria indica* and *Ipomoea* species. Tree species include *L. leucocephala, M. calabura* and *P. odorata*. A small creek perpendicular to the proposed alignment with diverse plant species that includes pioneer *S. cuneiformis*, *Streblus asper*, *Mallotus philippinensis* and *Ficus spp*.;

Photo 3.1.2 Photographs of Transect 4 and Transect 5

3) Transect Profiles

409. The transects were identified and selected based on the presence of vegetation units across the proposed alignment, including the presence of major landscape features such as small ecological units (e.g. creek, rivers, etc.). Additionally, presence of high value species such as those endemic, threatened plant and tree species located either on a patch of forest or aggregate within the proposed alignment also served as basis for selecting sampling sites. The selected transect or sampling sites are the areas with remaining forest or vegetation formation based on present satellite imagery and ground reconnaissance survey. The vegetation was described per transect with nine (9) quadrats each at an interval of 250 m, with the flora at each of these quadrats recorded in detail. The flora records provided the names for use in the vegetation descriptions, and contributed to the flora species lists and frequency of occurrence data. Several parameters relating to the individual quadrats were used to assist in both the description of vegetation types and the determination of flora distribution (particularly in terms of defining associated habitats). The following transect are described in detail in terms of vegetation profile, location and other aspects of biological information.

<u>Transect 1 (Brgy. Aranguren, Capas, Tarlac)</u>

410. Transect 1 is located at Brgy. Aranguren, Capas, Tarlac (**Figure 3.1.44**). The transect plot is approximately 2-km from the main road and is characterized by a bare and open land. The 2-km transect shows each point (from start-midpoint-end) where there are notable vegetation either in patches or being sparse. Note that visual resources include (1) Few Residential areas; (2) Barangay Road; (3) Trails; (4) Rice paddies; (5) Small creek. The mid-point includes a small creek with

patch of small vegetation of native and exotic plant and tree species with thick vegetation of Bamboo and grasses. A dense stand of Tithonia diversifolia (ASTERACEAE) at the end of the transect plot can be observed.

411. The vegetation in Transect 1 is less in terms of trees but more on ground cover layer. This vegetation occurred on low clayey soils abandoned rice farms and small tree orchard of Mangga (Mangifera indica) and Sampaloc (Tamarindus indicus) in low-lying, areas within the alignment. It was characterized by occasional areas of sparse tree vegetation and small existing grassland with the presence of very scattered shrubs and trees. Shrubs are represented by Hagonoi (Chromolaena odorata), Cleome rutidosperma, Blumea lacera, Urena lobata and Stachytarpeta jamaicensis. The most dominant shrub in the area is Tithonia diversifolia forming a dense stand which is observed to grow more than 1m in height in very dry soils. The territory is dry, and from hydrogeological standpoint, the place is acceptable for the construction of the railway route and its exploitation.

412. Trees are represented by few individuals of forest tree species such as Pakiling (Ficus odorata), Hauili (Ficus septica), Tibig (Ficus nota), Rain tree (Samanea saman) and Is-Is (Ficus ulmifolia). On the other hand, tree species such as Gmelina (Gmelina arborea) and Rimas (Artocarpus altilis) are also present. The small creek line (Mid-plot section: Transect 1_Mid) shelters more plant species covered by dense bamboo stands with bamboo species of Kawayan tinik (Bambusa blumeana). Several tree species of native classes documented here are Banato (Mallotus philippinensis), Alim (Melanolepis multiglandulosa), Kalios (Streblus asper), Halobagat (Capparis micrantha) and several individuals of Rattan (Calamus sp.).

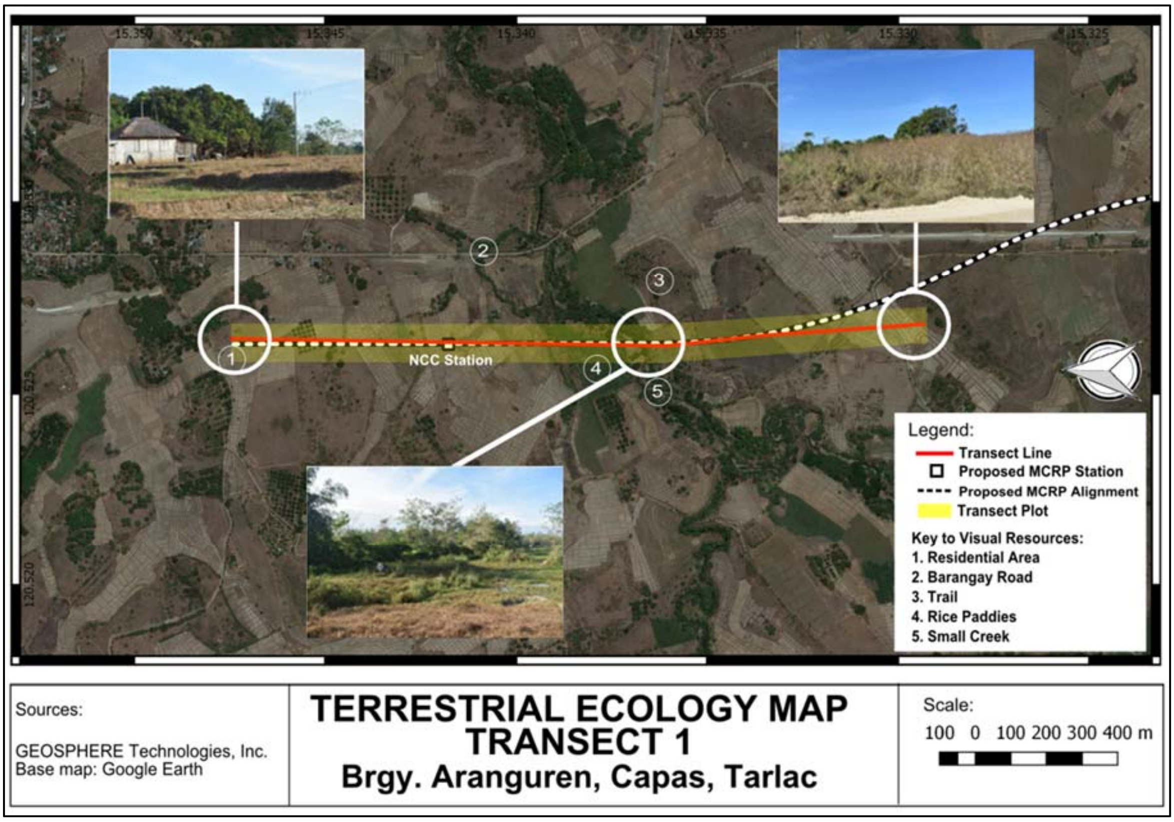


Figure 3.1.45 Map showing Transect 1 established at Brgy. Aranguren, Capas, Tarlac

Transect 2 (Brgy. Cutcut, Capas, Tarlac)

413. Transect 2 is located at Brgy. Cutcut, Capas, Tarlac. The transect plot is approximately 1-km from Transect 2 and characterized again by bare and open shrub land (**Figure 3.1.45**). The 2-

km transect shows each point (from start-midpoint-end) where there are notable vegetation either in patches or being sparse. Note that visual resources include shrub lands and sparse trees near residential houses. The starting point of the transect plot shows an open and bare area adjacent to a sugar cane farm and a small unit of grasslands with dense stand of T. diversifolia. The mid-point includes some sparse tree individuals of native plant and tree species with thick vegetation of grasses with some sections that are burned because of unconfirmed intentional fires and natural cause. A dense stand of Tithonia diversifolia (ASTERACEAE) at the end of the transect plot can be observed. Residential houses of Aeta tribe living near the proposed alignment were also observed.

414. The vegetation in Transect 2 is very minimal than the previous transect plot in terms of trees but more on ground and shrub layer. On the mid-point section, sparse tree individuals of Rain tree (Samanea saman) can be observed along with Alibangbang (Bauhinia malabarica), one tree individual of Chionanthus ramiflorus and scattered treelets of endemic Is-Is (Ficus ulmifolia). Other sparse tree species include Binayuyu (Antidesma ghaesemballa). This vegetation occurred on low clayey soils abandoned rice farms and small tree orchard of Mangga (Mangifera indica) and Sampaloc (Tamarindus indicus) in low-lying, areas within the alignment. It was characterized by occasional areas of sparse tree vegetation and small existing grassland with the presence of very scattered shrubs and trees. A species of Asteraceae Tithonia diversifolia forming a dense stand also dominate some open areas of the transect plot. Other shrubs species are represented by Hagonoi (Chromolaena odorata), Cleome rutidosperma, Blumea lacera, Urena lobata and Stachytarpeta jamaicensis. Grasses are represented by Pennisetum sp., Sacharrum spontaenum and Imperata cylindrica.

415. Trees are represented by few individuals of forest tree species such as Hauili (Ficus septica), Tibig (Ficus nota), Rain tree (Samanea saman) and Is-Is (Ficus ulmifolia). On the other hand, tree species such as Gmelina (Gmelina arborea) and Rimas (Artocarpus altilis) are also present. The small creek line shelters more plant species covered by thick bamboo vegetation with bamboo species of Kawayan tinik (Bambusa blumeana). Several tree species of native classes present here are Kalios (Streblus asper) and several individuals of Datiles (Muntigia calabura). An old structure was also observed in the area covered with burned grasses caused by undetermined cause of either intentional fire or natural incidence due to extreme heat in the area. On the other hand, not far from the transect plot are Aeta tribes living within the proposed alignment (**Photo 3.1.3**).

Note: (a) An old structure located at burned grasslands of Brgy. Cutcut; (b) Residential houses of indigenous tribe Aeta, living near the proposed alignment.

Photo 3.1.3 Some Notable Landmarks and Ground References during the Survey

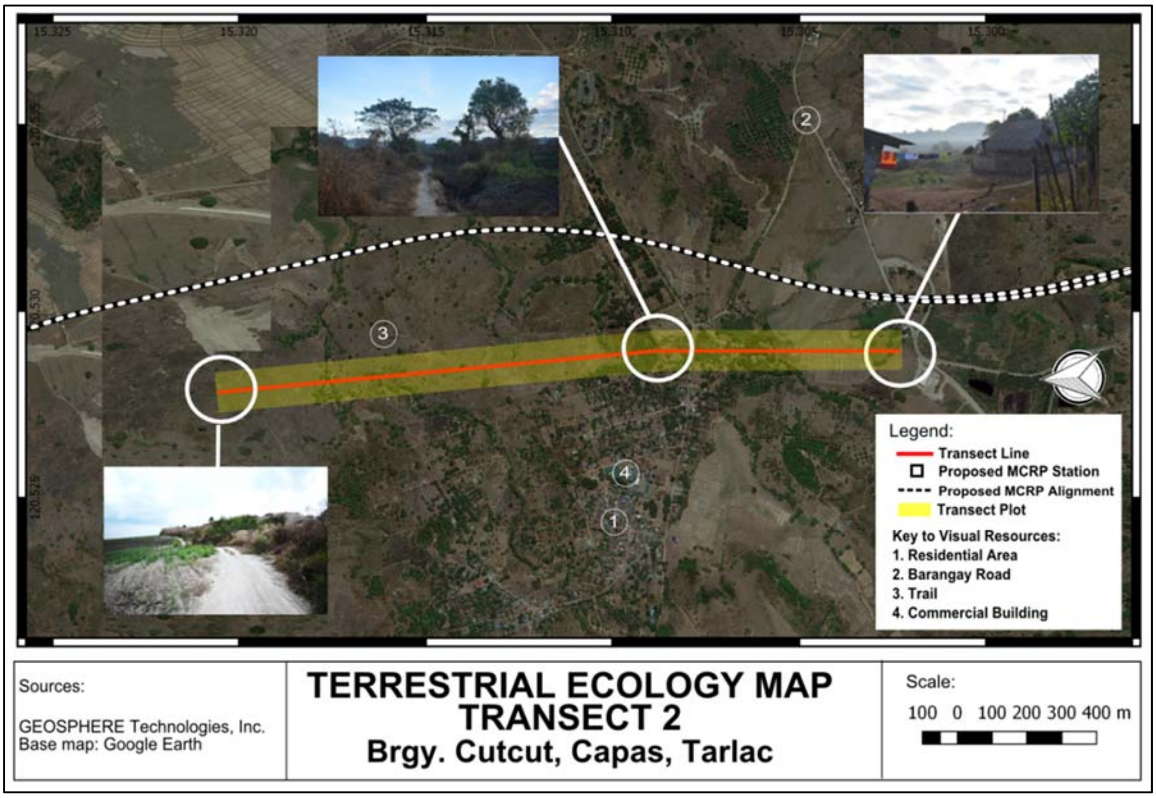


Figure 3.1.46 Map showing Transect 2 Established at Brgy. Cutcut, Capas, Tarlac

Transect 3 (Brgy. San Roque, Bamban, Tarlac)

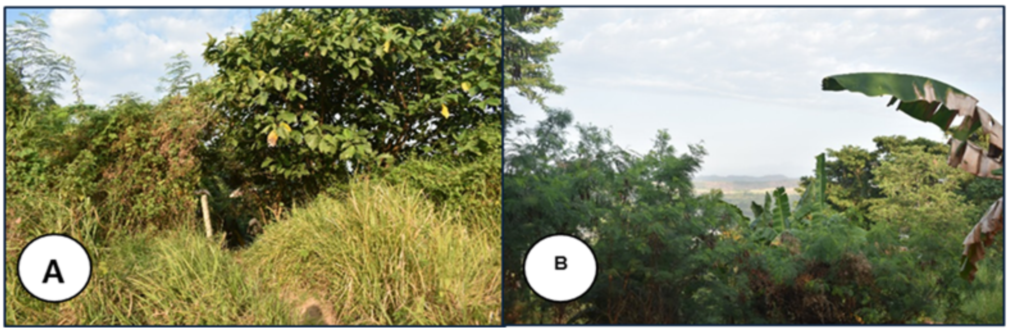
416. Transect 3 is located at Brgy. San Roque Bamban, Tarlac. It is characterized by a second growth vegetation which is actually a remnant of a secondary forest with sections of bare and open shrub to grassland transitions (**Figure 3.1.46**). The 2-km transect shows each point (from start-midpoint-end) where there are notable vegetation either in patches or being sparse. Note that visual resources include shrub lands and sparse trees near residential houses. The starting point of the transect plot shows an open and bare area adjacent to native vegetation and a small unit of grasslands with endemic Anubing (Artocarpus ovatus) and Is-Is (Ficus ulmifolia) trees. The mid-point includes is mixed open second growth forest with pioneer tree species, banana stand and a small agroforestry farm. Some sections of the area are generally a remnant a secondary forest and a small reforestation site.

417. The vegetation here is moderately thicker than the previous two transect plots in terms of trees, ground cover, grasses and shrub layer (**Photo 3.1.4**). On the mid-point section, sparse tree individuals of Rain tree (Samanea saman) and Gmelina (Gmelina arborea) can be observed along with native tree species of Rimas (Artocarpus altilis), Is-Is (Ficus ulmifolia) and Niog-Niogan (Ficus psuedopalma), Alagau (Premna odorata), Kalios (Streblus asper) and Anabiong (Trema orientalis). In terms of understorey and intermediate species layer, several individuals of Ligas (Semecarpus cuneiformis), Binunga (Macaranga tanarius), Sablot (Litsea glutinosa) and Anubing (Artocarpus ovatus) were observed.

418. Ground cover species typically include thick vegetation of grass species such as Talahib (Sacharrum spontaenum), Cogon (Imperata cylindrica) and Penissetum sp. Other species such as a poisonous legume Abrus precatorius were observed along with Dilang butiki (Centrocema pubescens), Kalalaknit (Merremia vitifolia), Dagad (Tridax procumbens) and Bunga-Bunga (Alternanthera sessilis). Big diameter trees were represented by Rimas (A. altilis), Anubing (A. ovatus) and Gmelina (G. arborea). There are sections in the transect plot that is characterized

topographically by rolling to steep slopes which is hard to access for survey. A listing of vegetation species in this section were also done and incorporated in the computation of parameters for the diversity indices. Some of the tree species were flowering and fruiting at the time of survey which facilitate identification and recording of species.

419. Other sections of the transect plot exhibits rolling to undulating topography dominated by bamboo species Kawayan tinik (Bambusa blumea). Saplings and poles of Ligas (Semecarpus cuneiformis), Ipil-Ipil (Leucaena leucocephala) and Mahogany (Sweitenia macrophylla) can also be observed in shaded and moderately sloping terrain. There are some residential areas observed in the proposed alignment in which they are claiming as private lands. Dense vegetation of grasses dominates these areas with sparse tree individuals of Gmelina, Narra and Mahogany tree species.



Note: (a) Dense stand of Talahib (*S. spontaenum*) and Elephant grass (*Pennisetum purpureum)* and some tree individuals of Tibig (*Ficus nota*); (b) Dense stands of Ipil-Ipil (*Leucaena leucocephala*).

Photo 3.1.4 Thick Vegetation of Grasses and Pioneer Species in Transect 3

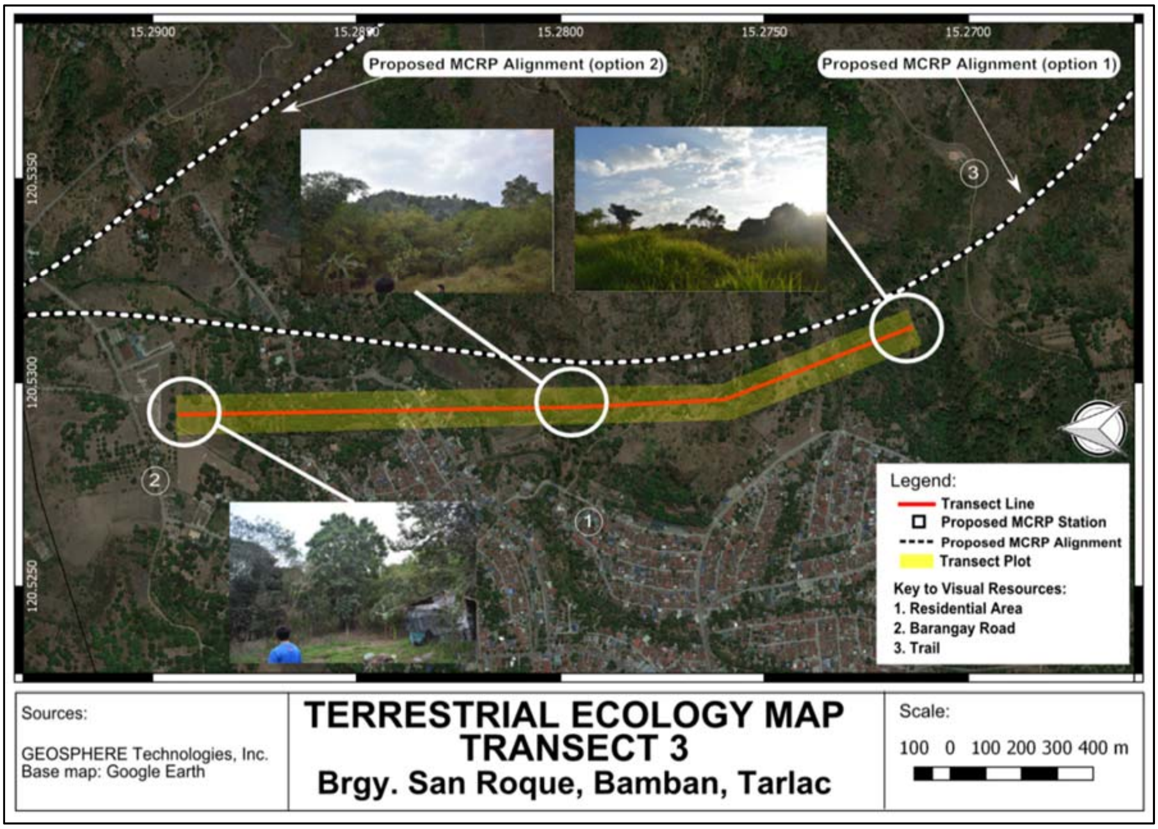


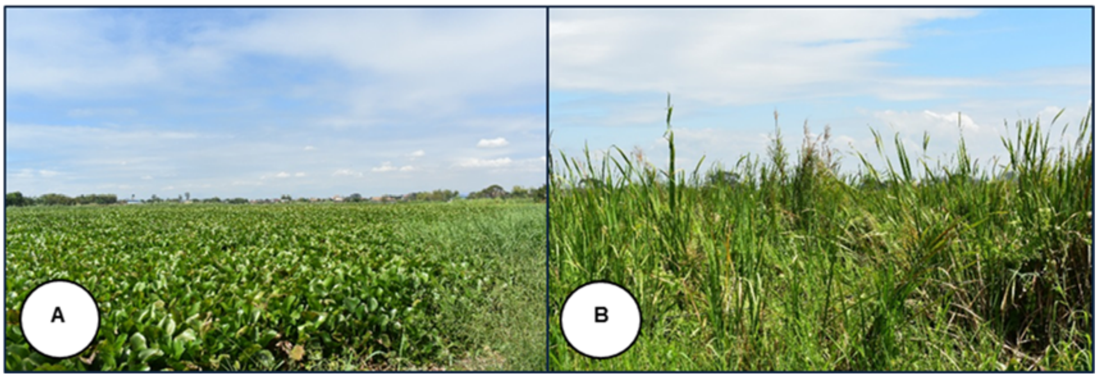
Figure 3.1.47 Map showing Transect 3 Established at Brgy. San Roque, Bamban, Tarlac

Transect 4 (Brgy. San Matias, Sto. Tomas, Pampanga)

420. Transect 4 is located at Brgy. San Matias, Sto.Tomas, Pampanga. Transect 4 is characterized by fishponds actively operating in almost the whole transect plot (**Figure 3.1.48**). The 2-km transect shows each point (from start-midpoint-end) where there are notable vegetation either in patches or being sparse. Fish ponds are among the primary land use of the area with very few remaining natural vegetation that includes grasses, shrubs and some individual trees of pioneer species. Among the general plant forms, grasses and herbaceous species such as Talahib (Sacharrum spontaenum), Johnson grass (Sorghum halepense) and Karunggut (Passiflora foetida) are the ground cover species. Some sparse trees of Ipil-Ipil (Leucaena leucocephala) and Kamachile (Pithecelobium dulce) and Rain tree (Samanea saman).

421. The vegetation in Transect 4 is dominated by ground and shrub layer species with combination of aquatic plants such as Water hyacinth (E. crassipes) and I. aquatic (**Photo 3.1.5**). On the mid-point section, sparse tree individuals of Ipil-Ipil (Leucaena leucocephala), Datiles (Muntigia calabura), Rain tree (Samanea saman) and Kamachile (Pithecelobium dulce) can be observed along the sides of a small creek within the proposed alignment. In terms of understorey and intermediate species layer, the same species were observed. Further inland some remnants of planted bananas (Musa sp.) which were abandoned because the existing condition of the area, according to the officials present during the survey.

422. Ground cover species includes thick vegetation of grass species such as Talahib (Sacharrum spontaenum), Cogon (Imperata cylindrica) and Penissetum sp. Since the whole transect plot is almost devoid of tree vegetation, the presence of sparse trees makes the inventory of flora for this plot including ground cover species. Moreover, the presence of migratory bird species in the area makes a little shelter to the patches of grasses and sparse trees in the area which justify the establishment of a transect plot here. There is no significant vegetation neither endangered species of plants and trees. As the area is dominated by fishponds, there are still idle lands that are dominated by aquatic plants. These areas are not used for any other land use including fishpond which are predominantly inundated by low water levels. Water hyacinth dominates the inundated sections with some herbaceous vine species of Karunggut (Passiflora foetida).



Note: (a) Water hyacinth (*Eichhornia crassipes* Mart.), LILIACEAE; (b) Sections from the transect plot dominated by Elephant grass (*Pennisetum purpureum)*, Talahib (Saccharum *spontaenum*) and (*Echinocloa crus-gali*) all from the family POACEAE.

Photo 3.1.5 Vegetation at Transect 4

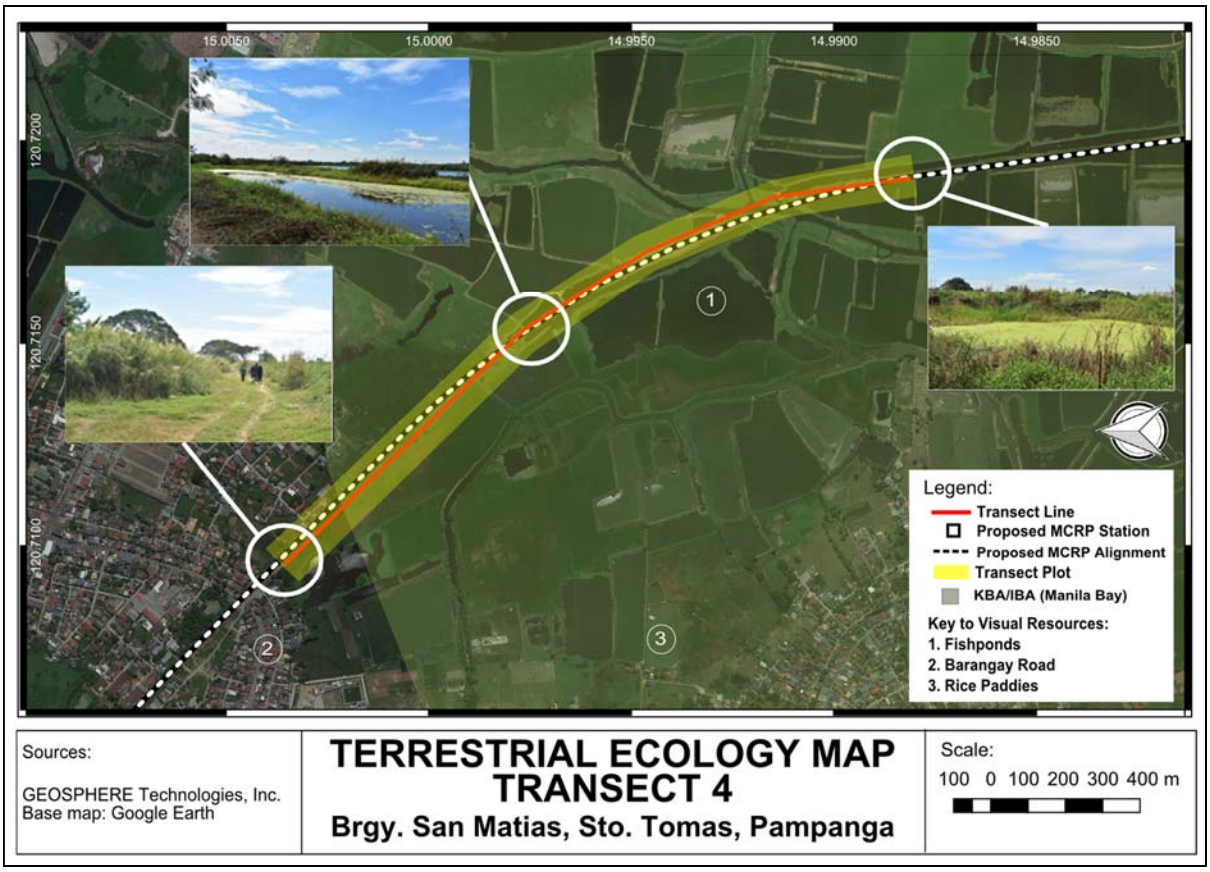


Figure 3.1.48 Map showing Transect 4 Established at Brgy. San Matias, Sto. Tomas Pampanga

Transect 5 (Brgy. Lourdes, Minalin, Pampanga)

423. Transect 5 is located at Brgy. Brgy. Lourdes, Minalin, Pampanga. The transect plot is characterized by abandoned fishponds and vast areas of wetlands or inundated area smothered by different plant species (**Figure 3.1.49**). The 2-km transect shows each point (from start-midpoint-end) where there are notable vegetation either in patches or being sparse. Fish ponds are among the primary land use of the area with very few remaining natural vegetation that includes grasses, shrubs and some individual trees of pioneer species. Among the general plant forms, grasses and herbaceous species such as Johnson grass (Sorghum halepense) and Karunggut (Passiflora foetida) are the ground cover species.

424. The vegetation in Transect 5 is less than Transect 4. On the mid-point section, sparse tree individuals of Rain tree (Samanea saman) and Ipil-Ipil (Leucaena leucocephala) can be observed further inland. Rain tree (Samanea saman) and Kamachile (Pithecelobium dulce) can be observed along the sides of a small creek within the proposed alignment. In terms of understorey and intermediate species layer, the same species were documented from Transect 4.

425. Ground cover species includes thick vegetation of grass species such as Tambo (Thysanolaena latifolia), Talahib (Sacharrum spontaenum), Cogon (Imperata cylindrica) and Penissetum sp. Other species such as a poisonous legume Abrus precatorius were observed along with Dilang butiki (Centrocema pubescens), Kalalaknit (Merremia vitifolia), Dagad (Tridax procumbens) and Bunga-Bunga (Alternanthera sessilis). Big diameter trees were represented by Kamachile (Pithecelobium dulce) and Duhat (Syzigum cuminii). Further inland, some young saplings of Ipil-Ipil (Leucaena leucocephala) are also observed providing shelter for many local

and migratory bird species in the area along with Kamachile (Pithecelobium dulce) both from the plant family of Fabaceae.

Note: (a) Bamboo-like Tambo (Thysanolaena latifolia) inflorescence and mature clump (b) Sections from the transect plot dominated by Ipil-Ipil (Leucaena leucocephala) along trails and open spaces from inland portion.

Photo 3.1.6 Dense Grass and Shrub Vegetation at Transect 4

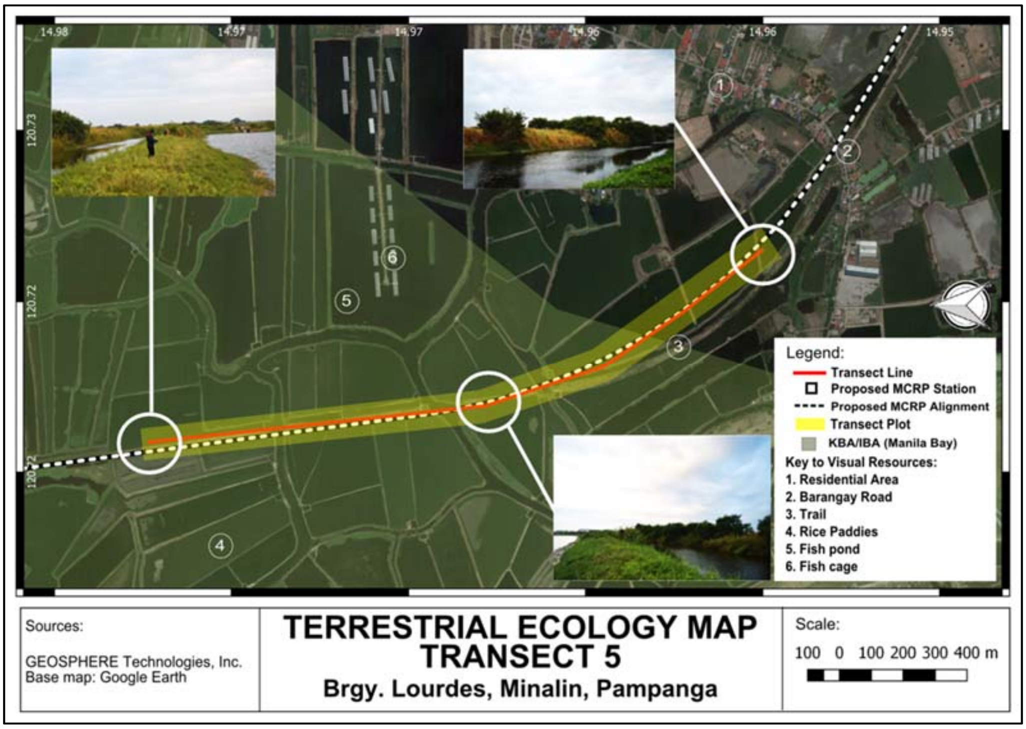
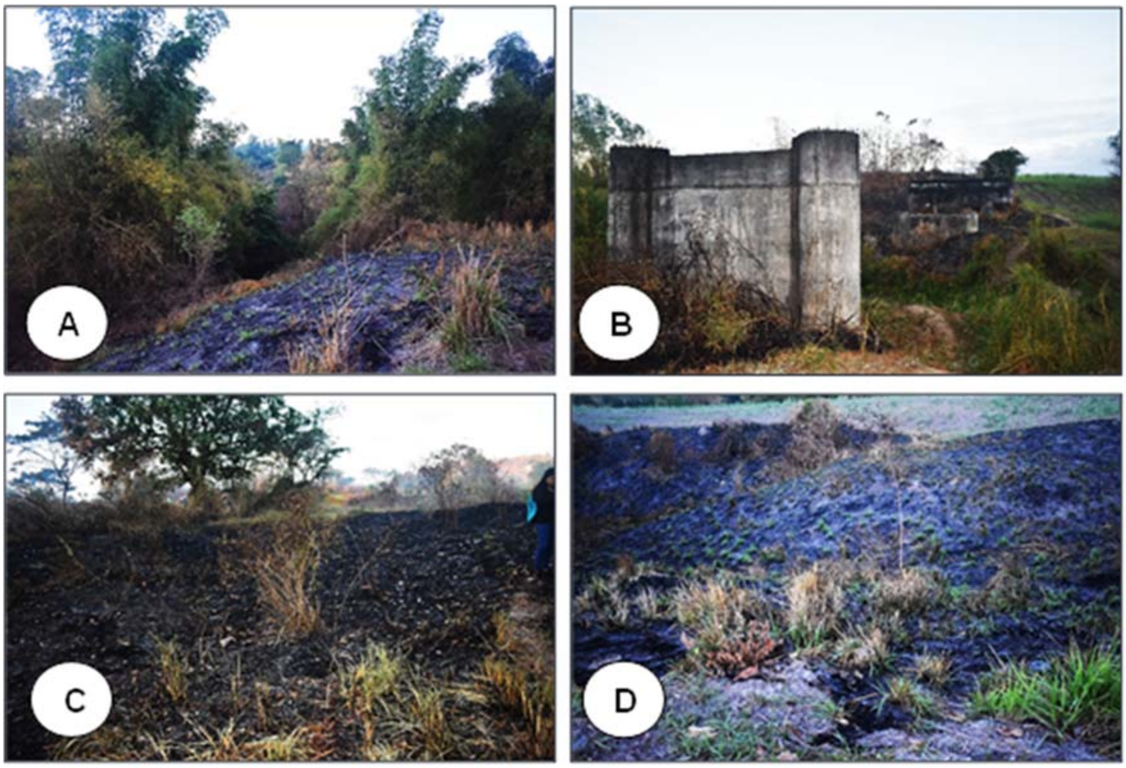


Figure 3.1.49 Map showing Transect 5 Established at Brgy. Lourdes, Minalin, Pampanga

426. Based from the observation of the whole transect plots, extreme heat exposure and physical disturbance (e.g. fire, cultivation, land clearing, etc.) was observed on the vegetation especially in private properties where the railway alignment is located. There were grass fires occurred in Transect 2 and Transect 3 where in large areas of grass were burned on unidentified cause. Some trees were also burned such as Alibangbang (Bauhinia malabarica), Binayuyu (Antidesma ghaesembilla) and Duhat (Syzigum cuminii) located near an open wooded area. However, open woodland trees have thick, fire resistant bark and if burnt to the ground in severe fires, the trees have the ability to regrow from rootstocks. Example of these tree species are Binayuyu (Antidesma ghaesambalia), Alibangbang (Bauhinia malabarica) and Anabiong (Trema orientalis). These features are usually absent in forest tree species. **Photo 3.1.7** shows some of the areas where in fire incidents occurred before the survey was conducted.



Note: (a) Rolling slopes near a small creek dominated by bamboos and Johnson grass (S. halepense); (b) Old Structure surround by burned grasslands; (c) Burned sections of Transect 2 on open wooded lands and shrub lands; (d) Grass fire incident at Transect 1 in Brgy. Aranguren.

Photo 3.1.7 Burned Areas Observed at the Established Transects

4) Species Diversity

a. Species Composition, Density and Abundance

427. One hundred eight (108) morpho-species, 107 genera belonging to 45 families were documented in five (5) transect plots established within the MCRP. Dominant families in the said transect plots were Fabacae, Moraceae, Anacardiaceae, Lamiaceae, Euphorbiaceae, Annonaceae, Malvaceae, Poaceae, Convulvolaceae and Asteraceae. The most frequently occurring tree species were Artocarpus altilis (Park.) Fosb, Ficus ulmifolia Lamk, Muntigia calabura L., Premna odorata Blanco, Leucaena leucocephala (Lam.) de Wit, Gmelina arborea Roxb., and Macaranga tanarius (L.) Muell.-Arg. The aforementioned species were present in all transects except for Artocarpus ovatus Blanco which were recorded in Transect 3 only.

428. Apart from the species recorded from the quadrat sampling, additional 10 species (not resent in the quadrats) were recorded from the opportunistic survey. Hence, a total of 118 morpho-species of plants were encountered within the vicinity of the proposed MCRP. **Annex 3-2_Table 1** presents the taxonomic list of all plant species recorded the vicinity of the proposed MCRP.

429. The large number of vascular flora recorded reflects a number of factors:

- The long, linear nature of the project area, meaning that it intersected a wide variety of plant communities and therefore vegetation types;
- The relatively large number of intensively sampled quadrats across the railway alignment; and
- The timing of the field surveys following substantial dry season species that were available for recording; approximately 50% of the species recorded were annual or weakly perennial flora.
- Species Composition, Density and Abundance

Tree Flora

430. A total of 62 morpho-species with 52 genera belonging to 24 families were recorded in the whole proposed MCRP. The average number of trees per quadrat (20m x 20m) is about two (2) individuals or an average density of 0.005 tree/m^2 (1 tree for every 100 m^2). This is understandable since the area is disturbed and generally dominated by shrubs and grasses, which compete with relatively few individual trees. The lower tree density of the quadrats can be attributed to the general land use and condition of the area where in the vegetation are almost devoid of mature sized diameter trees. The existing observable land uses of the area are agricultural and livestock production coupled with some built-up residential areas. Most areas surveyed are almost bare in vegetation but with sparse trees characterized by the dominance of medium-sized pioneer trees. The trees with the largest diameter include both fruit tree and forest trees which are represented by Rimas (Artocarpus altilis), Anabiong (Trema orientalis), Banato (Mallotus philippinensis), Mangga (Mangifera indica), Gmelina (Gmelina arborea), Rain tree (Samanea saman), Duhat (Syzigium cumnii), Sampaloc (Tamarindus indica), Santol (Sandoricum koetjape) and Anubing (Artocarpus ovatus). These tree species are present in all transect plots except for the species of A. ovatus which is only documented in Transect 3 in Brgy. San Roque at rolling to undulating slopes.

431. The relative density, relative dominance, and relative frequency values for each tree species in all the quadrats were determined to obtain their Importance Value (IV), a standard measure in ecology that determines the rank relationships of species. High Importance values of species indicate a composite score for high relative species dominance, density, and frequency. Based on the computed IV (**Table 3.1.15**), the three most important species (with the highest IV) are Mangga (22.64), Narra (11.57), and Cainito (10.25). It is interesting to note that most of the species listed are native and endemic yet they are dominating the remaining patches of vegetation in the area. This implies considerable conservation value of the area. However, the variation of IV among the canopy species, except for Mangga, Narra and Cainito, is significant. This, therefore, suggests an imbalance distribution (imbalance co-existence) among the native plants.

Table 3.1.15 Top 10 Species with the Highest Importance Value (IV)

Scientific Name	Common Name	Family Name	IV
Mangifera indica L.	Mangga	ANACARDIACEAE	22.645
Pterocarpus indicus Willd. forma indicus	Narra	FABACEAE	11.575
Chrysophyllum cainito L.	Cainito	SAPOTACEAE	10.253
Artocarpus ovatus Blanco	Anubing	MORACEAE	8.131
Mallotus philippensis (Lamk) Muell.-Arg.	Banato	EUPHORBIACEAE	6.399
Tamarindus indica L.	Sampaloc	FABACEAE	5.663
Streblus asper Lour.	Kalios	MORACEAE	5.388
Samanea saman (Jacq.) Merr.	Rain tree	FABACEAE	3.702
Gmelina arborea Roxb.	Gmelina	LAMIACEAE	3.486
Leucaena leucocephala (Lam.) de Wit	Ipil-Ipil	FABACEAE	3.449

Note: IV –Importance Value

432. The dominance of pioneer tree species in the area is due to the degradation and exposure of the environment to extreme sunlight. These trigger opportunistic and light demanding species to grow faster than neighboring plant species. The high presence of these pioneer species is a bit unexpected but can be explained by the high environmental heterogeneity of the site compared in other sections of the whole project area in early successional stages. Some individual trees of Gmelina (G. arborea) sprout from mature trunks, while strong disturbances (like clearing and site preparation) allow light demanding pioneer species to recruit and establish, therefore increasing the number of species as observed in the area. With ongoing succession, some of the original vegetation remnants are disappearing, in part due to environmental stress and to losing out in light competition with early succession species, which causes a decline in species diversity. At the same time, the light demanding pioneer species are already establishing cover in disturbed sections of along the proposed alignment.

433. Other plant and tree species documented in the area are closed from young to mature stage and been able to regenerate quickly after disturbance of fire and clearing, by maximizing the coexistence of fast growing pioneers and more competitive ground cover species. However, the disturbance intensity of site preparation in relation to habitat fragmentation and loss may be too high for fast regeneration dynamics. The re-establishment of the vegetation species is a slow process, which demands longer time periods.

Intermediate and Understorey

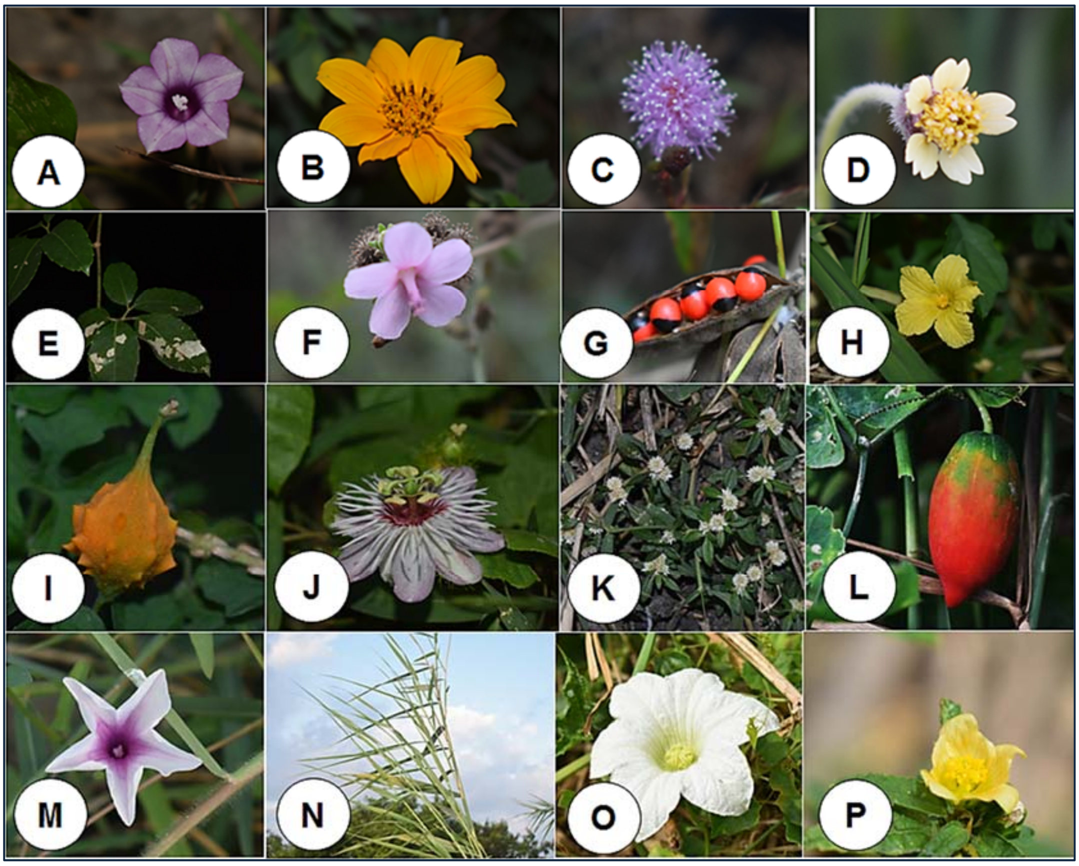
434. Similar to any disturbed forests, lower plant forms or the understories are significantly more diverse than larger trees. A total of 58 morpho-species with 55 genera belonging to 25 families were recorded for understorey layer. The average density is slightly higher than that of trees, at 0.72 individual/m^2 or equivalent to 72 individuals for every $100m^2$. The two most abundant understorey species are Wild sunflower (Tithonia diversifolia) with 41 individuals and Hagonoy (Chromolaena odorata) and Kulot-Kulot (Urena lobata) with 34 and 22, respectively. The most dominant families at the understorey are Asteraceae with 41 individuals and Malvaceae with 22 individuals. The representative species of family Asteraceae are predominantly shrubs with ten (10) species, while those representing family Malvaceae are herbaceous plants. The list of all understorey species recorded is presented in **Annex 3-2_Table 2**.

Table 3.1.16 Top 10 Most Abundant Understorey Species

Scientific Name	Family Name	Total Count
Tithonia diversifolia	ASTERACEAE	41
Chromolaena odorata (L.) R.M. King & H. Rob.	ASTERACEAE	34
*Urena lobata L.	MALVACEAE	22
Hyptis capitata Jacq.	LAMIACEAE	14
Ageratum conyzoides L.	ROSACEAE	13
Cleome rutidosperma DC.	CLEOMACEAE	13
Synedrella nodiflora (L.) Gaertn.	ASTERACEAE	11
Tabernaemontana pandacaqui Poir.	APOCYNACEAE	11
Breynia vitis-idaea (Burm.f.)	PHYLLANTHACEAE	11
Blumea lacera (Burn.f.) DC.	ASTERACEAE	10

Ground Cover

435. In terms of ground cover, majority of the species are represented by the family of Asteraceae such as Tridax procumbens, Mikania cordata, Chromolaena odorata and some individuals of Ipomoea triloba. Other leguminous ground cover species include Caesalpinia latisiliquum, Mimosa pudica, Centrosema pubescens and Mucuna pruriens. Ground cover is dense in open areas especially in areas where idle and abandoned farms are present.



Note: (a) (*Ipomoea triloba*), CONVOLVULACEAE, (*Ficus odorata* (Blanco) Merr.), MORACEAE; (b) Wild Sunflower (*Tithonia diversifolia* (Hemsl.) A. Gray., ASTERACEAE; (c) Makahiya (**Mimosa pudica L.*), MORACEAE; (d) Dagad (*Tridax procumbens* Linn.), ASTERACEAE; (e) Ayo (*Tetrastigma harmandii* Planch.), VITACEAE; (f) Kulot-Kulot (*Urena lobata* L.), MALVACEAE; (g) *Abrus precatorius* L., FABACEAE; (h) Ampalayang ligaw (Momordica conchinchinensis), CUCURBITACEAE; (i) Fruits of *M. conchinchinensis*, CUCURBITACEAE; (j) Karunggut (*Passiflora foetida* L.), PASSIFLORACEAE; (k) Bunga-Bunga (*Alternanthera sessilis* (L.) R.Br. ex DC.), AMARANTHACEAE; (l) Tamling (*Coccinea* grandis (L.) Voigt), CUCURBITACEAE; (m) Kamoteng baging (*Ipomea batatas* (L.) Lamk.), CONVOLVULACEAE; (n) Tambo (*Phragmites vulgaris*), POACEAE; (o) Flower of *C.grandis* (CUCURBITACEAE); (p) Taklang baka (*Sida rhombifolia* L.), MALVACEAE.

Photo 3.1.8 Photographs of the Dominant Ground Cover Species Recorded at the established Transects within the proposed MCRP

436. There are 33 ground cover species recorded from Transect plots (**Annex 3-2_Table 3**). It must be noted that the ground cover species referred in this survey are all species (crawling or erect) inside the 1m x 1m quadrat with height of less than 1 meter. Hence, seedlings of different tree species are included as ground cover. This treatment gives us better understanding of the stand structure of the forest from the ground to the canopy. Based on the survey, forest litter occupies more than 52% of the forest floor leaving less growing spaces for the ground cover species, hence, low species diversity.

437. The most dominant species that occupy the highest relative cover are Dagad (23.21%), Uuko (5.47%), and a species of tuberous annual vine, Kalalaknit (4.86%) (**Table 3.1.17**).

Table 3.1.17 Top 10 Most Dominant Ground Cover Species

Scientific Name	Family Name	Relative % Cover
Tridax procumbens Linn.	ASTERACEAE	23.21
Mikania cordata (Burm. f.) B.L. Rob.	ASTERACEAE	5.47
Merremia vitifolia (Burm. f.) Hall. f.	CONVULVULACEAE	4.86
*Mimosa pudica L.	FABACEAE	4.56
*Centrosema pubescens Benth.	FABACEAE	4.25
Imperata cylindrica (L.) Beauv.	POACEAE	4.25

Scientific Name	Family Name	Relative % Cover
Zehneria indica (Lour.) Keraudren	CUCURBITACEAE	3.65
*Sida rhombifolia L.	MALVACEAE	3.65
*Urena lobata L.	MALVACEAE	3.34
*Passiflora foetida L.	PASSIFLORACEAE	2.73

Note: * Invasive species

438. It is noted to thrive well on clearings along roadside and highly disturbed areas particularly at the westernmost section of the project site. The species is a prolific seeder and dissemination can be done by both natural and anthropogenic agents of dispersal.

b. Species Diversity Indices

439. Based on the number and abundance of all the species, Paleontological Statistical software package for education and data analysis (PAST version 3.12) was used to compute for diversity indices including Shannon (H'), Evenness (J') and Simpson's (D) index for all the sampling plots. Shannon Index gives an estimate of species richness and distribution. Evenness Index tells us how evenly species and/or individuals are distributed inside a plot or quadrat. Simpson's Index gives the probability of getting different species when two individuals were drawn (with replacement) inside a plot.

440. The diversity index of the area ranged from low to moderately low, while evenness indices varied from very low to low. Diversity indices were highest in the understorey and herbaceous layer. The vegetation in some of the transect plots (e.g. T1, T2, T3) is considered as shrub to open wooded land vegetation where trees are not that dominant but are sparse, which provides a more favorable environment for the growth of the ground cover, invasive and understorey layers including opportunistic species. Evenness index was very low in the tree layer.

441. Additionally, the abundance of species will be enhanced through the selection of rehabilitation species which only focus on indigenous and endemic tree species. **Table 3.1.18** shows the species diversity per plot established in the whole project area which suggest introduction, disturbance, and invasion. Consequently, the number of species per plot recorded in the survey coincide with the general trend that the disturbed areas are dominated with more understorey and ground cover species which are mostly opportunistic and light tolerant species.

Table 3.1.18 Species Diversity, Dominant Families and Abundance per Transect

Sampling Stations	Number of Species (S)	Number of Individuals (N)	Dominant Plant Families
Transect 1	46	174	Asteraceae, Poaceae, Fabaceae, Verbenaceae, Lamiaceae, Malvaceae, Euphorbiaceae, Meliaceae, Moraceae, Cannabaceae
Transect 2	19	156	Poaceae, Fabaceae, Verbenaceae, Lamiaceae, Malvaceae, Euphorbiaceae, Meliaceae, Moraceae, Cannabaceae
Transect 3	22	175	Moraceae, Verbenaceae, Lamiaceae, Euphorbiaceae, Muntigiaceae, Asteraceae, Cannabaceae
Transect 4	18	154	Euphorbiaceae, Asteraceae, Fabaceae, Verbenaceae, Lamiaceae, Malvaceae, Burseraceae, Cannabaceae, Arecaceae
Transect 5	24	132	Euphorbiaceae, Muntigiaceae, Moraceae, Fabaceae, Lamiaceae, Araceae, Musaceae, Asteraceae, Cannabaceae

442. The diversity indices and number of species and individuals per transect are presented in (**Table 3.1.19**). Transect 1 (H'=2.679) is moderately diverse based from the index used. Transect 1 has typically more species than any other transect plots primarily due to the diverse species of ground cover, grass, shrub and herbaceous layer. Tree layer is apparently less in number because the transect plot is almost devoid of trees and basically sparse trees are present in each plot at around one (1) tree for every 100m². As the transect is an abandoned farm lands, some sections are totally devoid of tree vegetation and only diverse groups of ground cover species dominate the area. On the other hand, a small creek was observed perpendicular to the transect where in most of the species aggregate primarily due to abundant amount of water, nutrients and shade from a

number of trees. Species of fig trees such as Tibig (Ficus nota), Is-Is (Ficus ulmifolia) and Hauili (Ficus septica) are present. Transect 5 (H'=2.781) is moderately diverse due to adjacent sparse trees and patches of vegetation remaining in some idle spaces not used for fishponds which contains additional presence of some ground cover and shrub species unlike Transect plot 6 which are totally dominated by fishponds and bare abandoned areas devoid of canopy trees.

443. The influence of the ground cover species into the vegetation affects the growth and recruitment of other plant forms such as trees. Other physical factors include cultivation and fire which promotes the growth of weeds and grasses such as Cogon (Imperata cylindrica) and Themeda sp. followed by C. odorata. The dense ground cover species in general are represented by families of Asteraceae, Malvaceae and Lamiaceae. Transect 2 (H'=2.304) is generally an open shrub to grassland and is characterized similarly by sparse trees and thick vegetation of grasses and shrubs. Thick vegetation of Wild sunflower or Tree Marigold (Tithonia diversifolia) was also observed as transition from Transect 1. This species is native to Mexico and Central America but has a nearly pantropical distribution as an introduced species. It is an ornamental plant introduced to the Philippines but became a common weed in waste places and abandoned fields. Transect 1 and Transect 2 has experienced the most disturbances as depicted by extensive shrublands and/or cultivated lands. Transect 3 (H'=2.197) is more or less a second growth vegetation with young saplings and medium sized diameter trees along rolling slopes represented by Anubing (Artocarpus ovatus), Kalios (Streblus asper), Rimas (Artocarpus altilis) and Sablot (Litsea glutinosa). These trees are actually part of the transect plot on a 1-km radius opportunistic survey. The area is characterized by less than 5% having a natural vegetation with disturbed environments due to cutting and kaingin farming, therefore, species is not that diverse. Presence of dense vegetation of grasses impedes growth of native trees and too much exposed environments to heat limits the area to seral succession. The transect plot is also near to a small river in which common riparian and weeds species exist.

Table 3.1.19 Diversity Indices and Number of Species and Individuals per Transect

Sampling Station	No. of species	No. of Individuals	Diversity Indices		
			H'	D'	J'
Transect 1	49	174	2.679	2.945	0.972
Transect 2	24	156	2.304	2.130	0.432
Transect 3	22	175	2.197	2.670	0.645
Transect 4	20	110	2.781	2.936	0.928
Transect 5	25	195	2.196	2.361	0.543

Note: H' – Shannon index; D = Simpson's index; J – Evenness index
Diversity Index: vh – very high (3.50 above), h – high (3.00 – 3.49), m – moderate (2.50 – 2.99), l – low (2.00 – 2.49), vl – very low (1.99 – below); Evenness Index: vh – very high (0.75 – 1.00), h – high (0.50 – 0.74), m – moderate (0.25 – 0.49), l – low (0.15 – 0.24), vl – very low (0.05 – 0.14).

5) Biodiversity Value

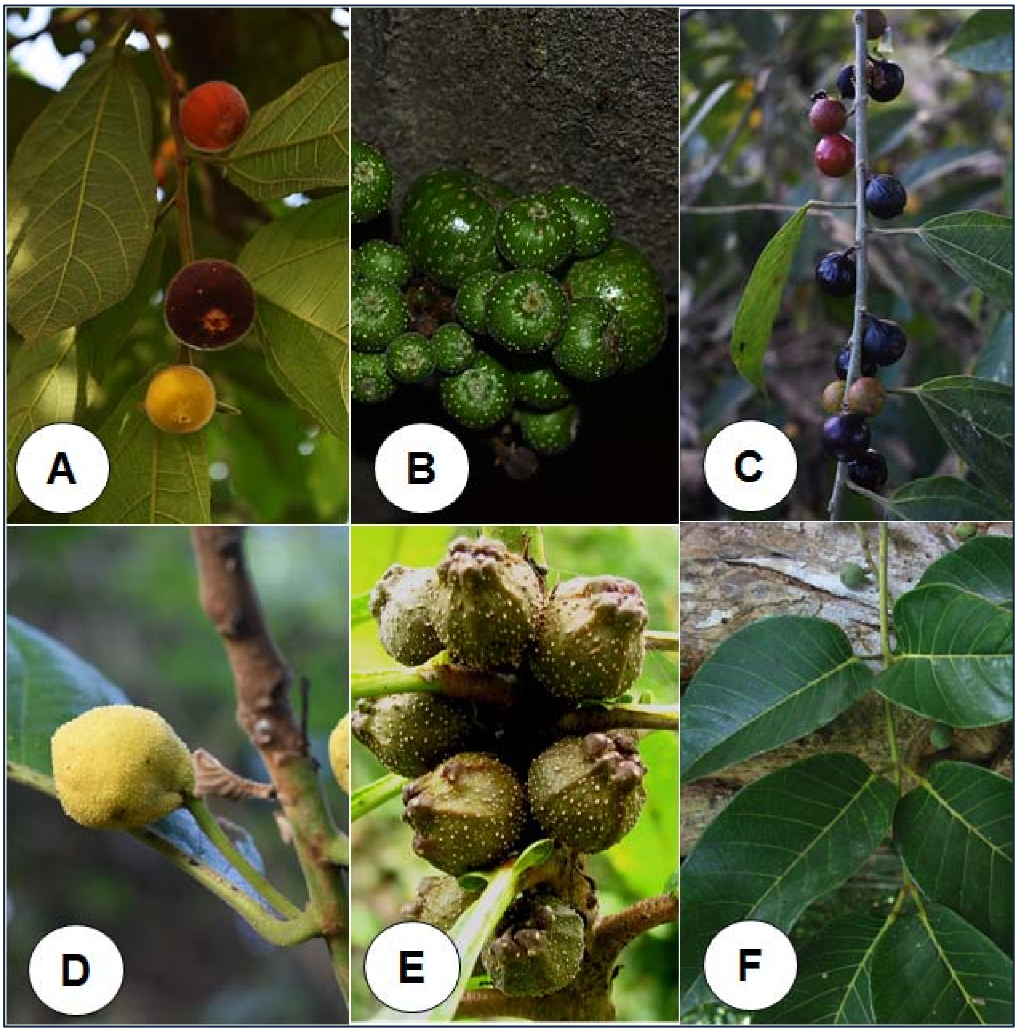
a. Ecologically Important Species

444. The ecological or biodiversity value of an area is always measured in terms of species richness and in the number of endemic and threatened species present.

Endemic and Indigenous Species

445. The geographical distribution of plant species has been very useful for assessing biodiversity values of regions, countries, and islands. Species confined to a particular site will be given particular conservation management strategies, as they are more vulnerable to disturbance due to their narrow range. Of the total 127 taxa identified to species level, 42 species (5.5%) were found to be Philippine endemics or have natural habitat confined only in the country (**Table 3.1.20**). Noteworthy among the list are those species that are also included in either the Philippine red list or in the International Union for Conservation of Nature (IUCN). These include Antipolo, Piling liitan, Niog-Niogan, and Anubing (**Photo 3.1.9**).

446. Eighty four percent (84%) of the total number of species recorded in the area are indigenous to the Philippines and exhibit different economic and ecological importance. These species are represented by different general plant forms such as trees, vines, herb, and shrub. **Annex 3-2_Table 4** presents the taxonomic list of all indigenous (native) plant and tree species recorded in MCRP.



Note: (a) Pakiling (*Ficus odorata* (Blanco) Merr.), MORACEAE; (b) Tibig (*Ficus nota* (Blanco) Merr.), MORACEAE; (c) Is-Is (*Ficus ulmifolia* Lamk.), MORACEAE; (d) Anubing (*Artocarpus ovatus* Blanco), MORACEAE; (e) Niog-Niogan (*Ficus pseudopalma* Blanco), MORACEAE; (f) Piling liitan (*Canarium luzonicum* (Blume) A. Gray), BURSERACEAE.

Photo 3.1.9 Photographs of the Endemic Tree Species Recorded at Different Transect Plots Established within the Proposed MCRP

447. It should be emphasized that categorizing species as endemic is very much dependent on availability of published biodiversity data, recent taxonomic revisions, nomenclatural changes, and new evidences from various disciplines used in systematics among others. Thus, estimates of endemism should be interpreted within the context of the methodologies and limitations imposed by contributing factors aforementioned.

Table 3.1.20 List of Philippine Endemic Species Recorded at the Established Transects

SPECIES	Common Name	Family Name	Endemism
Artocarpus blancoi (Elmer) Merr.	Antipolo	MORACEAE	PE
Artocarpus ovatus Blanco	Anubing	MORACEAE	PE

SPECIES	Common Name	Family Name	Endemism
Canarium luzonicum (Blume) A. Gray	Piling liitan	BURSERACEAE	PE
Ficus pseudopalma Blanco	Niog-Niogan	MORACEAE	PE
Ficus ulmifolia Lamk	Is-Is	MORACEAE	PE
Ficus nota (Blanco) Merr	Tibig	MORACEAE	PE
Ficus odorata (Blanco) Merr.	Pakiling	MORACEAE	PE

Note: **PE: Philippine Endemic Species

Threatened Species

448. The conservation status of species is based on the most recent recommendations of the Philippine Plant Conservation Committee (PPCC) of the Protected Areas and Wildlife Bureau (PAWB) now the BMB, officially issued as DENR Administrative Order No. 2007-01 better known as ‘‘The National List of Threatened Philippine Plants and their Categories’. The listing of threatened species of the IUCN red list was aso used as reference.

449. Five (5) species recorded from MCRP Railway alignment are listed under either the Philippine Red List (DAO 2007-01) or the IUCN Red List of Threatened Species (2016.3) (**Table 3.1.21**). Noteworthy among the list are the critically endangered (CR) Smooth Narra (*Pterocarpus indicus*) (IUCN), and a premium tree species which is specifically used in railroad ties, Molave (*Vitex parviflora*) (DAO 2007-01). The transect plots where the threatened species occurred were included to guide the PAWB in their species conservation efforts. Even if Narra is widely seen in the whole country, its basis of its conservation status is that its low population in the wild. Further, Narra is one of the notable tree species in the alignment, hence, appropriate management and monitoring strategies to ensure the continued survival of its population (as well as other threatened species) will be developed.

Table 3.1.21 List of Threatened Species Recorded at the Established Transects

Species	Common name	Family	IUCN 2016 ver.3	DAO 2007-01
Artocarpus blancoi	Antipolo	MORACEAE	VU	
Canarium luzonicum	Piling liitan	BURSERACEAE	VU	
Ficus ulmifolia	Is-is	MORACEAE	VU	
Pterocarpus indicus	Narra	FABACEAE	VU	CR
Vitex parviflora	Molave	LAMIACEAE	VU	EN

450. DAO 2007-11 updated checklist (2011) pursuant to “Wildlife Resources Conservation and Protection Act 9147” defines the different threatened categories as follows:

- **Critically Endangered Species (CE)** - refers to a species or subspecies facing extremely high risk of extinction in the wild in the immediate future. This shall include varieties, formae or other infraspecific categories.
- **Endangered Species (EN) -** refers to a species or subspecies that is not critically endangered but whose survival in the wild is unlikely if the causal factors continue operating. This shall include varieties, formae or other infraspecific categories.
- **Vulnerable Species (VU) -** refers to a species or subspecies that is not critically endangered nor endangered but is under threat from adverse factors throughout its range and is likely to move to the endangered category in the future. This shall include varieties, formae or other infraspecific categories.
- **Other Threatened Species (OTS)** - refers to a species or subspecies that is not critically endangered, endangered nor vulnerable but is under threat from adverse factors, such as over collection, throughout its range and is likely to move to the vulnerable category in the near future. This shall include varieties, formae or other infraspecific categories.

- **Other Wildlife species (OWS)** - refers to non-threatened species of plants that have the tendency to become threatened due to destruction of habitat or other similar causes as may be listed by the Secretary upon the recommendation of the National Wildlife Management Committee. This shall include varieties, formae or other infraspecific categories.

451. IUCN defines the different threatened categories as follows:

- **Critically Endangered (CR)** - A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered (EN)** - A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.
- **Vulnerable (VU)** - A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

452. Other tree species includes Philippine Endemic tree species such as Is-Is (*Ficus ulmifolia*), Piling liitan (*Canarium luzonicum*), and Antipolo (*Artocarpus blancoi*). These species are observed in either patches of vegetation or as sparse individual trees within and outside the transect plots. Others are also documented during opportunistic survey present near farms and small creeks surrounded by thick vegetation of grass and bamboo species such as Kawayan tinik (*Bambusa blumeana*). These species are regarded as keystone species for fauna such as bats, birds and other frugivorous mammals and vertebrates. They are also widely dispersed by these animals through their droppings and pollination. Their uses and economic importance are listed in **Annex 3-2_Table 5**.

Table 3.1.22 List of Indigenous and Endemic Tree Species

Species	Local Name	Family Name	Transect Plot(s) where Species Occurred
Artocarpus blancoi	Antipolo	MORACEAE	T3 and opportunistic survey
Canarium luzonicum	Piling liitan	BURSERACEAE	T2 and opportunistic survey
Ficus ulmifolia	Is-is	MORACEAE	T1, T2, T3
Pterocarpus indicus	Narra	FABACEAE	T1, T3
Vitex parviflora	Molave	LAMIACEAE	T2 and T3
Ficus odorata (Blanco) Merr.	Pakiling	MORACEAE	T1
Artocarpus ovatus Blanco	Anubing	MORACEAE	T3 only
Mallotus philippinensis	Banato	EUPHORBIACEAE	T1 and T3
Bauhinia malabarica	Alibangbang	FABACEAE	T2 only
Antidesma ghaesembilla	Binayuyu	PHYLLANTHACEAE	T2 only
Chionanthus ramiflorus		OLEACEAE	T2 only

b. Economic Uses

453. In terms of economic uses and importance, some plants and trees recorded have potential for medicinal, ornamental, field, fodder and timber purposes (**Table 3.1.23**). Most of the floral species recorded are tree species with known economic and human use values (tangible products) such as source of timber, fruits, medicines, ornamentals and fuel wood. These include members of the families of Anacardiaceae, Meliaceae, Moraceae, Lamiaceae, Fabaceae and Euphorbiaceae.

454. Other economic uses such as raw materials (e.g. fiber, timber, fuel wood, fodder, fertilizer) can be obtained from Narra (Pterocarpus inidicus), Molave (Vitex parviflora), Anubing (Artocarpus ovatus), Banato (Mallotus philippinensis) and Rimas (Artocarpus altilis). Fodder and fuel wood uses can be derived from tree species such as Ipil-Ipil (Leucaena leucocephala) and Kakawate (Gliricidia sepium). However, cutting and utilizing some threatened tree species are banned by the DENR because of its current status in the wild or its present conservation status. Consequently, there are also species recorded that actually belongs to "lesser known or used

species". A great number of these tree species are potentially valuable timber species such as Alibangbang (Bauhinia malabarica), Binayuyu (Antidesma ghaesembilla), Alim (Melanolepis multiglandulosa) and African Tulip (Spathodea campanulata).

455. Food sources (e.g. oils, fruits, seeds, juices/extracts) can also be obtained from Psidium guajava, Mangifera indica, Passiflora foetida, Terminalia catappa, including palm species, Calamus sp. and Cocos nucifera. Medicinal and other known herbal uses from plants are also noted to some species recorded in the site such as Uuko (Mikania cordata), Cassia alata, seeds of Mahogany (Swietenia macrophylla), among others. Other tree species includes Philippine Endemic tree species such as Is-Is (Ficus ulmifolia), Piling liitan (Canarium luzonicum), and Antipolo (Artocarpus blancoi). These species are observed in either patches of vegetation or as sparse individual trees within and outside the transect plots. Others are also documented during opportunistic survey present near farms and small creeks surrounded by thick vegetation of grass and bamboo species such as Kawayan tinik (Bambusa blumeana). These species are regarded as keystone species for fauna such as bats, birds and other frugivorous mammals and vertebrates. They are also widely dispersed by these animals through their droppings and pollination.

Table 3.1.23 List of Some Economic Uses and Importance of Significant Flora Recorded at the Establish Transects along the Proposed MCRP

Species	Family Name	Economic Uses and Importance
Artocarpus blancoi	MORACEAE	Timber; paper production and being a shade provider are its primary uses, although its seeds and fruits are edible.
Canarium luzonicum	BURSERACEAE	The resin is primarily from volatile turpentines; Fruits are edible; Seeds are sources of oils.
Ficus ulmifolia	MORACEAE	The fruits are edible but have little flavor; sometimes eaten with sugar and cream. The hard and rough leaves are used to clean household materials.
Pterocarpus indicus	FABACEAE	Timber; Wood is used for furniture; Reforestation species.
Vitex parviflora	LAMIACEAE	Timber; Wood are used in railroad ties. Fruits are medicinal.
Ficus odorata (Blanco) Merr.	MORACEAE	Fruits are medicinal. Wood used as source of timber.
Artocarpus ovatus Blanco	MORACEAE	Timber; The wood is used for furniture, house building, turnery, light carpentry, interior joinery and panelling, boxes and crates, boats.
Mallotus philippinensis	EUPHORBIACEAE	Tree is used to produce red dye and herbal remedies. It produces rottlerin, a potent large conductance potassium channel opener.
Bauhinia malabarica	FABACEAE	Timber; leaves are edible; decoction of root bark used for liver problems.
Antidesma ghaesembilla	PHYLLANTHACEAE	The fruits are eaten raw and prepared into jams, etc. Young shoots are used as a vegetable and as a spice; the leaves are used in traditional medicine against fever.
Chionanthus ramiflorus	OLEACEAE	Timber; Leaves are medicinal.

3.1.4.2 Terrestrial Fauna

456. According to the BMB memorandum, the annual migratory season starts in September and ends in March. For this study, the terrestrial flauna survey was conducted during the dry season in February 4-7, 2018, which is within the migratory season.

(1) Field Survey

457. A survey to determine the presence of terrestrial vertebrates along the proposed MCRP was conducted using rapid sampling at the same five (5) transects for terrestrial flora survey, which cover five (5) barangays namely: Barangays Aranguren and Cut-cut in Capas, Barangay San Roque in Bamban, Barangay San Matias in Sto. Tomas and Barangay Lourdes in Minalin (**Table 3.1.24** and **Figure 3.1.44**).

458. The terrestrial fauna survey was focused on the terrestrial vertebrate groups of Philippine wildlife; birds, mammals, amphibians and reptiles (herpotofauna). Standard field methods and procedures were used for each taxa during the survey. Direct and indirect transect identification such as tracks, signs and auditory cues, trapping and mist-netting were used. Microhabitat searches were also done in the immediate vicinities of the transect line, 10 meters to the left and 10 meters to the right, to ascertain the presence of small and/or cryptic species of wildlife.

1) Birds

459. Direct observations of birds were done wherein observers walked along existing trails and streams and occasionally in a perpendicular or parallel direction several meters from existing paths. The pace of walking was varied in order to detect different species. Standardized 2km transect was used in each site. Where possible, observer walked across different habitat types and spent time searching in habitat breaks. Searches were conducted from 5:30-9:00 in the morning, and in the afternoon at 3:30-6:00 or before sunset. Observers were equipped with binoculars. Birds flying and perching over the area were counted individually.

460. Mist netting was employed to confirm species occurrence and distribution as well as identification of cryptic species of birds. Mist nets were hoisted along possible flight paths of birds, e.g., in between trees, along streams, just above the ground with clearance of at least 15 cm to 1 m. Net locations were recorded using a handheld GPS unit. The nets were set in the afternoon and checked in the morning of the next day. For each site, three sets of nets with two nets each were set serially along the transect line. These nets were also used to catch Volant mammals during the night. Nets were checked before noon and at 5:00 pm or an hour before dusk.

461. Birds were identified using the Field Guide to Philippine Birds (Kennedy, Gonzales, Dickinson, Miranda and Fisher, 2000; Rosell, 2010, and Allen et al., 2013). New nomenclature was based on the WBCP-Checklist of Birds of the Philippines 2016.

2) Mammal

462. Mist nets used for birds were also employed for catching bats. Mist nets were set and positioned in strategic points of the sampling sites (e.g., flyways, across established trails near a river or stream, forest edges, openings and forest interior) but away from human habitations. The nets were set and opened at 6:00 pm and removed the following morning at 6:00AM. Net watching for insectivores was done at 6:00-8:00PM. Numbers of individual present were counted or estimated. Then, photographs of selected captured individuals were taken.

463. Live traps were used to catch non-volant mammals. Roasted coconut meat mixed with peanut butter, bread, and fried dried fish were used as bait for live traps, which were placed along possible runways, near holes or among root tangles and fallen logs, where small non-volant mammals might be present. Checking of traps were done early in the morning of the next day.

464. Tracks and sign identification (e.g. droppings, wallowing areas, dens) and direct sighting techniques were used for terrestrial and arboreal (but non-volant) species.

465. Identification, nomenclature, classification and conservation status were determined based on Heaney et al. (1998), Fieldiana (Peterson et al., 2008), published taxonomic keys, and IUCN.

3) Herpetofauna

466. Reptiles and amphibians (herps) survey were conducted using the Visual Encounter Survey and hand-grabbing technique (Heyer et al., 1994; Matsui, 2006) while doing the transect walks. The Visual Encounter Survey was used in the sampling to conduct searches in high potential areas throughout the sampling sites. These methods were supplemented with acoustic

searching for frogs, turning of rocks and logs, peeling bark, digging through leaf litter, and excavating burrows and termite mounds.

467. Purposive time-constrained herpetofaunal survey was conducted at 6:00-9:00 in the morning and 19:00-21:00 hours in the evening. Any amphibian or reptile seen and captured were identified, recorded, and released in the same habitat after being measured and photographed.

468. Identification, nomenclature, classification and conservation status were determined based on Brown and Alcala (1978, 1980), published taxonomic keys, IUCN, AmphibiaWeb, Frost et al. (2006), Frost (2007), and other available field guides. Paleontological STatistics (PaST), ver. 1.42 by Hammer, Harper and Ryan (2016) was used to compute diversity indices.

(2) Results

469. There are no endangered or endemic birds, mammals and herpetofauna species that will be affected by the construction of the proposed MCRP.

1) General Fauna

470. A total of 89 fauna species were observed at recorded during the survey for the proposed MCRP. It is composed of 71 species of birds, 3 species of mammals (2 volant and 1 non-volant) and 15 species of amphibians and reptiles (5 species of frog, 5 species of lizards and 5 species of snakes).

2) Transect Profiles

471. Most of the sampling stations are located in ricefields and planes, except in San Roque which had a rolling topography with varying elevation. Most of the sites are disturbed because of close proximity to human settlements. There are secondary agro-forest patches that can be observed, however, most of the land covered by the 2 km transect are privately owned. There is less observed variation in the habitat types. Most of the sites are brushland (**Table 3.1.24**). Transect 1 in Barangay.Aranguren has less forest patch or fruit bearing tress compared to Transect 2 in Barangay Cut-cut and Transect 3 in Barangay San Roque. Transect 4 in Barangay San Matias and Transect 5 in Brgy. Lourdes are of the same habitat types which are private fish ponds, marshes, rivers, and swamps near human habitation.

Table 3.1.24 Terrestrial Fauna Sampling Stations

Sampling Station	Start	End	Habitat Type
Transect 1 - Brgy. Aranguren	N120.5263 E15.34738	N120.5281 E15.33014	Brushland, wetland (stream and pond), plains, Cultivated trees and plants (i.e. Bamboo, Cocos nucifera), Undergrowth vegetation (Sedges, weeds, and grass)
Transect 2 - Brgy. Cut-Cut	N120.5278 E15.32036	N120.5281 E15.33014	Brushland, Undergrowth vegetation (Sedges weeds, and grass), Sugar cane plantation, Fragmented Bamboo forest near stream crossing the Sitio Kalangitan
Transect 3 - Brgy. San Roque	N120. 5314 E15.27138	N120.5292 E15.28928	Bamboo, sugarcane plantation, Undergrowth vegetation, Cultivated trees (i.e. Musa sp., Cocos nucifera
Transect 4 - Bgry. San Matias	N120.70959 E15.0035	N120.71887 E14.9913	Marsh, privately owned fishponds
Transect 5 - Brgy. Lourdes	N120.72651 E14.9601	N120.72184E1 4.9690	Marsh, privately owned fishponds

3) Species Diversity

Birds

472. Seventy-one (71) species of birds belonging to 35 families were documented during the survey of terrestrial vertebrate wildlife along the areas where the proposed MCRP will be built. Transect 5 in Barangay Lourdes has the highest number of species recorded with 41, this is maybe due to the presence of migratory birds in the area, the same as with Transect 4 in Barangay San

Matias. These areas are mainly composed of marshland and privately-owned fish ponds which teem with fish and other aquatic resources which the birds feed on. The differences in the habitat types in five (5) transects showed different species compositions as shown in **Table 3.1.25**. All sites have a high anthropogenic disturbance due to close proximity to human settlement.

473. Out of the 70 species of birds, only five (5) species are common in all transects. These species are *Geopelia strata* whose range extend from most of Southeast Asia, *Hirundo rustica*, which is one of the most widespread species not only the Philippines but in the world; *Megalurus palustris* which is a wide-ranging bird; *Passer montanus,* an introduced bird widespread in Asia; and *Pycnonotus goiaver,* a Southeastern Asia resident breeder. All of the aforementioned species are found in a variety of open habitats and somehow has adapted to environmental disturbances.

Table 3.1.25 Inventory of Birds

Family	Scientific Name	Common Name	Feeding Guild	Endemicity	Conservation Status	Transect					Total
						1	2	3	4	5	
Acanthizidae	Gerygone sulphurea	Golden-bellied Flyeater	I	Resident	Least Concern	-	8	-	-	-	8
Accipitridae	Haliastur indus	Brahminy Kite	C	Resident	Least Concern	2	-	1	-	-	3
Alcedinidae	Todirhamphus chloris	Collared Kingfisher	C,I	Resident	Least Concern	2	-	-	-	-	2
	Halcyon smyrnensis	White-throated kingfisher	P,I	Resident	Least Concern	-	-	1	-	-	1
	Alcedo atthis	Common Kingfisher	P	Resident	Least Concern	-	-	-	-	2	2
Anatidae	Dendrocygna arcuata	Wandering Whistling Duck	O	Migratory	Least Concern	-	-	-	30	-	30
Apodidae	Collocalia esculenta	Glossy Swiftlet	I	Resident	Least Concern	-	4	-	-	-	4
Ardeidae	Ardea intermedia	Intermediate Egret	C	Resident	Least Concern	5	-	-	9	15	29
	Ardea alba	Great White Egret	C,I	Migratory	Least Concern	-	-	-	9	40	49
	Egreta garzetta	Little Egret	C	Migratory	Least Concern	-	-	-	8	13	21
	Ardea cinerea	Grey Heron	C	Migratory	Least Concern	-	-	-	6	10	16
	Ardea purpurea	Purple Heron	C	Migratory	Least Concern	-	-	-	5	15	20
	Ixobrychus flavicollis	Black Bittern	C,I	Migratory	Least Concern	-	-	-	6	8	14
	Ixobrychus sinensis	Yellow Bittern	C,I	Migratory	Least Concern	-	-	-	8	12	20
	Butoroides striata	Little heron	P, I	Resident	Least Concern	-	-	2	-	9	11
	Ixobrychus cinnamomeus	Cinnamon Bittern	C,I	Migratory	Least Concern	-	-	-	-	15	15
	Nycticorax caledonicus	Rufous Night Heron	C,I	Migratory	Least Concern	-	-	-	-	7	7
	Nycticorax nycticorax	Black-crowned Night Heron	C	Migratory	Least Concern	-	-	-	-	13	13
Artamidae	Artamus leucorynchus	White-breasted Woodswallow	I	Resident	Least Concern	-	-	-	-	-	0
Charadriidae	Charadrius dubius	Little-ringed Plover	I	Migratory	Least Concern	-	-	-	-	10	10
Cisticolidae	Cisticola juncidis	Zitting Cisticola	I	Resident	Least Concern	-	4	-	-	2	6
Columbidae	Geopelia striata	Zebra Dove	G	Resident	Least Concern	3	5	7	8	9	32
	Spilopelia chinensis	Spotted Dove	G	Resident	Least Concern	4	2	-	-	-	6
	Streptopelia tranquebarica	Red Turtle Dove	G	Resident	Least Concern	-	4	-	-	16	20
	Streptopelia bitorquata	Island collar dove	G	Resident	Least Concern	-	-	2	-	-	2
Corvidae	Corvus enca	Slender-billed Crow	C	Resident	Least Concern	-	2	-	-	-	2
Cuculidae	Centropus viridis	Philippine Coucal	I	Endemic	Least Concern	2	2	2	-	-	6
	Phaenicophaeus cumingi	Scale-feathered Malkoha	C	Endemic	Least Concern	-	1	-	-	-	1
	Cacomantis sepulchralis	Brush cuckoo	I	Resident	Least Concern	-	-	3	-	-	3
Dicaeidae	Dicaeum australe	Red-keeled Flowerpecker	F	Endemic	Least Concern	-	5	-	-	-	5
	Dicaeum pygmaeum	Pygmy flowerpecker	F	Resident	Least Concern	-	-	4	-	-	4
Estrildidae	Lonchura atricapilla	Chestnut Munia	G	Resident	Least Concern	-	32	-	20	28	80
	Lonchura punctulata	Scaly-breasted munia	G	Resident	Least Concern	-	-	4	-	23	27
Hirundinidae	Hirundo rustica	Barn Swallow	I	Resident	Least Concern	60	10	5	38	30	143
	Hirundo tahitica	Pacific Swallow	I	Resident	Least Concern	52	-	3	-	25	80
Jacanidae	Hydrophasianus chirurgus	Pheasant-tailed Jacana	I	Migratory	Least Concern	-	-	-	2	-	2
Laniidae	Lanius cristatus	Brown Shrike	C,I	Resident	Least Concern	4	10	9	-	13	36
	Lanius schach	Long-tailed Shrike	C,I	Resident	Least Concern	13	8	2	-	-	23
Laridae	Chlidonias hybrida	Whiskered Tern	C,I	Migratory	Least Concern	-	-	-	110	500	610
	Sternula albifrons	Little Tern	P	Migratory	Least Concern	-	-	-	70	350	420

Family	Scientific Name	Common Name	Feeding Guild	Endemicity	Conservation Status	Transect 1	2	3	4	5	Total
	Sterna hirundo	Common Tern	C	Migratory	Least Concern	-	-	-	-	450	450
Locustellidae	Megalurus palustris	Striated Grassbird	I	Resident	Least Concern	7	4	-	8	12	31
	Megalurus timoriensis	Tawny Grassbird	I	Resident	Least Concern	14	6	7	7	-	34
Megalamidae	Psilopogon haemacephalus	Coppersmith barbet	F,I	Resident	Least Concern	-	-	6	-	-	6
Meropidae	Merops viridis	Blue-tailed Bee-eater	I	Resident	Least Concern	-	5	-	15	-	20
	Merops philippinus	Blue-tailed Bee-eater	I	Resident	Least Concern	-	-	-	-	10	10
Motacillidae	Anthus richardi	Richard's Pipit	I	Resident	Least Concern	-	4	-	-	12	16
Muscicapidae	Copsychus saularis	Oriental Magpie Robin	I	Resident	Least Concern	6	5	-	-	4	15
	Saxicola caprata	Pied Bushchat	I	Resident	Least Concern	-	-	-	2	-	2
	Monticola solitarius	Blue rock thrush	O	Resident	Least Concern	-	-	1	-	-	1
Nectarinniidae	Cinnyris jugularis	Olive-backed Sunbird	I,F	Resident	Least Concern	4	6	4	-	-	14
Oriolidae	Oriolus chinensis	Black-naped Oriole	I	Resident	Least Concern	2	-	-	-	-	2
Passeridae	Passer montanus	Eurasian Tree Sparrow	G,I	Resident	Least Concern	22	15	7	15	20	79
Phasionidae	Gallus gallus	Jungle fowl	O	Resident	Least Concern	-	-	2	-	-	2
Picidae	Picoides maculatus	Philippine Pygmy Woodpecker	I	Endemic	Least Concern	2	-	-	-	-	2
Podicipedidae	Tachybaptus ruficollis	Little Grebe	I	Resident	Least Concern	-	-	-	14	50	64
Pycnonotidae	Pycnonotus goiavier	Yellow-vented Bulbul	I,F	Resident	Least Concern	9	50	15	15	16	105
Rallidae	Gallinula chloropus	Common Moorhen	O	Resident	Least Concern	-	-	-	16	20	36
	Hypotaenidia torquatus	Barred Rail	O	Resident	Least Concern	-	-	-	5	13	18
	Hypotaenidia philippensis	Buff banded rail	O	Resident	Least Concern	-	-	1	-	18	19
	Amaurornis phoenicurus	White-breasted Waterhen	O	Resident	Least Concern	2	3	-	-	-	5
	Amaurornis cinerea	White-browed Crake	O	Migratory	Least Concern	-	-	-	-	20	20
	Gallirallus striatus	Slaty Breasted Rail	O	Resident	Least Concern	-	-	-	-	14	14
	Porphyrio porphyrio	Purple Swamphen	C	Migratory	Least Concern	-	-	-	-	9	9
Recurvirostridae	Himantopus himantopus	Black-winged Stilt	I	Migratory	Least Concern	-	-	-	120	600	720
Rhipiduridae	Rhipidura nigritorquis	Philippine Pied Fantail	I	Endemic	Least Concern	6	7	-	6	8	27
Scolopacidae	Calidris subminuta	Long-toed Stint	O	Migratory	Least Concern	-	-	-	-	4	4
	Tringa nebularia	Common Greenshank	I,C	Migartory	Least Concern	-	-	-	-	18	18
Turnicidae	Turnix suscitator	Barred quail	O	Resident	Least Concern	-	1	1	-	-	2
Tytonidae	Tyto capensis	Grass Owl	C	Resident	Least Concern	2	2	3	-	-	7
Zosteropidae	Zosterops everetti	Lowland White-eye	I	Resident	Least Concern	4	-	-	-	-	4
Total Number of Individuals						227	205	92	552	2463	3539
Total Number of Species						22	26	23	25	41	71
Total Number of Families						18	21	19	15	20	37

Note: I-Insectivore; O-Omnivore; P-Piscivore; C-Carnivore; F-Frugivore; G-Granivore

474. Ten (10) types of feeding guilds were observed and recorded for all bird species at five (5) transects. Insectivory is the dominant feeding guild and comprises 31% of the total number of species. This is followed by omnivores with 16%, carnivores (15%), carnivores-insectivore (14%), granivore (8%), Frugivore and insectivore (5%), Piscivore and Insectivore (4%), both Piscivore and frugivore with 3%, and granivore-insectivore (1%). Insectivores are the most affected when there are perturbances or disturbances happening in an area or habitat. The percentage of species belonging to different feeding guilds is presented in **Figure 3.1.50**.

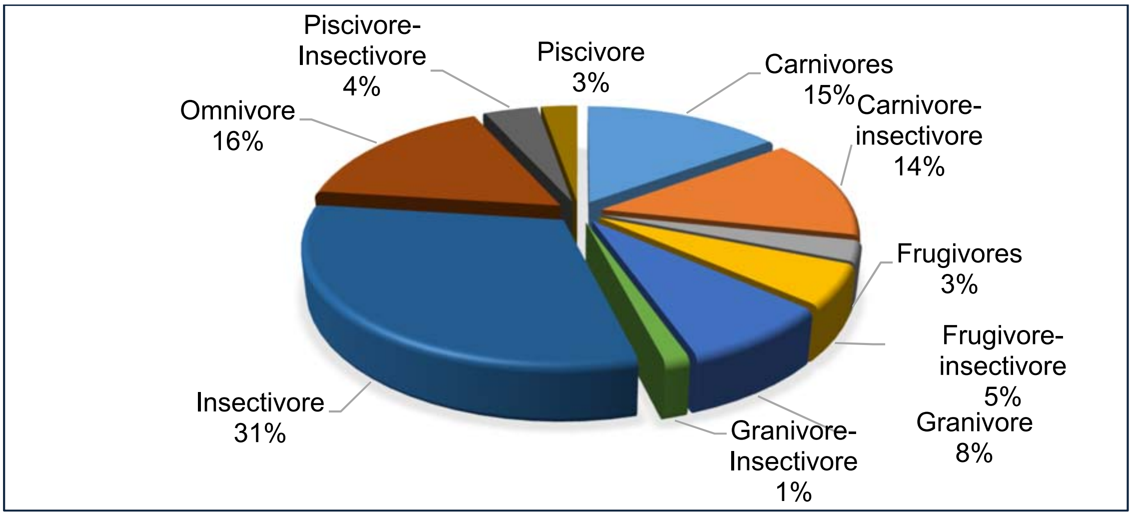


Figure 3.1.50 Percentage of Observed Birds Species Belonging to Different Feeding Guilds

475. **Figure 3.1.51** shows that most of the species of birds present at five (5) transects are residents (65%), twenty-eight percent (28%) are migrants, and 7% are endemic. It is understandable that there is a high percentage of migratory birds because Pampanga is a 'stop-over' area of migratory birds flying south to Australia. Some individuals stay in the Pampanga wetlands until the time for them to fly back north.

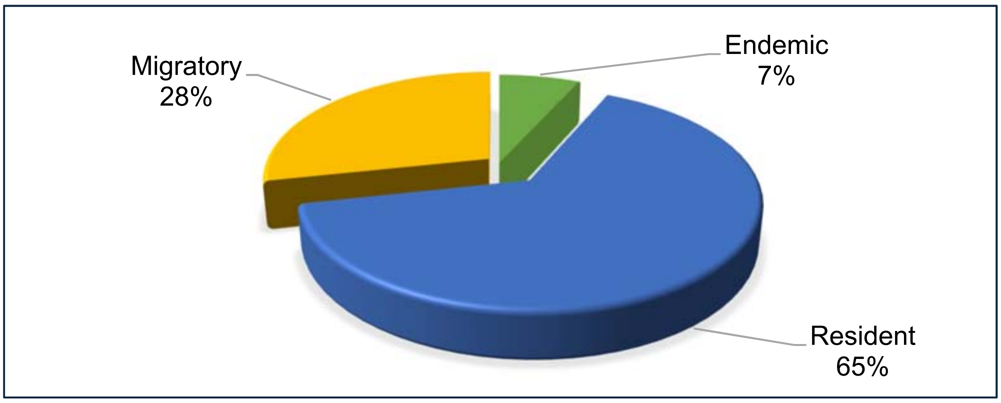


Figure 3.1.51 Percentage of Bird Species Belonging to Different Distribution Patterns

476. There were more bird species recorded in Transect 5 in Barangay Lourdes (41), Transect 2 in Barangay Cut-cut (27), Transect 4 in Barangay San Matias (25), Transect 3 in Barangay San Roque (24), and Transect 1 in Barangay Aranguren (22) (**Figure 3.1.52**). Because of the presence of migratory birds which flocked to Pampanga during the months of December to March, there were more individuals of birds counted in Transect 5 in Barangay Lourdes (2463) followed by the site near the vicinity of Transect 4 in Barangay San Matias (552), Transect 1 in Barangay

Aranguren (227), Transect 2 in Barangay Cut-cut (213), and the least was in Transect 3 in Barangay San Roque (97). Transect 1 in Barangay Aranguren has the least number of species recorded because there is less variety of habitat composed of rice fields, and is near a ranch. It is also a disturbed site because it is near a road construction project.

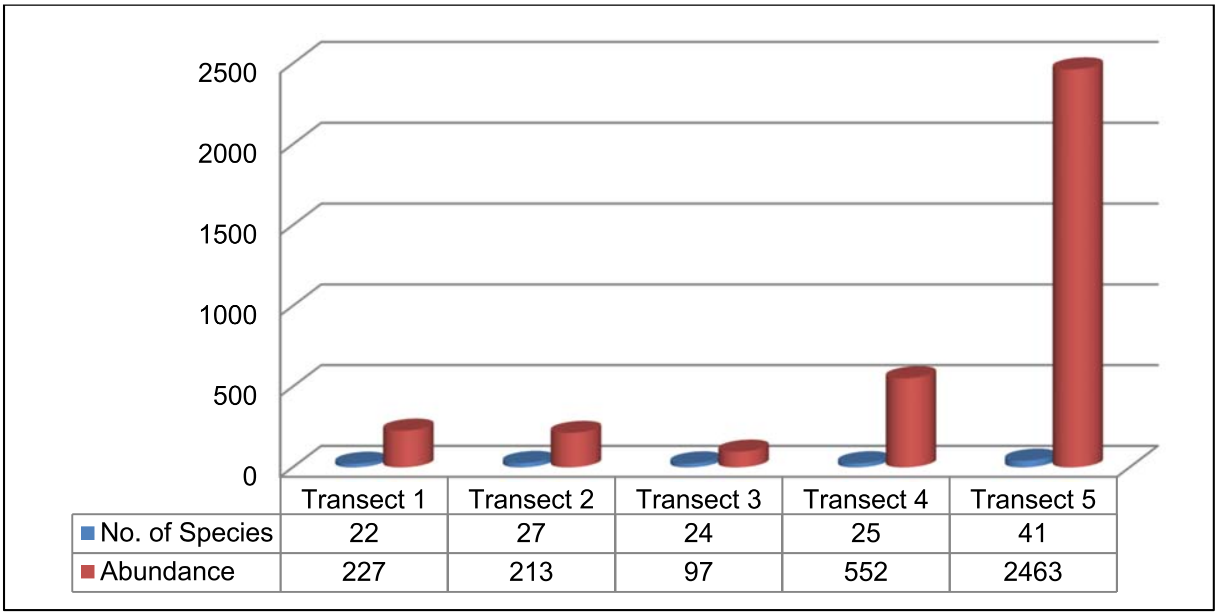


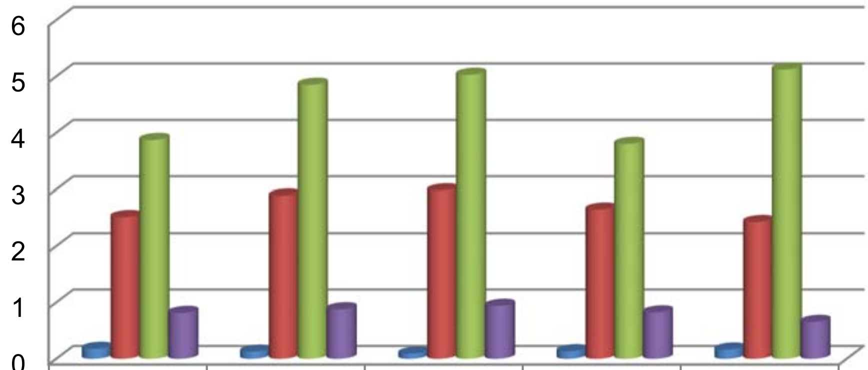
Figure 3.1.52 Comparison of the Number and Abundance of Bird Species at Five (5) Transects

477. **Figure 3.1.53** shows a comparison of the values of diversity indices for bird species between sites. Species dominance is highest in Transect 1 in Barangay Aranguren (0.176), and the least in Transect 3 in Barangay San Roque (0.09066). This indicates that although Transect 5 in Barangay Lourdes is the highest in abundance, Transect 1 in Barangay Aranguren has more dominant species over the other sites. This is maybe due to the high number of individuals recorded per species that contributes to the high dominance value of the said sites.

478. Species diversity is moderate in all sites with Transect 3 in Barangay San Roque having the highest value (2.98) and the least in Lourdes (2.426). Although Transect 3 in San Roque has the least number of individuals present, it means that the species are equitably distributed in the community.

479. Species Richness is moderate in Transects 1, 2 & 4. Transect 3 in Barangay San Roque and Transect 5 in Barangay Lourdes had high species richness with the highest value recorded in Transect 5.

480. Comparing the evenness of each site, it showed in the graph that although Transect 5 in Barangay Lourdes has the highest dominance value; it has the least evenness value. This means that the number of individuals per species is not equally or normally distributed in the said area.



	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5
Species Dominance	0.176	0.1253	0.09066	0.1333	0.1633
Species Diversity	2.512	2.888	2.98	2.646	2.426
Species Richness	3.871	4.85	5.028	3.801	5.122
Evenness	0.8129	0.8778	0.9389	0.822	0.6534

Figure 3.1.53 Comparison of Values of Diversity Indices of Bird Species at Five (5) Transects

Mammals

481. A total of three (3) species of mammals belonging to two (2) families were recorded at five (5) transects (**Table 3.1.26**). Mammals observed and recorded during the survey are composed of two (2) volant fruit bats namely; Cynopterus brachyotis and Macroglossus minimus of the Family Pteropodidae and one (2) introduced species of non-volant mammal Rattus tanezumi of the Family Muridae. The highest number of species was observed from Transect 3 in Barangay San Roque where both two (2) species are captured and released from the mist nets. In terms of the number of individuals captured, Transect 1 in Barangay Aranguren has the highest captured-released individuals of a species of fruit bat (Cynopterus brachyotis). This is followed by Transect 2 in Barangay Cut-cut with ten (10) captured-released individual and six (6) from Transect 5 in Barangay Lourdes. Based on the data, Cynopterus brachyotis is the most dominant species. It is noted that this species is much highly adapted to disturbances compared to other species of bats.

482. On the other hand, there is only one (1) species of non-volant mammal captured using live traps. Transect 1 in Barangay Aranguren and Transect 2 in Barangay Cut-cut has the highest recorded number of individuals of this invasive and introduced species. This may be attributed to less proximity to human settlements and less presence of cats and dogs because these sites are both in an open field mainly composed dry brushland and ricefields. This species of non-volant mammal is commonly found in and around villages or human settlements and agricultural areas and is a persistent pest.

483. All of the species caught in the mist nets and live traps are adapted to different habitat types and abundant and widespread.

Table 3.1.26 List Mammals Species Recorded at Five (5) Transects

Family	Scientific Name	Common Name	Habitat	Population Status	Residency Status	Conservation Status	Transect 1	2	3	4	5	Total
Volant												
Pteropodidae	Cynopterus brachyotis	Lesser Musky Fruit Bat	Lower montane forests, dipterocarp forests, gardens, mangrove and strand vegetation	Abundant and widespread; populations stable and increasing	Native	Least Concern	26	10	4	0	6	46
	Macroglossus minimus	Dagger-toothed nectar bat	Found in disturbed and agricultural areas	Abundant and widespread; populations stable and increasing	Native	Least Concern	0	0	3	0	0	3
Non-Volant												
Muridae	Rattus tanezumi	Oriental House Rat	abundant in all habitats	Non-native pest; abundant	Introduced	Least Concern	5	5	0	0	0	10
Total Number of Individuals							31	15	7	0	6	59
Total Number of Species							2	2	2	0	1	3
Total Number of Families							2	2	1	0	1	2

484. The number of species in each transect range from zero (0) in Transect 4 in Barangay San Matias to two (2) in Transects 1, 2 and 3 in Barangays Aranguren, Cut-cut and San Roque, respectively (**Figure 3.1.54**). The paucity of species of mammals in all transects may indicate that the areas are not able to sustain such species because of the lack of forests and fruiting trees where Volant mammals can roost or feed on, especially in brush and marsh lands in Transect 4 in Barangay San Matias and in Transect 5 in Barangay Lourdes.

485. Fruit bats are abundant in Transect 1 in Barangay Aranguren with more than 31 individuals caught in the mist nets because there are adjacent farms, which have patches of fruit bearing trees with flowers, particularly mangoes, Cacao, Ficus and other agricultural crops compared to the other sites. The availability of resources and the adaptive capability of each species to thrive in different types of environment is a factor that can contribute to the high number of individuals present in each site interspersed between fields. A few rats were caught in the live traps because the fields were newly harvested and there are still grain stalks scattered in the fields where the rats can feed on.

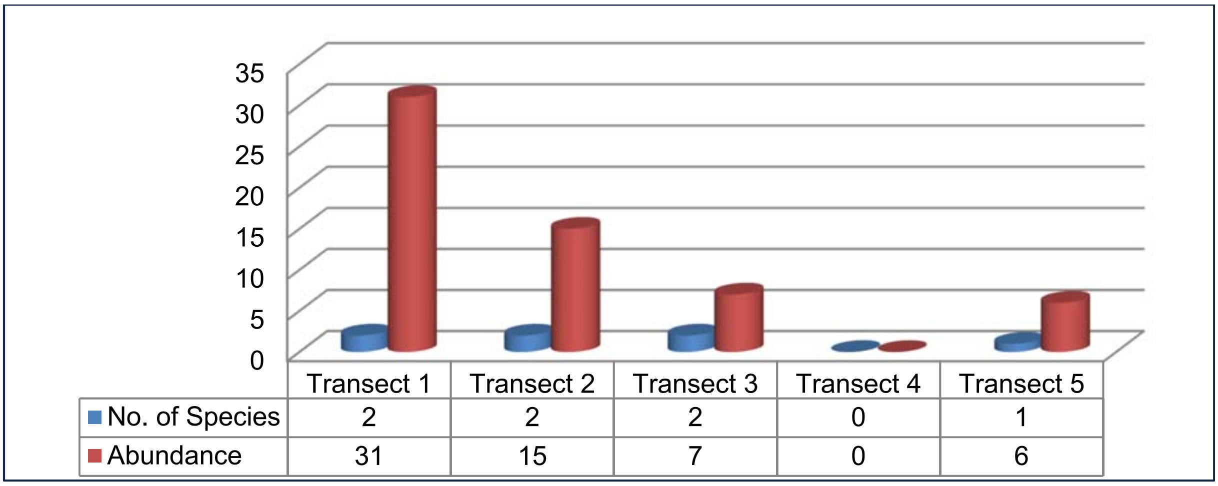
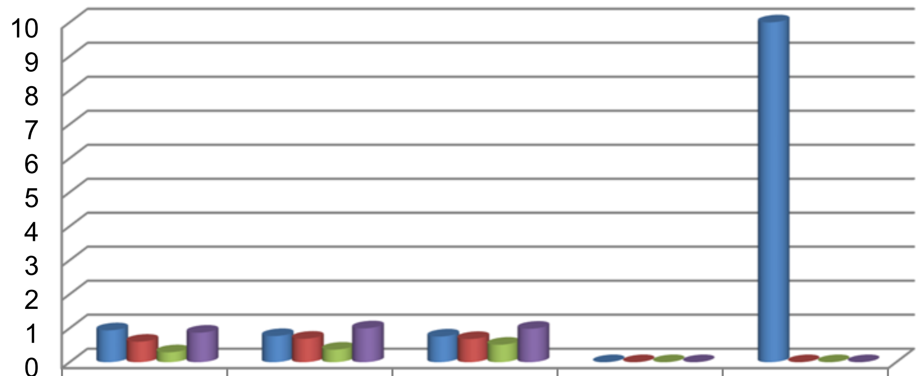


Figure 3.1.54 Comparison of the Number and Abundance of Mammal Species at Five (5) Transects

486. Values of diversity indices are very low in all transects (**Figure 3.1.55**). This is because of the very low number of species documented in all the sites especially in Transect 4 in Barangay San Matias where there was no species caught whether volant or non-volant mammal.



	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5
Species Dominance	0.9376	0.7689	0.7551	0	10
Species Diversity	0.6024	0.6909	0.6829	0	0
Species Richness	0.2912	0.3693	0.5139	0	0
Evenness	0.8691	0.9968	0.9852	0	0

Figure 3.1.55 Comparison of Values of Diversity Indices of Mammal Species at Five (5) Transects

Herpetofauna

487. Fifteen (15) species of herpetofauna were observed and recorded at five (5) transects. Five (5) of these are Amphibians, belonging to four (4) families including the ubiquitous, exotic and invasive Rhinella marina which was the most common amphibian. The reptiles are composed of five (5) species of lizards belonging to three (3) families and five (5) species of snakes from three (3) families (**Table 3.1.27**).

488. Transect 3 in Barangay San Roque had the highest number of species with eight (8) followed by Transect 1 in Barangay Aranguren (7), Transect 2 in Barangay Cut-cut and Transect 5 in Barangay Lourdes with six (6) species each. The lowest was in Transect 4 in Barangay San Matias with only two (2) species documented. Transect 3 in Barangay San Roque was the only site which had a variety of habitats including patches of forests, groves of fruit trees and grassland.

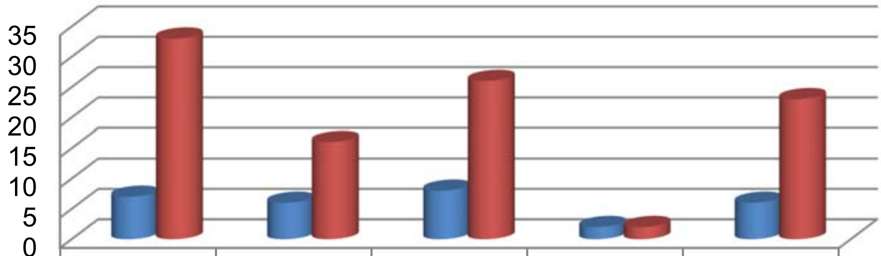
489. Aside from the Cane Toad Rhinella marina, the Tokay Gecko Gekko gekko was common in most of the sites except Transect 4 in Barangay San Matias. The Indian Wolfsnake Lycodon capucinus was documented in Transect 2 in Barangay Cut-cut and in Transect 5 in Barangay Lourdes while the rest were observed and recorded only once in each of the site where they were caught.

490. Amphibians and reptiles use microhabitat such as rock crevices, rotten logs, leaf litters, tree holes, epiphytes, ponds, streams, puddle as their habitat compared to mammals with roosting sites. Also, compared to mammals they are highly dependent on environmental variables such as temperature and humidity as common environmental variable. Meaning they are more sensitive to induced or natural environmental changes. Hence, they are good bio-indicators.

Table 3.1.27 Inventory of Herpetofauna

Family	Scientific Name	Common Name	Habitat	Residency Status	Conservation Status	Transect					Total
						1	2	3	4	5	
AMPHIBIANS											
Bufonidae	Rhinella marina	Cane Toad	All habitat types	Introduced	Invasive	20	6	15	-	8	49
Dicroglossidae	Hoplobatracus rugulosus	Chinese Edible Frog	All habitat types	Introduced	Invasive	2	-	-	-	-	2
	Fejervarya cancrivora	Asian Brackish Frog	Aquatic habitat type	Native	Data deficient	-	-	-	-	2	2
Ranidae	Hylarana erythraea	Common Green Frog	Aquatic habitat type and open areas	Native	Least Concern	-	2	-	-	-	2
Rhacophoridae	Polypedates leucomystax	Common Tree Frog	Forest and open areas; arboreal	Native	Least Concern	2	2	-	-	-	4
REPTILES	Lizards										
Agamidae	Bronchocela marmorata	Green agamid	Secondary forest and agricultural areas	Native	Least Concern	-	-	1	-	-	1
Gekkonidae	Gekko gecko	Tokay Gecko	Found in diverse range of habitat	Native	Least Concern	1	3	1	-	1	6
	Hemidactylus frenatus	Common House Gecko	Diverse habitat range	Native	Least Concern	6	-	1	-	10	17
Scincidae	Eutropis multicarinata borealis	Many-keeled sun Skink	Forests, disturbed and undisturbed areas	Native	Least Concern	1	-	2	1	-	4
	Eutropis multifasciata	Many-lined Sun Skink	Forests, disturbed and undisturbed areas	Native	Least Concern	1	-	-	1	1	3
	Snakes										
Colubridae	Dendrelaphis cf. philippinensis	Philippine bronzeback	Forest, vegetation above land or streams, bushes or trees	Native	Least Concern	-	1	-	-	-	1
	Lycodon cf. capucinus	Indian Wolfsnake (need confirmation)	Lowland tropical forest and in disturbed habitat such as plantations, cultivated areas, villages, and urban areas	Native	Least Concern	-	2	-	-	1	3
	Gonyosoma oxycephalum	Red-tailed green rat snake	Primary forest, but appears to prefer edge habitats, secondary growth, plantations and rural gardens	Native	Least Concern	-	-	2	-	-	2
Elapidae	Naja naja	Asian cobra	Inhabits lowland and upland forest, cultivated areas, and rice paddies. It is found in deciduous, disturbed and open forest, and is absent from closed-canopy evergreen forest	Native	Least Concern	-	-	3	-	-	3
Pythonidae	Malayopython reticulatus	Reticulated Python	Lives in rain forests, woodlands, and nearby grasslands. It is also associated with rivers and is found in areas with nearby streams and lakes	Native	Least Concern	-	-	1	-	-	1
Total Number of Individuals						33	16	26	2	23	100
Total Number of Species						7	6	8	2	6	15
Total Number of Families						5	5	7	1	5	10

492. **Figure 3.1.56** shows that there are no major differences observed and recorded in terms of the number of species present in five (5) transects except in Transect 4 in Barangay San Matias where no nocturnal survey was conducted. Transect 1 in Barangay Aranguren showed the highest number of individuals with 33, 25 from Transect 3 in Barangay San Roque, 23 from Transect 5 Barangay Lourdes, 16 from Transect 2 Barangay Cut-cut, and 2 from Transect 4 Barangay San Matias.

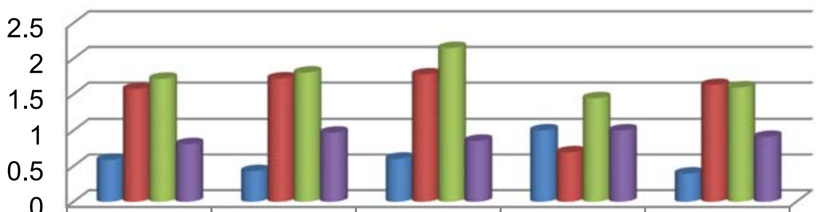


	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5
No. of Species	7	6	8	2	6
Abundance	33	16	26	2	23

Figure 3.1.56 Comparison of the Number and Abundance of Species of Herpetofauna at Five (5) Transects

493. Species dominance and evenness is highest in Transect 4 in Barangay San Matias with a value of 1 for both indices (**Figure 3.1.57**). This shows that the sampled number of individuals for the site are less variable or most likely the same or normally distributed for the whole transect in comparison with other sites. Species diversity and richness are very low in all sites with Transect 3 in Barangay San Roque having the highest value of 1.777 and 2.148 respectively while it is lowest in Transect 4 in Barangay San Matias (0.6931).

494. Recorded species of amphibians and reptiles recorded in five (5) transects needs less conservation management since most of the species observed are species that occur in diverse range of habitats that can be classified to no to high disturbance areas. Further monitoring needs to be performed since all of the species has its own role in their respective environment where they thrive and adapt.



	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5
Species Dominance	0.5868	0.4297	0.6036	1	0.3951
Species Diversity	1.572	1.721	1.777	0.6931	1.629
Species Richness	1.716	1.803	2.148	1.443	1.595
Evenness	0.8079	0.9681	0.8545	1	0.909

Figure 3.1.57 Comparison of Values of Diversity Indices of Species of Herpetofauna at Five (5) Transects

(3) Biodiversity Value

1) Birds

495. Based on the conservation status, 100% of the bird species are of Least Concern (**Table 3.1.25)**. This indicates that the species of birds observed and recorded along the proposed railway are widespread and abundant and are not in any danger of becoming extinct.

2) Mammals

496. There is no much variation in species observed in all survey sites. All captured and recorded species are native species and introduced species of mammals that are highly adapted to disturbed areas especially areas near human settlements (**Table 3.1.26**).

3) Herpetofauna

497. The distribution and conservation status of amphibians and reptiles observed and recorded in five (5) transects are mostly species that inhabits varied habitat types and appears to thrive even in degraded and man-made environments; hence forest loss might not be a significant threat also. Amphibians and reptiles were found in or near streams and pools, trees within agricultural areas or near settlements. Most of the species noted and recorded were found in disturbed habitats.

498. No endemic species of amphibians and reptiles were recorded (**Table 3.1.27**). There are only two residency status noted during the survey (Native and Introduced). Approximately 13% are introduced species and 87% are native species of amphibians and reptiles. All species recorded are categorized as Least Concern based on IUCN like the recorded mammals and bird species.

3.1.4.3 Impact Identification, prediction and assessment and mitigation

(1) Pre-construction and Construction phase

1) Vegetation Removal and Loss of Habitat

499. Clearing of vegetation will be required along the railway, and for establishment of infrastructure such as borrow pits, laydown areas, water bores, and access tracks. Some significant cut and fill may be required where the proposed rail corridor traverses ridges and valleys respectively, which would extend the limit of clearing beyond the immediate vicinity of the rail line.

500. While the MCRP will utilize the existing PNR ROW for its alignment from Malolos to Clark, removal of vegetation cover along this route is minimal. However, the MCRP alignment from Clark to NCC which will traverse an area that is predominantly agricultural, the removal of vegetation in this area will be significant. Additionally, the removal of vegetation cover in a 40 ha depot will be also significant for this is also an agricultural area.

501. The vegetation communities documented at the established Transects depend largely on: (1) soil quality and fertility, (2) relative elevations and slopes, (3) moisture availability, (4) solar radiation, and (5) degree and type of disturbance in the area. The proposed MCRP may affect the existing vegetation communities by eliminating them or by altering one or more of the five (5) factors. Since the project area will undergo many and succeeding development activities to complete the components of the proposed MCRP, disturbance and further disruption of existing environment within and outside the project area will be soon observed.

502. Earthworks, disturbance to vegetation, vehicle movement and other factors have the potential to introduce additional weeds to the area and to spread existing populations of introduced flora along the length of the proposed rail alignment. The mesic environments such as minor creek

lines in Transect 1, Transect 2 and Transect 3 and wetlands are particularly susceptible to weed invasion.

503. Vegetation clearing and other site preparation activities will also destroy grasslands/marshland and some tree patches which serve as shelter and food for most wildlife species. This will lead to loss of habitats for most of the birds especially those, which are migratory. The effects during pre-construction will increase or magnify during the construction period. This may result to the disappearance of some species which will not be able to withstand the perturbations brought about by the entry of equipment added by people trampling over the habitats of wildlife. Other disturbances, which will affect species, are dust and noise pollution, which may drive fauna away from their habitats.

504. A complete census/inventory of flora along the alignment will be conducted after completion of parcellary survey under DED to determine the total counts of trees and other arborecent taxa that will be affected during pre-construction and construction activities. The list of affected trees will be submitted to EMB and DENR for application of tree cutting permit.

505. Vegetation clearing will be kept to the minimum necessary for safe construction and operation of the railway, particularly in areas adjacent to vegetation of higher conservation significance. The design of the rail alignment will be refined, taking into account the locations of significant vegetation types and populations of significant flora, with the objective of avoiding these through final design.

506. Prior to clearing activities, a tree cutting permit will be acquired from the DENR. A detailed plan for the management of affected flora will be prepared by DOTr. Proper assessment of the matured trees will be conducted in coordination with the DENR and LGUs to determine appropriate method of removal, if it will be transferred/earth balled or cut.

507. Matured trees will be transferred carefully to designated receiving areas. A detailed plan for transfer/earth balling of matured trees will be prepared prior to removal. The detailed plan will include proper handling of the uprooted tree and preparation of the recipient site to ensure high survival rate of the trees. A system to periodically monitor and maintain survival of these species will be set in place to assure high survival rate. DOTr will coordinate with the DENR and LGUs for the identification of relocation area for the potential trees that will be transplanted.

508. Tree planting activities will also be conducted to replace trees and vegetation that will be removed and affected by site clearing. DOTr will identify planting areas within the ROW, around the stations and depot not part of the development for replanting activity. For those that cannot be replanted within the project area, coordination with the DENR and LGUs on the identification of potential trees to be relocated and/ or replanted. The native/endemic/indigenous species of trees, shrubs and grasses should be cultivated/grown in nurseries. These will be used to restore habitats of wildlife at the buffer zone which will be established at the side of the railway. Buffer areas near or adjacent to the construction sites should be established where wildlife can flee or find shelter.

509. During construction, tree planting activities can be conducted where possible and regular monitoring of replanted trees will be conducted to check survival. Any of failed trees will be replanted as necessary.

2) Threat to Existence and/or Loss of Important Local Species

510. Based on the survey conducted, there are no endangered or endemic birds, mammals and herpetofauna species that will be affected by the construction of the proposed MCRP.

511. The proposed MCRP, on the basis of similarity of landscape and botanic-geographic features, form a large impact to the remaining terrestrial flora of the areas. The flora assessment

recorded 127 species of angiosperms which is documented only in the transect plots and within 1-km radius in sections. Among them, in terms of quantitative and population diversity, the rare, endemic and relict species are of considerable significance. These include Antipolo, Piling liitan, Is-is, Narra and Molave Pakiling, Anubing, Banato, Alibangbang, Binayuyu. Endangered and threatened species should be prioritized for species conservation. Indigenous and native plant and tree species naturally growing in the project site will be emphasized for conservation and protection planning in response to the conservation status reported in this report. Native tree species that is light tolerant and can withstand heat stress such as Lanete (Wrightia pubescens ssp. laniti), Batino (Alstonia macrophylla Wall. ex DC), and Dita (Alstonia scholaris (L.) R. Br.) will be used for tree planting activities.

3) Threat to Abundance, Frequency and Distribution of Important Species

512. The construction of the railway will result in the clearing of approximately 1,845 ha of vegetation, affecting most vegetation types along the alignment. Moreover, there could be adverse effects on the insects, wildlife or other organisms that depend on the vegetation as a source of food for insects, wildlife, or other organisms.

513. Results of the plant diversity assessment revealed that the project area has low to moderately low biodiversity index value while evenness indices varied from very low to low. However, a number of critically endangered, endangered, and vulnerable species were observed in the area namely: Antipolo, Piling liitan, Is-is, Narra and Molave.

514. Loss of habitat during land and site preparations prior to construction will result to the decrease in abundance and frequency of observed wildlife. Endemic species which may not be able to withstand disturbances (e.g. construction of structures, depots) may not thrive in the area.

515. To mitigate the impacts of the project, wildlings of the endangered and threatened species will be collected before construction and placed in the nursery and will be given priority during nursery operation to be used for rehabilitation of areas that will be affected by project. Buffer areas near or adjacent to the construction sites will be established where wildlife can flee or find shelter.

4) Hindrance to Wildlife Access

516. The amphibians will be mostly affected during pre-construction and construction phase. If the grassland/marshland is cleared, the area will dry up and access routes will be closed to these taxa. This may result to disappearance of some species from the affected areas. Alternate access routes or corridors for amphibians and mammals may be set aside inside work sites to allow wildlife to traverse.

517. As for mammals, very few species were recorded, with very few individuals. The two (2) species of bats were frugivores/nectarivores and the rat was a pest. The bats may have just been flying through from their feeding area returning to their roosts when caught in the nets. There were no trees which were suitable for roosting or feeding of bats along the proposed MCRP alignment.

518. The only natural habitat that could be considered significant to fauna is the open shrub to wooded land in the transect plots established in the proposed MCRP which are being visited by local bird species in the area. Most of the areas are either intentionally burned, cleared or occupied for residential purposes.

519. The annual migratory season starts in September and ends in March. Migratory birds were only observed in the fishponds/swamps and wetlands in Pampanga. However, the construction of the railway system along/beside or on those ponds and wetlands will destroy the feeding area of the migratory birds whether or not construction is done during the wet or dry season. For any concerns that may arise during pre-construction and construction phase, DOTr will consult the

DENR Biodiversity Management Bureau or the Society for Conservation of Philippine Wetland, Inc. (SCPW).

520. Insectivory is the dominant feeding guild among birds which may not be affected by the activities of the project because of the ability of birds to feed on trees, on air and on land. Most herpetofauna are insectivores except for those which prey on small mammals, e.g., snakes.

521. Construction Management Plan will be prepared and strictly implemented accordingly to minimize unnecessary removal of vegetation, generation of noise, vibration, illumination, and vehicular movement which can disrupt animal activities to minimize the ecological impact of construction activities in the vicinity to the ecologically significant areas. After hiring, all construction workers will be provided with training and orientation on the Construction Management Plan including the potential ecological impact of construction activities and the corresponding preventive and mitigative measures.

(2) Operation Phase

1) Vegetation Removal and Loss of Habitat

522. During the operation phase, no vegetation removal and clearing are expected. Tree planting activities will be conducted to replace trees and vegetation that were removed and affected by site clearing. Also, a regular monitoring of flora and fauna at sensitive area and survival of replanted trees will be conducted.

2) Threat to Existence and/or Loss of Important Local Species

523. During the operation phase, no vegetation removal and clearing are expected so there would be no threat to the existence and/or loss of important local flora species. As an additional consideration, implementation of vegetation management plan will be enforced including but not limited to the minimal use of herbicide and machineries.

3) Threat to Abundance, Frequency, and Distribution of Important Species

524. As previously mentioned, no vegetation removal and clearing are expected during operation phase. For landscaping of open areas, local or endemic species will be used as much as possible.

4) Hindrance to Wildlife Access

525. The grassland/marshland will be re-vegetated to allow wildlife to traverse. Regular maintenance of ROW to control vegetation may involve the use of mechanical methods, such as mowing or pruning machinery, in addition to manual hand clearing and herbicide use, all of which can disrupt wildlife and their habitats. Noise, vibration, illumination, and vehicular movement can disrupt animal activities.

Table 3.1.28 Summary of Impact Identification, Prediction, Assessment and Mitigation for Land

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
PRE-CONSTRUCTION / CONSTRUCTION				
Land acquisition for the MCRP ROW	Land use and Classification	Incompatibility with the Existing Land Use	C-	[Pre-Construction] • Maximise the use of existing PNR ROW from Malolos to Clark and BCDA property from Clark to NCC • Information sharing to the affected LGU to align and ensure that proposed MCRP will be accommodated in their future land use plan • Identification of future land use of surrounding areas that will result to a significant increase of transportation-oriented developments in cooperation with urban planners of LGUs to adopt in the future developments.
Construction of the proposed MCRP at the following: • Areas with the existing old PNR structures • Areas with high risk to typhoon passage, high susceptibility to flooding • Prime agricultural areas in depot site	ECA	Incompatibility with Classification as an ECA	B-	[Pre-Construction] • Plan and design the site, structure foundation, and structure including construction activities in consideration to the ECAs. • Coordinate with relevant government agencies and stakeholders as required
Land acquisition for the MCRP ROW	Land Tenure	Involuntary resettlement of informal settlers who had encroached portion of the existing PNR ROW; settlements outside the existing PNR ROW	B-	[Pre-Construction] • Implement Resettlement Action Plan in coordination with KSAs/ NHA, LGUs, lot owners and other concerned stakeholders and agencies to address the issue on land acquisition and relocation of informal settlers.
		Potential conflict with other government infrastructure projects	B-	[Pre-Construction] • Coordinate with BCDA, DPWH (depot site), and other relevant agencies
		Areas with CADT/CADC	B-	[Pre-Construction] • Coordinate with the NCIP for the conduct of FBI to determine the possible overlap with the CADT/CADC
Construction activities	Visual aesthetic	Degradation of aesthetic view	B-	[Pre-Construction/ Construction] • Design and install facilities to harmonise with the surrounding environments (shape, colour, size, etc.) • Identify planting area within the ROW that will not be covered by development to act as buffer zone, green corridor and to lessen aesthetic sore brought by construction and railway structures, and plant trees [Construction] • Maintain the construction site/ yards tidy and clean and rehabilitate after construction. • Provision for temporary screens/ walls to minimise the visual clatter.
Generation and improper handling and disposal of domestic and hazardous solid waste.	Land Value	Devaluation of land value as a result of improper solid waste management	B-	[Pre-Construction] • Identify the final disposal site for solid waste, excavated soil and hazard waste at each LGUs. [Construction] • 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 monitoring on disposal/handling

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
				• Conduct Social Development Plan (SDP) including waste management to the communities
Generation and improper handling and disposal of excavated soil, leftover concrete by excavation activities (Excavated Soil)	Land Value	Devaluation of land value as a result of improper handling of excavated soil	B-	[Pre-Construction/Construction] • Plan and implement recycling and reuse of excavated soil to be utilised for the project/ other project as much as possible. In case of excessive soil to be generated, identify the final spoil disposal site. [Construction] • Place excavated materials on appropriate dump sites or spoils area and with adequate containment. • Strictly implement construction plan, soil management plan, and proper disposal by contractor in accordance to RA 9003, minimization of waste, segregation.
Construction of embankment	Topography	Permanent and major modification of the terrain and alteration of landform	C-	[Pre-Construction /Construction] • Formulate appropriate design measures for the protection on slopes and banks, soil improvement / ground reinforcement to minimise ground failure during construction based on the results of the geological survey and geotechnical investigations.
Earthworks, (excavation, backfilling, stockpiling, tunneling/ underground) and natural hazards	Geology/ Geomorphology	Ground Subsidence Liquefaction Landslide, Mud/ Debris Flow, etc.	B-	[Pre-Construction/Construction] • Design and implement appropriate foundation and structures based on combination of geotechnical, geodetic and hydrologic study, and seismicity studies, and in compliance with the National Building Code and the Structural Code of the Philippines and internationally accepted guideline. • Design and install emergency escape route, early warning (alarm) system, emergency power supplies in the design of the structure particularly in the viaduct. • Plan and implement appropriate construction method, schedule, and activities based on combination of geotechnical and geological investigations, and seismicity studies in coordination with the PHIVOLCS. [Construction] • Install sufficient protection measure 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.
Clearing and removal of vegetation, stripping of soil cover, excavation of underlying rock, grading or construction of embankments.	Pedology	Soil erosion/loss of top soil	B-	[Pre-Construction/ Construction] • Design and install of appropriate mitigating measures to prevent or minimize slope failure during construction based on the results of the geohazard assessment and geotechnical investigations. [Construction] • Minimise the removal of vegetation cover as much as possible, provision of slope stabilization measure/s, when necessary. • Install surface water runoff drainages system, protection of slope and bank as required. • Implement appropriate materials handling program or a site protection and rehabilitation program including but not limited to the following; - Scheduling of clearing and excavation activities in speedy manner during dry season if possible. - Installation of temporary erosion ponds or silt traps around the major work areas. - Placement of excavated materials on appropriate staging site or spoils area and with adequate containment. Limit stock pile height up to 2 m high only. - Installation of fence at the stockpiles of sand and gravel to reduce sediment transport during heavy rains including reduction of storage time in the work areas.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
				• Utilize heavy equipment for transporting, hauling and excavating material from one area to another so as to avoid spills into drainage system
• Accidental spills of fuels /lubricants from construction vehicles & machineries/ hazardous chemicals. • Generation and improper handling/ disposal of construction/ domestic /hazardous wastes.	Pedology	Degradation of soil quality (soil contamination)	B-	[Construction] • Proper inspection and maintenance of machines and equipment. • 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.
Drilling and excavation at previously contaminated site (e.g. Old Calumpit Dump Site)	Pedology	Exposure to contaminated soil	C	[Pre-Construction] • Identify a potential contaminated site and conduct of soil sampling survey at potential contained site, if necessary. • Conduct Environmental Site Assessment if there is suspected contamination on the proposed location of facilities (e.g. depot). In case that toxic substances are found within the project area and/or adjacent sites, prepare contaminated soil management plan and implement necessary remediation measures. • Storage, handling, transport, treatment and disposal of contaminated soil will be in accordance with RA 6969 [Construction] • Conduct continuous monitoring of toxic level to ensure that contaminants will not pose hazards. In case traces are detected, construction activities on affected site will be paused until a soil management plan is developed and implemented in consultation to the DENR – EMB.
Removal of vegetation along the proposed MCRP particularly the planted trees at other areas along the ROW	Terrestrial Ecology (Flora)	• Loss of Habitat • Threat to Existence and/or Loss of Important Local Species • Threat to Abundance, Frequency and Distribution of Important Species • Hindrance to Wildlife Access	B-	[Pre-Construction] • Design, plan and implement the project that will minimise vegetation clearing, alteration of landform, generation of noise, vibration, illumination, and vehicular movement particularly in areas adjacent to flora of higher conservation significance (i.e. Antipolo, Is-is, Narra) and in the vicinity of ecological significant areas. • Conduct 100% inventory of the affected trees along the alignment to determine the total counts, category, and characteristics of affected trees and minimise removal particularly in areas adjacent to vegetation of higher conservation significance as much as possible. Native/endemic/ indigenous species of trees, shrubs and grasses will be specified. • Wildlings of the endangered and threatened species, if any, will be collected before construction, placed in the nursery, and give priority during nursery operation to be used for rehabilitation of areas that will be affected by project • For tree replanting, areas not part of the development within the ROW, around the stations and depot will be prioritized for replanting activity to create buffer zone and to improve habitat for wildlife. For those that cannot be replanted within the project area, DOTr will coordinate with the DENR and LGUs on the identification of area for the potential trees that will be relocated. • Earthballing of trees (if there are any) will be coordinated with the DENR and LGUs including the site where the earthballed trees will be transplanted • Secure tree cutting permit in compliance with DENR Memorandum Order No. 2012-02. [Construction] • Prior to any clearing activity, clearly mark the ROW to avoid the unnecessary clearance of tree cutting.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
				• Conduct tree planting activities to compensate site clearing activities. Conduct regular monitoring on survival of replanted trees and replant if necessary.
• Earthworks and vehicle movement. • Generation of dust and noise, vibration, and illumination pollution.	Terrestrial Ecology (Fauna)	• Loss of Habitat • Threat to Existence and/or Loss of Important Local Species • Threat to Abundance, Frequency and Distribution of Important Species • Hindrance to Wildlife Access	B-	[Pre-Construction/ Construction] • Design, plan and implement the project that will minimise vegetation clearing, alteration of landform, generation of noise, vibration, illumination, and vehicular movement particularly in areas adjacent to flora of higher conservation significance (i.e. Antipolo, Is-is, Narra) and in the vicinity of ecological significant areas. • Prepare and implement a tree and vegetation management plan as part of the construction plan considering the significance to fauna (local bird species) such as installing buffer zone, minimising the use of herbicide and machinery as much as possible. • Coordinate with BMB-DENR and SCPW for the conservation of migratory birds if required.
OPERATION				
Operation and maintenance of the proposed MCRP	ECA	Incompatibility with the area that will be hardly hit by natural calamities.	B-	• Coordinate with PAGASA / PHIVOLCS and adjustment of train schedules. • Implement proper inspection and prompt maintenance of drainage systems.
Presence of the proposed MCRP structures (railway, passenger facilities, depot etc.)	Visual aesthetics	Impairment of visual aesthetic	C-	• Maintain tree planting to minimise the visual impact by the project and harmonise to the surrounding environments in open areas within the ROW, depot and around the stations, to create green corridor.
Generation and improper handling of domestic and hazardous wastes including accidental oil and lubricant spills from passenger facilities (station), depot.	Land value	• Degradation of land value • Change in soil quality	C-	• Conduct proper inspection and prompt maintenance of machines and equipment, and facilities • Strictly implement solid waste management plan in accordance to RA 9003, and treatment of hazardous chemicals and contaminated soil in accordance with RA 6969 including monitoring. • Conduct of soil quality monitoring when necessary.
• Occurrence of landslides, volcanic hazards, ground shaking and liquefaction • Likely seismic events around MCRP line	Subsidence, Liquefaction, Landslide, Mud/Debris Flow, etc	• Damage to tracks • Risk to the life of passengers and workers • Damage to passenger facilities.	B-	• Conduct inspection in the event of natural hazard occurrence to assess damage of structures • Regular Coordination with the PHIVOLCS for earthquake and volcanic events to adjust the train schedule as necessary. • Conduct earthquake drills for train users are also advised • Conduct proper inspection and prompt maintenance checks to every single installed structure and facility and improve/ enhance capacity when possible • Upgrades or install new technological advances when available are also encouraged for the continued operation of MCRP
Operation of the proposed MCRP and passenger facility, Depot, service vehicle, Passenger movement	Terrestrial Ecology	• Loss of Habitat • Threat to Existence and/or Loss of Important Local Species • Hindrance to Wildlife Access	C-	• Minimised noise, vibration, illumination, and vehicular movement in significant fauna area • Continuous planting of replacement tress if any. • Conduct monitoring on survival of replanted trees and replant if required. • Implement vegetation management plan considering significant fauna (local bird species) to minimise the use of herbicide and machinery as much as possible.

Note:
A+/-: Significant positive/negative impact is expected.
B+/-: Moderate positive/negative impact is expected to some extent.
C+/-: Minor / Negligible positive/negative impact is expected to some extent.
D: Extent of impact is unknown.

3.2 WATER

3.2.1 Hydrology/Hydrogeology

3.2.1.1 Drainage Morphology / Inducement of Flooding / Reduction in Stream

(1) Drainage Morphology

526. The hydrological characteristics of the area are defined by the Pampanga River Basin (**Figure 3.2.1**). The Pampanga River basin system is the fourth largest basin in the Philippines. It is broadly divided into three (3) sub-basins namely: Pampanga Main River basin, Pasac River basin (or alternatively known as the Pasac-Guagua Allied river basin) and the Angat River basin. The headwaters of these three basins originate from different mountain areas with separate river channels draining into the Manila Bay.

Pampanga River

527. The Pampanga River has a channel length of around 265 km, originating in the Caraballo Mountains north of the basin, and flows into Pantabangan Dam. From the dam it further flows southward meeting with several tributaries until emptying into Manila Bay. The river's main tributaries are the Rio Chico River from the northwest side and the Coronel-Santor and Peñaranda Rivers on the eastern side of the basin.

Pasac-Guagua River

528. The Pasac-Guagua River system includes various channels draining on the eastern slope of Mt. Pinatubo, such as the Abacan-San Fernando, Pasig-Potrero and Porac-Gumain Rivers, which all flow into Manila Bay. In the lower reaches, the river system is connected with Main Pampanga River by the Bebe-San Esteban Cut-off Channel.

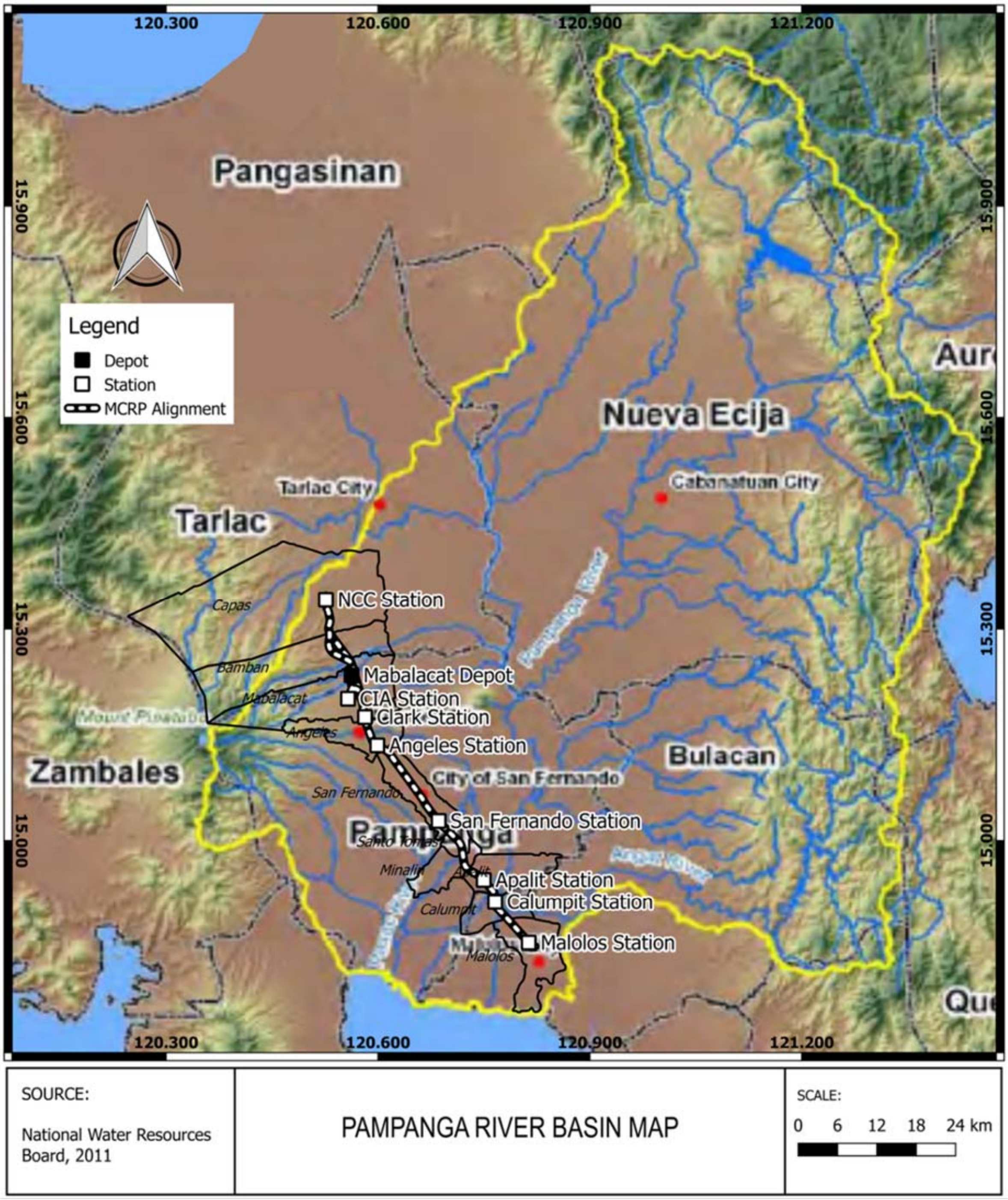
Angat River

529. The Angat River system originates in the Sierra Madre Mountains and flows into the Angat storage dam. From the dam the river flows westward and finally empties into the Manila Bay through Labangan Floodway. The Angat River joins the Pampanga River at Calumpit, Bulacan via a connecting waterway, the Bagbag River. Southeast of the Pampanga River is the Candaba Swamp, which covers an area of some 250 square kilometers. The Candaba Swamp absorbs most of the flood flows from the western slopes portion of the Sierra Madre and the overflows of the Pampanga River via the Cabiao Floodway. This area is submerged during the rainy season but is relatively dry during summer.

530. There are the two major hydraulic structures within the Pampanga River Basin, the Pantabangan Dam located upstream of the upper main Pampanga River and Angat Dam, located on the eastern lower portion. Both operate as a hydropower and as an irrigation reservoir. Within the province of Bulacan are two other dams, the Ipo and Bustos Dams. Ipo Dam, located about 7 km downstream of Angat Dam, is primarily a diversion dam and active reservoir for water supply requirements of Metro Manila. With a capacity of only around 7.5 million (M) m^3 compared to Angat Dam, which has a reservoir capacity of around 850M m^3, it supports and minimally regulates releases coming from the Angat Dam. If the impounded water exceeds this volume, water starts to overflow the radial gates. On the other hand, Bustos Dam located around 38 km downstream of Ipo serves mainly as an irrigation reservoir.

Sacobia River

531. The Sacobia River is a major river system of Pampanga whose channels were affected by the deposition of lahar during and after the 1991 eruption of Mt. Pinatubo.



Source: The Study on Integrated Water Resources Management for Poverty Alleviation and Economic Development in the Pampanga River Basin in the Republic of the Philippines, 2011, National Water Resources Board

Figure 3.2.1 Pampanga River Basin

(2) Stream and Lake Water Depth

532. The stream or river crossings were identified based on the MCRP Route and combination of field surveys and analysis of topographic maps and Google images. From the standpoint of environment, the river crossings were identified to facilitate the assessment of impacts on the water depths or flow. The inferred diversions will be validated during the DED by the engineers of the railway spans or bridges as these may have relevance on the height of the railway track or pile relative to the river bed.

533. The MCRP segments from Malolos to CIA and up to the Mabalacat Depot will traverse a flat area which corresponds to the lower section or floodplains of major river systems of Central Luzon. The segments from Mabalacat Depot to San Fernando will intersect the main channels and tributaries of the rivers originating from the western upper slopes of Mt. Pinatubo. These segments will intersect the valleys of these waterways 11 times. The main rivers include Mabalacat River which intersected north of the CIA Station and the Abacan River which intersected northwest of the Angeles Station. These two (2) rivers serve as the avenues for the transport of lahar to the lower slopes of the volcano and into Mabalacat and Angeles areas.

534. The hilly to mountainous segment from Mabalacat Depot to NCC Station is drained by east flowing rivers and streams. The alignment will intersect the valleys of these waterways at least five (5) times. The main drainage system corresponds to the Bamban River which intersected north of the Mabalacat Depot. The rest of the intersected streams are unnamed.

535. The segments from San Fernando to Malolos are drained by the lower reaches of the west flowing San Fernando River, Pampanga River, Angat River and their respective tributaries. These waterways are intersected by the railway segments 16 times. The main river crossings correspond to San Fernando River immediately south of San Fernando, Sulipan Floodway Channel and Pampanga River which are located south of the Apalit Station and Angat River which is located south of the Calumpit Station.

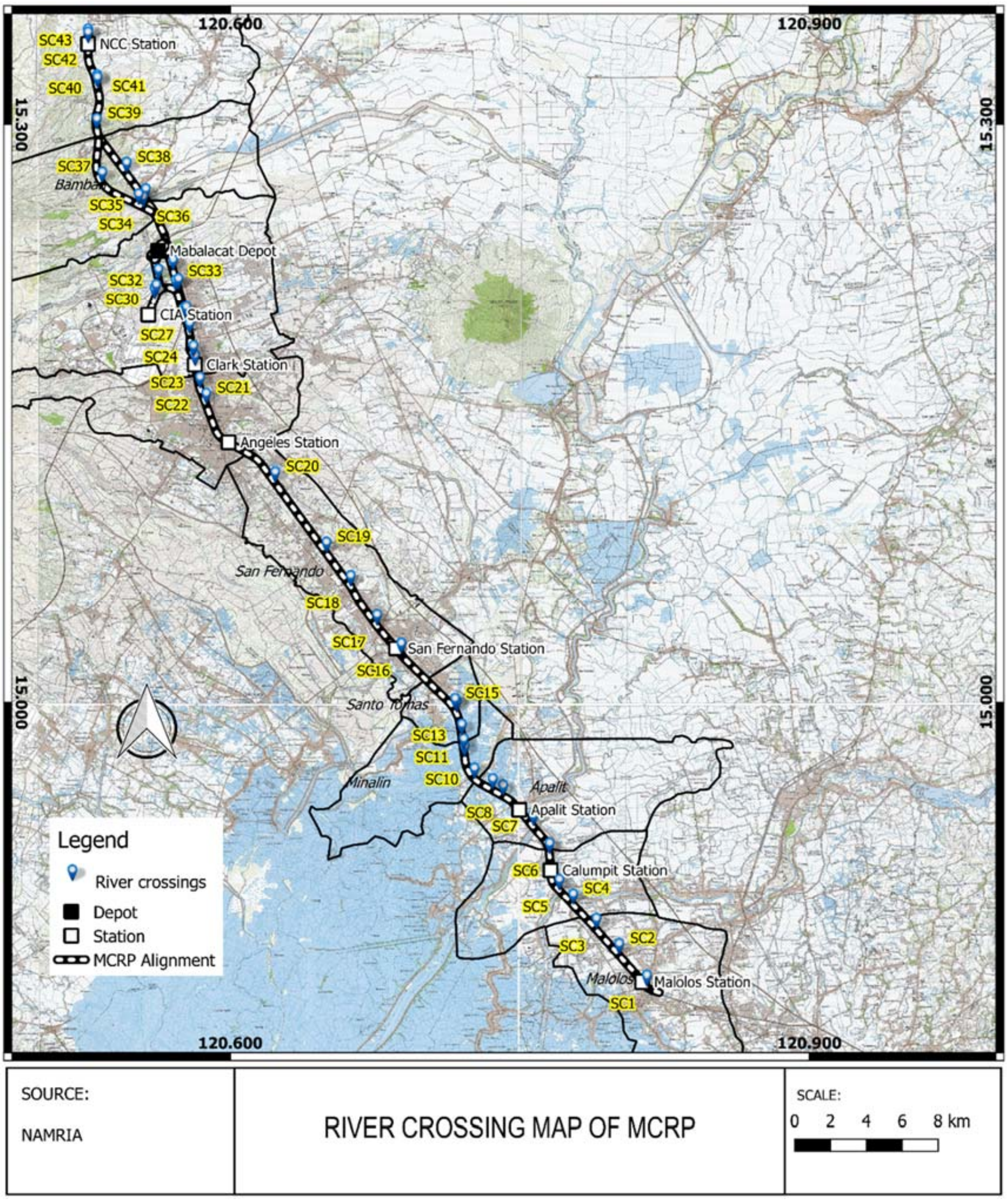
536. Overall, the MCRP alignment was intersected by rivers and streams at 43 locations as presented in **Table 3.2.1**. **Figure 3.2.2** shows the plot of 43 rivers/streams crossings with respect to the MCRP line, stations and depot. The maps of the rivers/streams crossings per municipality/city are presented in **Annex 3-3**.

537. At the time of the study, the water depths at the points of intersections of small streams and rivers, are generally less than or equal to 0.5 meters. Deeper waters are inferred at the main channels of Angat River, Pampanga River, and the floodway, San Fernando River, Bamban River and Abacan River. These conditions though will increase during the rainy season.

Table 3.2.1. MCRP Segments and Corresponding River/Stream Crossings

Segment	No. of River/ Stream Crossings	Label	River/Stream Name	Latitude	Longitude
Malolos to Calumpit Station	5	SC1	No Name	120°48'57"	14°51'9"
		SC2	No Name	120°48'5"	14°52'8"
		SC3	No Name	120°47'23"	14°52'55"
		SC4	No Name	120°46'39"	14°53'41"
		SC5	Angat River	120°46'14"	14°54'8"
Calumpit to Apalit Station	2	SC6	Pampanga River	120°45'55"	14°55'16"
		SC7	Floodway	120°45'25"	14°56'9"
Apalit to San Fernando	9	SC8	No Name	120°44'29"	14°57'5"
		SC9	No Name	120°44'9"	14°57'17"
		SC10	Locmit River	120°43'35"	14°57'37"
		SC11	No Name	120°43'17"	14°58'18"
		SC12	Bulaong River	120°43'15"	14°58'31"
		SC13	Masalausa River	120°43'12"	14°58'58"
		SC14	No Name	120°43'2"	14°59'41"
		SC15	No Name	120°42'59"	14°59'46"
		SC16	San Fernando River	120°41'19"	15°1'30"
San Fernando to Angeles	4	SC17	No Name	120°40'34"	15°2'23"
		SC18	No Name	120°39'44"	15°3'37"
		SC19	Sindalan Creek	120°38'59"	15°4'39"
		SC20	No Name	120°37'24"	15°6'50"
Angeles to Clark Station	3	SC21	Abacan River	120°35'15"	15°9'17"
		SC22	No Name	120°35'3"	15°9'46"
		SC23	No Name	120°34'54"	15°10'28"
Clark to Mabalacat Depot	5	SC24	No Name	120°34'51"	15°10'45"
		SC26	No Name	120°34'38"	15°11'58"

Segment	No. of River/ Stream Crossings	Label	River/Stream Name	Latitude	Longitude
		SC28	No Name	120°34'23"	15°12'51"
		SC33	No Name	120°34'13"	15°13'27"
		SC25	No Name	120°34'44"	15°11'28"
Clark Station to CIA station	4	SC27	No Name	120°34'35"	15°11'57"
		SC29	No Name	120°34'18"	15°12'49"
		SC30	No Name	120°33'39"	15°12'33"
		SC31	Quitangil River	120°33'42"	15°12'40"
CIA to Mabalacat Depot	1	SC32	Mabalacat River	120°33'46"	15°13'9"
Mabalacat Depot To NCC Station	10	SC34	No Name	120°33'18"	15°15'25"
		SC35	No Name	120°33'9"	15°15'30"
		SC36	Bamban River	120°33'22"	15°15'39"
		SC37	No Name	120°32'1"	15°16'10"
		SC38	No Name	120°32'46"	15°16'28"
		SC39	No Name	120°31'51"	15°17'50"
		SC40	No Name	120°31'52"	15°19'8"
		SC41	No Name	120°31'51"	15°19'12"
		SC42	No Name	120°31'35"	15°20'32"
		SC43	No Name	120°31'34"	15°20'37"
Option A	Option B				



Source: SRTM Data

Figure 3.2.2 Plot of the Major River or Stream Crossings with Respect to the Proposed MCRP

(3) Flooding

538. In terms of flood and flashflood susceptibility, the barangays assessed have different susceptibility to flooding based on the general location of the barangay. Flooding had been classified into flash flooding, sheet flooding, channel confined flooding and coastal flooding. Barangays or portion of the barangays found to be moderately or highly susceptible to flooding are located in low-lying areas and/or near a major river system, creeks and irrigation canals and/or located in the generally low-lying portion of the city.

539. **Figure 3.2.3** presents the Flood Susceptibility Map of Region 3 prepared by the Mines and Geosciences Bureau (MGB) which classifies susceptibility to flooding as follows:

- Areas with Low Susceptibility to Flooding experience floods with heights of less than or equal to 0.5 meter. Areas with Moderate Susceptibility to Flooding attain flood heights from 0.5 to one (1) meter. This condition is attained during prolonged and extensive heavy rainfall or extreme weather occurrences. These are the segments from Mabalacat to San Fernando, and Calumpit Station to Malolos Station.
- Areas with High Susceptibility to Flooding attain flood heights which exceed one (1) meter. These areas area are usually flooded for several hours during heavy rains. These include topographic lows such as active river channels, abandoned river channels and areas along river banks. The segments from the immediate banks of the main channels of Mabalacat and Abacan Rivers, from San Fernando Station to Calumpit Station form part of these areas.

540. The segments within Tarlac are not susceptible to flooding due to their elevated and sloping conditions.

541. The following briefly discusses flooding susceptibility for barangays affected by the MCRP Project per municipality, along with drainage situation in these municipalities.

Malolos

542. Based on the Flood Susceptibility Map of MGB, Barangays Longos and Bulihan in Malolos, Bulacan have low to moderate susceptibility to flooding as controlled by the topography.

543. General drainage issue in Malolos include lack of maintenance of the excavation/dredging of the rivers and waterways, making it filled with different wastes that results of slow absorption of water.

544. Illegal structures along the rivers and water, even in the drainage and irrigation canals in which the flood water would have flowed, often cause frequent flooding. This is one of the reasons for the slow subsidence of flood water. There are informal settlers who build their houses near the river banks or rivers itself, and some are on top of the drainage canals.

Calumpit

545. In Calumpit, Bulacan, Barangays Pio Cruzcosa, San Marcos, Palimbang, Iba O' Este, Iba Este, Calumpang and Balungao have low susceptibility to flooding, while Barangay Gatbuca has high susceptibility to flooding. These barangays are located along active river channels with history of overflowing and breaching of dikes protecting the barangays. These barangays are also generally located in a topographically low area.

546. Floods have become an annual occurrence in Calumpit and nearby towns. The construction of Calumpit Institute, a former location of a natural drainage, resulted in the reduced flow of waters toward Calumpit River, consequently raising the level of floods and retaining them for a longer period.

Apalit

547. Apalit, Pampanga is characterized as generally flat terrain with slopes of only 0-3%. The Pampanga River traverses the entire mid-eastern section, passing Barangays Sucad, San Juan, Tabuyuc, and Sulipan and branching out at Barangay Calapangan. Also traversing the town are numerous creeks serving as drainage basin from the upper part of Pampanga. Its low terrain and the presence of drainage creeks make the town susceptible to flooding particularly during the rainy season. The overflowing of Pampanga River in the past caused by continuous heavy rains had some of the barangays along the riverbank submerged in floodwater, affecting large tracks of ricelands in Barangays Tabuyuc, Cansinala, Capalangan, Sulipan, and Sucad. Barangays Sulipan and San Vicente where the alignment of the proposed MCRP traverses have moderate to high

susceptibility to flooding. Moreover, Barangay Capalangan which is located in the low-lying areas has high susceptibility to flooding.

548. Historically, the convergence of water brought about by the discharge of two dams results in the flooding of six (6) barangays along the riverbank of the river. These barangays namely: Cansinala, Sucad, San Juan, Tabuyuc, Capalangan and Sulipan experience flooding on a perennial basis and it is affected annually by intensive tropical weather patterns which resulted to a very significant financial cost and personal hardship within the affected areas in the municipality.

549. Infrastructure for roadside rainwater drainage is non-existent, primarily since barangay roads are located adjacent to the Pampanga River, thus surface run-off goes directly to the river, passing through the various structures found erected along the barangay roads. Meanwhile, national roads and highways have rainwater drainage systems.

Minalin

550. There are three (3) impact barangays with high susceptibility to flooding (San Isidro, Santa Catalina and San Pedro), and one (1) impact barangay with low to moderate susceptibility to flooding (Lourdes). These barangays have portions that are adjacent to active creeks and river channel and are generally located in the low-lying areas.

551. Surface drainage is imperfect, and internal drainage is poor, due to heavy water content of the subsoil and substratum. Maximum rainfall is observed to occur on the months of August, September and October, even extending until December that cause floods to low lying areas of the municipality. Most of the barangays were found to be susceptible to flooding.

Sto. Tomas

552. There are two (2) impact barangays susceptible to moderate to high level floods. These barangays have portions that are near active creeks and river channel (San Matias and Moras dela Paz). There are two (2) impact barangays susceptible to high level floods. These barangays have portions adjacent to active creek and river channels and are generally located in low-lying areas (Poblacion and Sto. Niño Sapa).

553. The San Vicente-Minalin tail dike serves as the municipality's major flood control infrastructure. Other activities to mitigate flooding in the municipality include the construction of line canals and barangay drainages and desilting of major rivers.

554. Sto. Tomas is part of the southern portion of the Pampanga River Basin which is nearer to the main drainage outlet, which is the Manila Bay. Numerous river bodies transect the municipality including the Sto. Tomas River, which transects the built-up area of the municipality, the Masaluso River, which is the central river channel and the Lourdes, Pambacud, Tiaong and Dalan Pare River which bounds portions of the municipality. Due to these characteristics, the municipality has vast potential for aquaculture development. However, this is also the main reason for flooding in the area.

San Fernando

555. San Fernando is located in the lower southeastern slopes of Mt. Pinatubo which falls under the classification of Low Flood Vulnerability. This classification is attributed to the well-drained condition of the underlying lahars, the favorable slope towards the east southeast and its higher elevation relative to the flood-prone Central Plain of Luzon to the east.

556. There are seven (7) impact barangays with low susceptibility to flooding (Baliti, Calulut, Maimpis, Malpitic, Panipunan, Pulung Bulo and Sindalan), while one impact barangay has low to moderate susceptibility to flooding (Quebiawan). The barangay has portions adjacent to active

creeks and river channel. There are five (5) impact barangays susceptible to moderate to high level floods. These barangays have portions that are near active creeks and river channel and with identified low lying portions (Dolores, San Agustin, San Pedro, Sta. Lucia and Sto. Niño), while two (2) impact barangays are susceptible to high level floods. These barangays have portions adjacent to active creek and river channels and are generally located in low-lying areas (San Nicolas and Lourdes).

557. Due to the eruption of Mt. Pinatubo in 1991, drainage ways were clogged especially the San Fernando River which resulted in frequent flooding. The threat of flooding in the southern portion of the city has been minimized with the implementation of Phase 3B of the Pinatubo Hazard Urgent Mitigation Project (PHUMP 3B) that increased the capacity of rivers, creeks and drainage systems including that of San Fernando River thereby reducing the flood occurrences in said area.

558. Though countermeasures for flood control and storm drainage improvement have been conducted for the last 10 years, frequency of flooding and inundation are still high. This can be attributed to inadequate capacity of existing drainage systems to accommodate excess run off from Angeles-Mexico areas.

559. Public disregard of the Ecological Solid Waste Management Act leads to using the existing drainage canals of the city as sewers for their wastes. This has been impairing the integrity of even the City's newly built canals and may aggravate the flooding problem.

Angeles

560. The Angeles is drained by a network of rivers and streams which radiate and emanate from the upper slopes of Mt. Pinatubo and flows towards the east. From north to south, the Clark Watershed is drained by Mabalacat River, Quitanguil River and Sapang Paraluman Creek. The Abacan River is the main drainage system of the northern part of the Angeles Watershed. The southern part is drained by an unnamed network of streams. The Pasig Watershed is drained by the Pasig Potrero River.

561. All thirty-three (33) barangays of Angeles have low susceptibility to flooding. Moderate to high level flooding are usually confined to creek and river channels and to identify low-lying portions of the barangay. Agricultural areas are usually inundated during heavy precipitation and are usually associated with typhoons. There are nine (9) barangays with identified riverbank erosion (Ninoy Aquino, Pandan, Tabun, Pulung Maragul, Amsic, Anunas, Margot, Sapangbato and Balibago). Barangays adjacent to Abacan River are threatened with lahar flows.

562. Angeles has a natural drainage provided by the Abacan River and the various creeks that are evenly distributed around the city. Since its general soil type is sandy, it has a very good internal drainage or the capability to absorb surface water compared to clay. But since the city's built-up areas are already fully paved, surface run-off goes directly to the drainage canals, and into the creeks and rivers.

563. Unfortunately, the capacity of the existing drainage and flood-water canals is no longer enough to accommodate the peak flow. Thus, localized flooding during rainy season or after a heavy downpour becomes ordinary. The increasing occurrence of high intensity, short duration rainfall brought by climate change and global warming phenomenon exacerbates this problem. Due to ineffective drainage system, the city still experiences localized flooding during the rainy season specifically in the areas of barangays Pandan, Ninoy Aquino, Santo Cristo, Lourdes Sur, Lourdes Northwest, Lourdes Sur East, Santo Rosario and Santa Teresita.

Mabalacat

564. The three major bodies of water that traverse Mabalacat City are Sacobia River, Sapang Balen, and Quitangil River. Sacobia River passes through barangays Tabun, Cacutud, Dolores, Calumpang, and Macapagal Village. Sapang Balen, on the other hand, passes through Sapang Balen, Paralayunan, Atlu Bola, Mangalit, Mamatitang, Poblacion, Sta. Ines, Francisco, and Marcos Village. Finally, Quitangil River goes through Dapdap, Bundagul, Sta. Maria, Sto. Rosario, Mabiga, and Marcos Village. There are also small creeks, which serve as sources for irrigation. Riverbank erosion was observed in the active creeks/river and natural channels traversing the municipality. Siltation is evident along the active channels traversing the city (Sacobia River, Quitanquil River, Sapang Biabas and unnamed natural channels traversing the city).

565. Barangays Dolores, Lakandula, Poblacion, San Joaquin, and Tabun where the proposed MCRP alignment traverses have low susceptibility to flooding.

566. Although Mabalacat City's elevation is relatively high, there are still reported cases of flash flooding in the city. Flooding is usually due to clogged and damaged drainages as well as the removal/loss of natural waterways.

Bamban

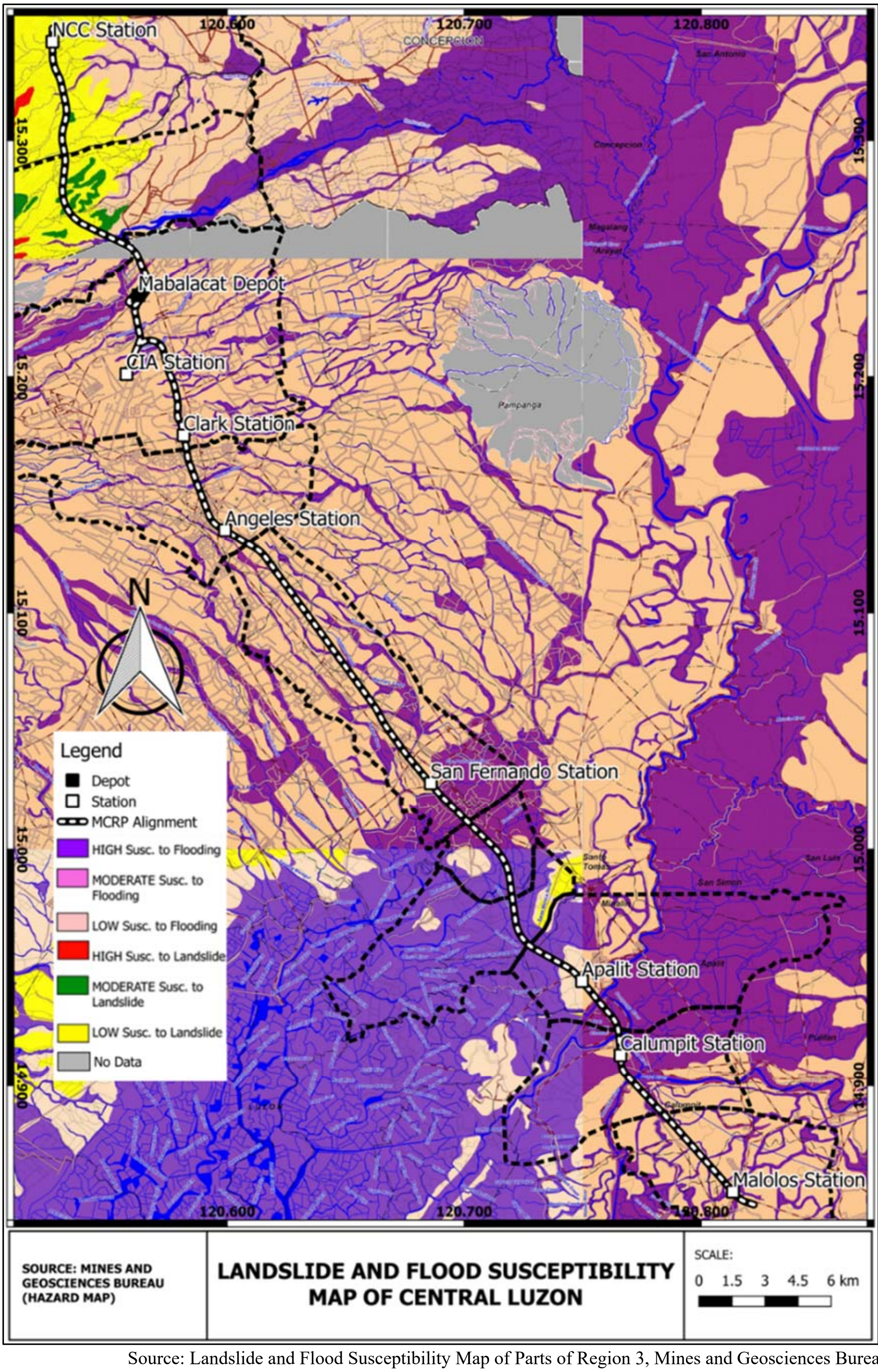
567. In Bamban, Tarlac, Barangays Anupul, Lourdes, San Nicoloas, Sto. Niño, San Vicente, and San Roque, where the proposed MCRP alignment traversed have low susceptibility to flooding.

568. All roads in Poblacion (Old Downtown) have concrete canals. However, there is no available data on canals in other roads.

Capas

569. In Capas, Tarlac, impact barangays Aranguen, Cutcut II and Sto. Rosario have low susceptibility to flooding. Barangay Maruglu has low susceptibility in most areas but with portions near major rivers and creeks that have moderate to high susceptibility.

570. Run-offs and other liquid wastes are flushed directly into rivers and streams due to the lack of Sewage Treatment Plants (STPs) in Capas. This includes the lack of effective drainage systems, particularly in-and-around the Poblacion area. This situation is aggravated by poor maintenance of the already existing drainage networks, particularly along the Manila North Road. All these wastewaters go untreated into the waterways of Capas and eventually, out to sea.



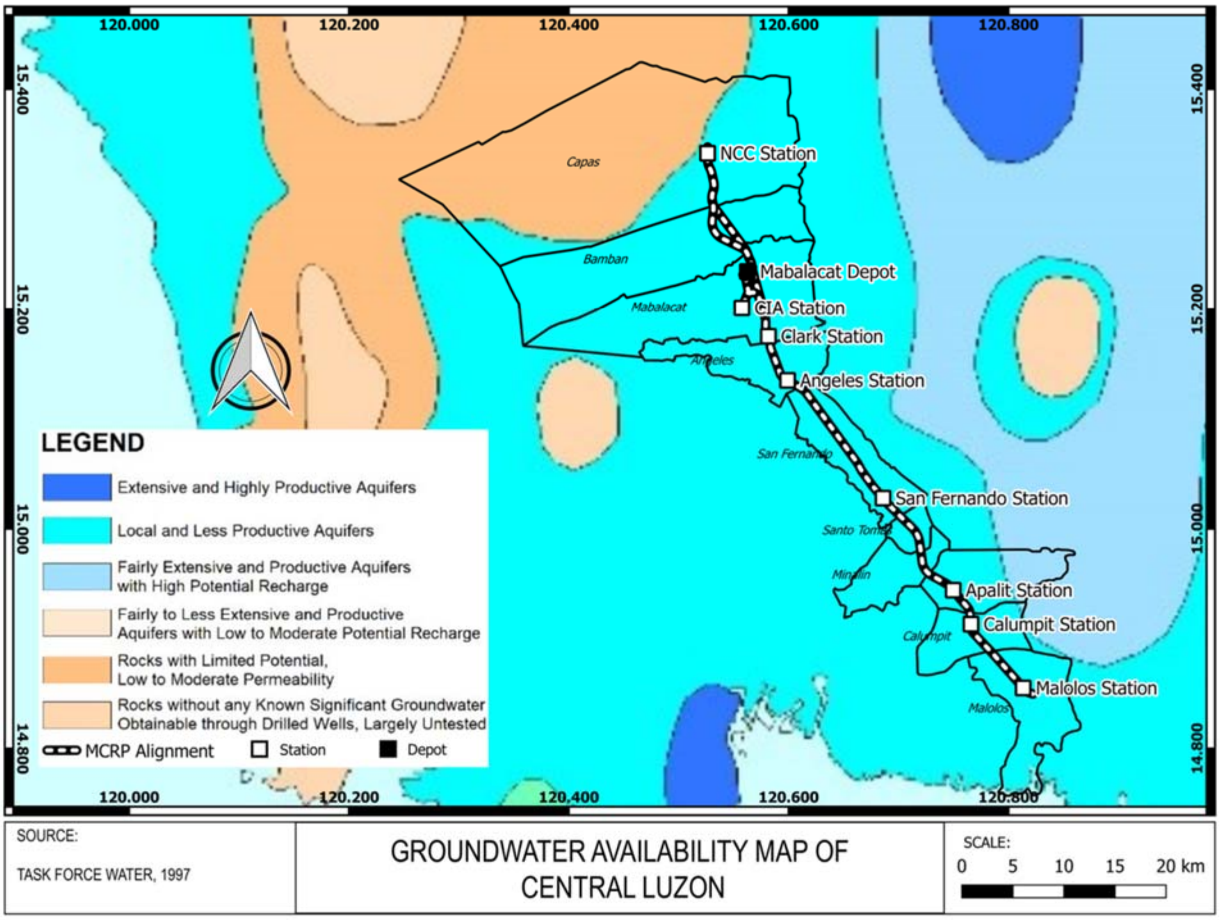
Source: Landslide and Flood Susceptibility Map of Parts of Region 3, Mines and Geosciences Bureau

Figure 3.2.3 Flood Susceptibility Map of Central Luzon (Region III)

3.2.1.2 Hydrogeology

571. The 1997 Groundwater Availability Map of the Philippines presented in **Figure 3.2.4** shows that the MCRP alignment will traverse an area classified as "Local and Less Productive Aquifers". Within the undulating to rolling segments from Mabalacat Depot to NCC Station, groundwater occurs under unconfined conditions within the interstices of consolidated pyroclastics and tuffaceuous sedimentary rocks. The water table occurs at the estimated depth range of 6 m near and within valleys and flat areas to 15 m at the lower and middle slopes. The thickness of the aquifer is not known. The aquifer in these segments is tapped by shallow wells which are pumped manually or with the aid of low capacity centrifugal pumps. Yield from the shallow wells near the NCC Station is used for domestic and irrigation purposes.

572. The segment from Malolos Station to Mabalacat Depot is underlain by unconsolidated sediments which hosts an unconfined aquifer from a minimum depth of 1 m. The thickness of this aquifer is not known. The water table occurs within an estimated depth range 1 m to 12 m. The aquifer in these segments is tapped mainly by shallow tube wells whose yields were used mainly for washing.



Source: Task Force Water, 1997

Figure 3.2.4 The Proposed MCRP as Situated in the Groundwater Availability in Luzon

3.2.1.3 Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction Phase

1) Change in Drainage Morphology / Inducement of Flooding/Reduction in Stream / Volumetric Flow

573. The construction of the proposed MCRP, specifically during site preparation, land clearing, excavation and earthworks may potentially induced flooding and cause inundation due to sediment run-off, siltation and drainage overflow. More so that the area is characterized by flat to gently undulating slopes from Malolos to Angeles with portions that are susceptible to flooding and it is frequented by typhoons. The primary culprit is the improper handling, storage, and hauling of stockpiles of excavated materials/spoils. In particular, location of stations may clog existing drainage systems and block creeks, canals and other waterways. Due to the construction of impervious structures such as the viaducts, storm water run-off may increase that would change the flood storage capacity of waterways and its floodplains.

574. Hydrologic and hydraulic studies will be conducted during DED. Based on the results and recommendations of the said studies, a proper drainage system for the project will be designed and installed in order to address the issue on flooding. Minimizing the removal of vegetation and alternation of topography during construction would alleviate the problem as this would preserve the natural drainage system of the area.

575. Given that flooding is an existing environmental problem in the project area, the DOTr will ensure that appropriate measures will be put in place and strictly complied with. The DOTr will prepare and implement construction plan indicating the contractor's commitment to proper disposal of demolition debris, construction spoils and solid wastes. These materials will not be put anywhere near watercourses and areas where it could be carried away into low-lying areas of the project or into the drainage system. Solid wastes will be collected and disposed in accordance with RA 9003.

576. Erosion controls such as vegetation on slope and silt traps will be implemented to address the issue. Upon the completion of the project, the contractor will take care of the disposal of all debris and waste materials into an appropriate designated area. The contractor will initiate erosion control measures before major earthmoving works begin.

577. Aside from being geomorphologically a catch basin, another reason that aggravated the existing flooding problem of the affected areas is the blockage of natural waterways. The pier of the proposed MCRP may block the waterways which may cause sedimentation and flooding in the surrounding areas during heavy rainfall. To address this, MCRP structures will be designed to have a clearance of above established flood level and discharges, which will be established and included in the detailed design. When necessary, sump pumps will be installed at the lowest points to pump out accumulated floodwater along the railway track. Construction of new sufficient and effective drainage system will also be incorporated. The proponent will also coordinate with DPWH how to integrate both parties' drainage plans along the project area. It is also important to share information to LGUs and incorporate their comments and inputs in the design to harmonize with existing drainage systems.

2) Change in Stream and Lake Water Depth

578. The proposed MCRP will entail the construction of engineered structures which will span the identified river or stream crossings. Accordingly, the project will not bring about a change in stream depth.

3) Depletion of Water Resources / Competition in Water Use

579. Concreting works at the stations and depot will bring about increase in water consumption. The amount of water will depend on the size of the structure that will require concreting. The depot will require more water compared to the relatively smaller stations.

580. The following assumptions were made in estimating the amount of water to be used for construction:

- One (1) cubic meter of concrete will require 180 liters of water
- The seven (7) stations will require a concrete volume[1] of 12,320 m^3
- About 30% of the depot will be paved
- Twelve (12) buildings of assumed 100 m^2 area will be constructed

581. The estimated concreting water requirement for the project during 1-year civil works aspect of construction is presented below:

- Seven (7) Stations: 2,217 m^3
- Depot: 1,512 m^3

582. The total water requirement for the estimated 1-year civil works phase of construction is about 3,729 m^3 or 10 m^3 per day spread over the seven (7) stations and depot. This amount is not significant and will not affect the water supply needs of the host LGUs.

583. The domestic water consumption during construction and operation were estimated using the following:

- Pre-construction, construction and operation personnel of 200, 12,000 and 1,400, respectively.
- Per capita water consumption of 100 liters per day[2]
- 9 major construction sites corresponding to the stations, depot and construction yard which translates to 619 persons per site
- 8 major operation sites corresponding to the stations and depot which translates to 120 persons per site

584. The estimated daily water consumption at the different stages of project development are presented in **Table 3.2.2**.

Table 3.2.2. Estimated Domestic Water Consumption of MCRP

Project Stage	No. of Personnel	No. of Sites	Daily Consumption per Site (m^3)	Total Daily Consumption (m^3)
Pre Construction	200	1	20	20
Construction	12000	9	133	1200
Operation	1400	8	12	96

585. As shown, the amount of water that will be consumed during construction is not significant. This can be sourced from existing water sources of the LGUs or through the local water providers in the area. Drilling of 1 to 2 wells along the railway route may be an option with permit from NWRB.

[1] Seven (7) stations with platform area of 220 m x 40-60 m and a thickness of 0.5 m
[2] Consumption will be essentially limited to drinking and flushing of toilet and cleaning of cars

586. The water consumption during operation is not significant. In practice, the drinking water of the train stations is bought from commercial water providers within the LGUs, Water used for cleaning and toilets could come from the Level III system of the LGUs.

587. Overall, the impact of the project on the water sources of the host LGUs is rated as low and not significant and will persist only during the period of construction. The mitigating measures identified include the implementation of a Water Conservation Program for the project and regular monitoring of water consumption for domestic and construction purposes.

(2) Operation phase

1) Change in Drainage Morphology / Inducement of Flooding / Reduction in Stream

588. As discussed in (1), the frequency of typhoons as well as the slope and drainage characteristics of the areas where the proposed MCRP is to be located is susceptible to flooding and inundation. This will affect the construction activities due to drainage overflows, surface run-off and siltation particularly in the underground segment of the railway in Clark, CIA, Mabalacat Depot and Tarlac. On the other hand, the elevated segment of the railway from Malolos-Clark and Bamban-NCC will experience low impacts. However, in case of extreme events (strong typhoon, extreme flooding), trip schedules may be affected. The operation of the train may be disrupted and cancelled. As such, necessary adjustments are to be taken. It is significant that the DOTr will regularly monitor weather bulletins issued by PAGASA and get their advice on necessary actions. The construction site will also be inspected to prevent any flooding in the area.

589. In the operation of the underground segment of the railway, it will be ensured that necessary railway features/ facilities against flooding are enabled such as water-shut panels at station entrances and drainage pumping stations to pump up inflow of water from ground level (water) and from the tunnel and direct them to the sewer.

2) Change in Stream and Lake Water Depth

590. The proposed MCRP will not bring about a change in stream depth.

3) Depletion of Water Resources / Competition in Water Use

591. Water requirements of the MCRP will not be significant and essentially limited to the drinking water requirement of the operations staff, maintenance of comfort rooms and the regular cleaning of the stations, depot and cars. Drinking water of the staff will be purchased from local water providers. The stations and depot will be linked to the Level III system of the nearby water districts.

592. Accordingly, railway operations will not contribute to the depletion of the local groundwater resources or compete in water use with local residents and establishments. A water conservation management plan will be implemented. This will include utilization of recycled water and rainwater.

3.2.2 Water Quality

3.2.2.1 Groundwater Quality

593. Uncontrolled discharge of wastewater or water-borne contaminants from project operation may percolate into ground and deteriorate the quality of the local groundwater, especially in the sandy areas in Pampanga, limiting the use of the local groundwater. The construction of the railway columns down to the bedrock for elevated viaducts and bridges may encounter groundwater at shallow depths. The groundwater in column holes may be pumped out and may

affect the nearby surface water. In addition, the quality of groundwater may influence the choice of material quality of the columns. These situations make the assessment of the existing or baseline groundwater quality relevant in this study.

(1) Field Survey

594. Groundwater samples were collected on February 8 and 21, 2018 to assess the physico-chemical properties of the groundwater within the vicinity of the project site. Nine (9) groundwater sampling stations were established for the proposed MCRP: two (2) in Bulacan, four (4) in Pampanga and three (3) in Tarlac. The groundwater samples were collected at seven (7) tube wells, one (1) dug well in Calumpit, Bulacan and one (1) spring in Bamban, Tarlac (**Table 3.2.3** and **Figure 3.2.5**). It was in the presumption that groundwater occurs in a great span at varying quality along the proposed 69-km alignment; hence, the results of groundwater sampling from the different sources are taken as examples of the groundwater quality along that alignment. More sampling sites may be established depending on the need for the proposed physical development. Locating the sources of groundwater at shallow depths was one constraint because the use of the shallow tube wells is no longer popular in highly developed areas in Bulacan and Pampanga, being served by local water utilities. The use of shallow groundwater is still popular in rural and agricultural areas of Tarlac, where the proposed alignment is located.

595. The water samples were collected after sufficient purging of wells. The samples for the analysis of microbes were collected into sterilized small glass bottles and wrapped with aluminum foil. The samples for the analyses of organics were collected into amber glass bottle. The samples for the analysis of other parameters were collected into Polyethylene Terephthalate (PET) bottles. The collected groundwater samples were labeled, stored in ice-chest and submitted to Mach Union Laboratory, Inc., a DENR recognized laboratory in Las Piñas City, Metro Manila to measure the levels of 21 water quality indicators as follows:

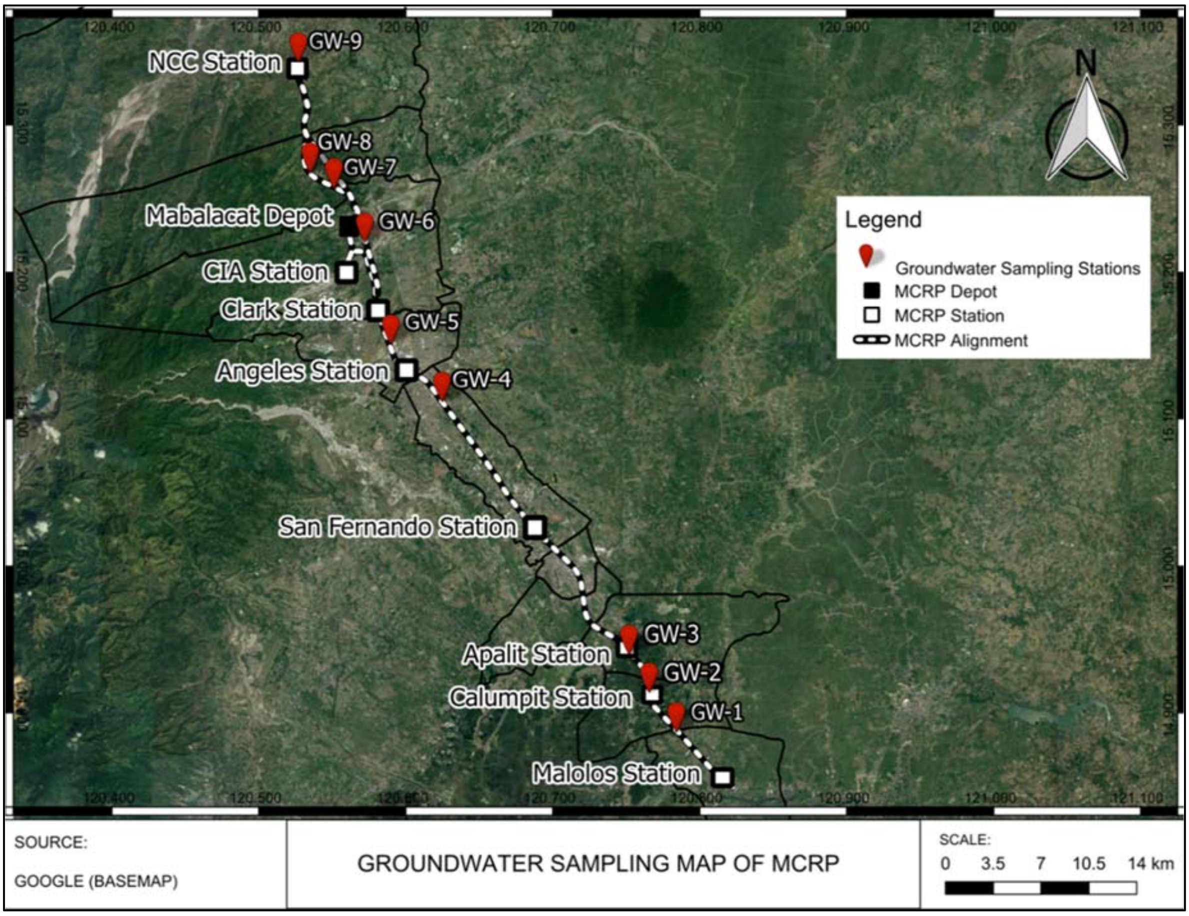
- Primary Parameters: Color, Chloride (Cl), Nitrate as Nitrogen (NO3-N), Fecal Coliform
- Secondary Parameters: Inorganics: Sulfate (SO4), Metals: Arsenic (As), Cadmium (Cd), Chromium Hexavalent (Cr^{+6}), Lead (Pb), Total Mercury (Hg), Organics: Cyanide
- Others: Total Coliform, Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K), Bicarbonate (HCO_3)

596. The Temperature, pH, Conductivity, Total Dissolved Solids (TDS) were measured on-site using a calibrated Thermo Scientific Orion Star A329 Water Quality Meter. Out of the 21 parameters measured, 16 are covered by PNSDW and DAO 2016-08. These are color, temperature, pH, Fecal Coliform, Total Coliforms, TDS, Na, Cl, SO4, NO3-N, As, Cd, Cr +6, Pb, Hg, and CN.

Table 3.2.3 Groundwater Quality Sampling Stations

Water Source Code	Description	Geodetic Coordinates	Depth	Well Age or Year Installed	Water Usage
GW-1	Dug Well (with motor) in Sitio Borneo, Barangay Pio Cruzcosa, Calumpit Bulacan About 54m from the alignment	14°53'14.57" N, 120°47'2.21" E	7 m	1960s	For watering of commercial gardening
GW-2	Hand Pump Tube Well in Sitio Uno, Barangay Balungao, Calumpit Bulacan About 67m from the alignment	14°54'53.66"N, 120°45'54.78"E	2 pipes (12.2 m)	1988	Not regularly in use For watering of residential garden
GW-3	Hand Pump Tube Well in Sitio Riles, San Vicente, Apalit Pampanga (agricultural land; indoor) About 25m from the alignment	14°56'27.77"N, 120°45'7.47"E	11 ½ pipes	2017	For cooking rice and bathing
GW-4	Hand Pump Tube Well in Barangay Balite, San Fernando City Pampanga (indoor) About 9m from the alignment	15° 06' 43.82"N, 120° 37' 27.91"E	1 ½ pipes (9.1 m)	2008	For cooking rice, previously source of drinking water
GW-5	Hand Pump Tube Well in Magkalinis Riverside, Barangay Malabañas, Angeles, Pampanga	15° 09' 9.03"N, 120° 35'21.49"E	About 5 pipes (30.5 m)	Before 1971	For community drinking water supply

Water Source Code	Description	Geodetic Coordinates	Depth	Well Age or Year Installed	Water Usage
	About 117m from the alignment				
GW-6	Hand Pump Tube Well in Barangay San Francisco, Mabalacat City, Pampanga About 73m from the alignment	15° 13' 18.39"N, 120° 34'17.52"E	3 pipes (18.2 m)	Before 1970	For washing and bathing
GW-7	Hand Pump Tube Well in Barangay Lourdes Mamban, Tarlac About 37m from the alignment	15°15'32.32"N, 120°33'5.68"E	2 ½ pipes (15.2 m)	2005	For washing and bathing
GW-8	Spring (in open concrete box) in Barangay Sto Niño, Bamban Tarlac, about 50 downstream of provincial road fronting CAMP MOA Resort About 4m from the alignment	15°16'5.03"N, 120°32'5.39"E	-	-	For drinking
GW-9	Hand Pump Tube Well in Barangay Cristo Rey, Capas, Tarlac (agricultural land) About 76m from the alignment	15°20'42.58"N, 120°31'37.21"E	No data	No data	For washing and bathing



Source: GEOSPHERE, 2018

Figure 3.2.5 Groundwater Quality Sampling Stations

(2) Applied Standard

597. The Department of Health (DOH) Administrative Order (DAO) No. 2017-0010 otherwise known as Philippine National Standards for Drinking Water (PNSDW) of 2017 establishes the criteria for drinking water quality. In cases where the criteria for certain parameters are not available in PNSDW, the guideline values from DAO 2016-08 Water Quality Guidelines (WQG) for Class A waters will be used. **Table 3.2.4** shows the comparison of applicable national and international standards on groundwater quality. The international standards used in comparison with Philippine standards are the WHO Guidelines for Drinking-Water Quality (2017). For Further detail criteria to be referred to Chapter 2, 2.6.4 Groundwater.

(3) Results and Analysis

598. The depth of the wells ranges from 7m to 31m. The structures were built as early as 1960 to recent 2017. The usage varies from community drinking water supply and use for cooking, bathing, and watering in residential and commercial garden. All yielded clear water but some has an objectionable odor. Usage varies from community drinking water supply (GW-5 Angeles and GW-8 Bamban), cooking, bathing, livestock watering, and commercial gardening (GW1). All yield clear water but odor range from no objectionable odor to objectionable odor. As such, drinking water generally comes from the commercial "mineral" water or from the local water utility.

599. Collectively, there is a high 89% conformance of the nine sampling sites with 16 parameters covered by PNSDW, WHO and DENR Class A guidelines. Out of 144 measurements, only 18 or 11% cases of varying non-conformance by water sample are attributed to color, temperature, fecal coliform, total coliforms, TDS and Cl. The groundwater qualities appeared to be within the current use. Similarities and trends in the major cations were also noted. A summary of the results is presented in **Table 3.2.4**.

1) Results by Sampling Stations

GW-1 Dug Well in Calumpit Bulacan

600. Measured levels of pH, Color, Temperature, Na, Cl, SO_4, Nitrate, As, Cd, Chromium Hexavalent, CN, Pb and Hg at Station GW-1 are below the PNSDW, DENR Guideline Values for Class A Water and WHO Guideline Values for drinking water. No objectionable odor was also observed in the water sample. However, levels of TDS and Chloride exceed the PNSDW of 600 mg/L for TDS and the PNDW and DENR Guideline Values of 250 mg/L for Chloride. Exceedance in TDS was attributed to saltwater intrusion or with high available soluble ions in the soil and rock in the areas. The levels of fecal and total coliforms showed non-conformance with WHO Guideline Values, DENR Class A water guideline value of <1.1 MPN/100mL for fecal coliforms and PNSDW standard value of <1.1 MPN/100mL for total coliforms. This indicates that the water is not safe for drinking unless appropriate water treatment is administered.

GW-2 Hand Pump Tube Well in Calumpit Bulacan

601. Measured levels of pH, Color, Na, Cl, SO_4, Nitrate, As, Cd, Chromium Hexavalent, CN, Pb and Hg at Station GW-2 are below the PNSDW, DENR Guideline Values for Class A Water and WHO Guideline Values for drinking water. The level of TDS, however exceed the PNSDW standard of 600 mg/L for Exceedance in TDS was attributed to saltwater intrusion or with high available soluble ions in the soil and rock in the areas. During sampling, the water temperature (30.8°C) was not within the PNSDW and DENR guideline values of 26ºC - 30ºC for Class A Water and objectionable odor was also observed. The levels of fecal and total coliforms showed non-conformance with WHO Guideline Values, DENR Class A water guideline value of <1.1 MPN/100mL for fecal coliforms and PNSDW standard value of <1.1 MPN/100mL for total coliforms. This indicates that the water is not safe for drinking unless appropriate water treatment is administered.

GW-3 Tube Well in Apalit, Pampanga

602. Measured levels of pH, Color, Na, SO_4, Nitrate, As, Cd, Chromium Hexavalent, CN, Pb, Hg Fecal Coliform and Total coliform at Station GW3 are below the PNSDW, DENR Guideline Values for Class A Water and WHO Guideline Values for drinking water. The levels of TDS and Cl, however, exceed the PNSDW standard of 600 mg/L for TDS and 250 mg/L for Cl. Station GW3 has the highest pH value and TDS concentrations in all sampling stations. During sampling, the water temperature (30.7°C) was not within the DENR guideline values of 26ºC - 30ºC for Class A Water and objectionable odor was also observed.

GW-4 Tube Well in San Fernando, Pampanga

603. Levels of pH, Color, Temperature, TDS, Na, Cl, SO_4, Nitrate, Arsenic, Cd, Chromium Hexavalent, CN, Pb, Hg, and Total coliform at Station GW4 are below the PNSDW, DENR Guideline Values for Class A Water and WHO Guideline Values for drinking water. However, during sampling, objectionable odor was observed in the sample.

GW-5 Tube Well in Angeles, Pampanga

604. Levels of pH, Color, Temperature, TDS, Na, Cl, SO_4, Nitrate, As, Cd, Chromium Hexavalent, CN, Pb, Hg, Fecal Coliform, and Total Coliform at Station GW5 are below the PNSDW, DENR Guideline Values for Class A Water and WHO Guideline Values for Drinking Water. No objectionable odor was also observed in the water sample.

GW-6 Tube Well in Mabalacat, Pampanga

605. Levels of pH, Color, Temperature, TDS, Na, Cl, SO_4, Nitrate, As, Cd, Chromium Hexavalent, CN, Pb, Hg, Fecal Coliform and Total Coliform at Station GW6 were below the PNSDW, DENR Guideline Values for Class A Water and WHO Guideline Values for Drinking Waters. No objectionable odor was also observed in the water samples. Station GW6 has the highest nitrate concentration in all sampling stations.

GW-7 Tube Well in Bamban, Tarlac

606. Levels of pH, Color, Temperature, TDS, Na, Cl, SO_4, Nitrate, As, Cd, Chromium Hexavalent, CN, Pb, and Hg at Station GW7 were below the PNSDW, DENR Guideline Values for Class A Water and WHO Guideline Values for Drinking Waters. No objectionable odor was also observed in the water samples. The levels of fecal and total coliforms, however, showed non-conformance with WHO Guideline Values, DENR Class A water guideline value of <1.1 MPN/100mL for fecal coliforms and PNSDW standard value of <1.1 MPN/100mL for total coliforms. This indicates that the water is not safe for drinking unless appropriate water treatment is administered.

GW-8 Spring in Bamban, Tarlac

607. Levels of pH, Color, TDS, Na, Cl, SO_4, Nitrate, As, Cd, Chromium Hexavalent, CN, Pb, Hg and Total Coliform at Station GW8 were below the PNSDW, DENR Guideline Values for Class A Water and WHO Guideline Values for Drinking Waters. During sampling, the water temperature (6.35°C) was not within the PNSDW and DENR guideline values of 26ºC - 30ºC for Class A Water. The levels of fecal and total coliforms also showed non-conformance with WHO Guideline Values, DENR Class A water guideline value of <1.1 MPN/100mL for fecal coliforms and PNSDW standard value of <1.1 MPN/100mL for total coliforms. This indicates that the water is not safe for drinking unless appropriate water treatment is administered. No objectionable odor was observed in the water samples.

GW-9 Tube Well in Capas, Tarlac

608. Levels of pH, Color, Temperature, TDS, Na, Cl, SO_4, Nitrate, As, Cd, Chromium Hexavalent, CN, Pb, Hg Fecal Coliform and Total Coliform at Station GW9 were below the PNSDW, DENR Guideline Values for Class A Water and WHO Guideline Values for Drinking Waters. Objectionable odor, however, was observed in the water samples.

Table 3.2.4 Groundwater Quality Sampling Results

Parameters	GW-1 Calumpit Dug Well	GW-2 Calumpit	GW-3 Apalit	GW-4 San Fernando	GW-5 Angeles	GW-6 Mabalacat	GW-7 Bamban	GW-8 Bamban Spring	GW-9 Capas	PNSDW 2017	DENR WQG Class A	WHO 2017
Use	Irrigation	Irrigation	cooking / bathing	cooking / bathing	drinking	washing / bathing	washing / bathing	drinking	washing / bathing			-
Date of sampling	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18			
Time of sampling (H)	1730	1650	1600	0820	0905	0930	1000	1100	1235			
Physical Characteristic												
pH	6.81	7.62	7.93	6.62	6.46	6.38	6.52	6.35	6.94	6.5-8.5	6.5-8.5	-
Color, TCU	5	5	<5	<5	<5	<5	<5	<5	10	10	50	-
Water temperature	29	30.8	30.7	27.9	28.2	28.3	28.6	27.6	29.1	-	26-30	-
Electric Conductivity	1,415	1,322	1,571	326	493	690	456	530	307	-	-	-
Total Dissolved Solids, mg/L	694	651	770	160	242	338	224	260	151	600	-	-
With objectionable odor	No	Yes	Yes	Yes	No	No	No	No	Yes	No		-
Cations and Anions												
Sodium, mg/L	160	110	120	15	21	29	11	9.1	3.4	200	-	-
Potassium, mg/L	3.1	23	10	6.4	7.2	15	3.4	1.9	0.29	-	-	-
Calcium, mg/L	50	130	96	15.3	29.9	33.6	26	10	12	-	-	-
Magnesium, mg/L	28	20	43	6.39	13.1	10.3	11	5.6	8.4	-	-	-
Bicarbonate, mg/L	301	405	267	86.3	113	113	141	113	283	-	-	-
Chloride, mg/L	257	170	321	31	61	40	11	3.6	4.1	250	250	-
Sulfate, mg/L	19	56	43	69	87	69	82	13	8	250	250	-
Nitrate-N, mg/L	0.3	0.35	0.13	0.18	0.55	6	0.21	0.21	0.19	50	-	50
Toxic and Other Deleterious Substances												
Arsenic, mg/L	<0.0009	<0.0009	<0.0009	0.0016	0.0022	0.0012	<0.0009	<0.0009	<0.0009	0.01	0.1	0.01
Cadmium, mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	0.003	0.003
Chromium Hexavalent, mg/L	0.0024	0.0043	<0.0021	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.05	0.01	0.05
Cyanide, mg/L	0.0112	0.0164	0.0191	0.0458	0.0333	0.0386	0.007	0.0055	0.0045	0.05	0.07	-
Lead, mg/L	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.01	0.01	0.01
Total Mercury, mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001	0.001	0.006
Microbes												
Fecal Coliforms, MPN/100mL	>8	>8	<1.1	<1.1	<1.1	<1.1	>8	1.1	<1.1	-	<1.1	ND
Total Coliforms, MPN/100mL	>8	>8	<1.1	<1.1	<1.1	<1.1	>8	1.1	<1.1	<1.1	-	ND

Note: The highlighted cells are the results that exceed the standard

2) Results by Parameter

Color

609. The color of the nine (9) groundwater samples ranged <5-10 TCU or within the DENR Guidelines for Class A Water of not more than 50 TCU and 10 TCU of PNSDW 2017 (**Figure 3.2.6**).

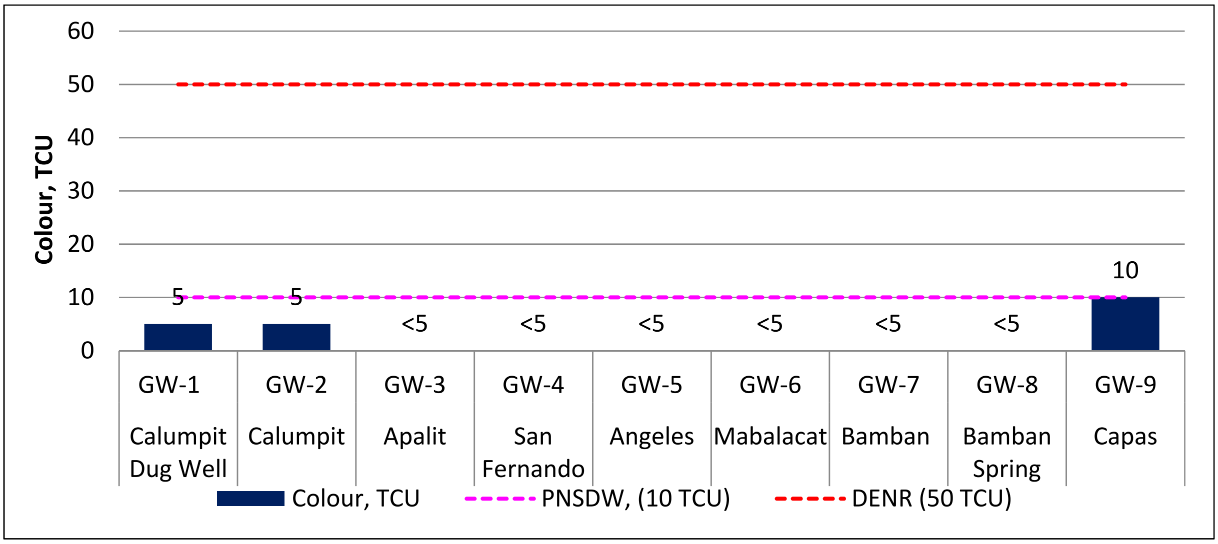


Figure 3.2.6 Results of Color Measurement of Groundwater Samples

Temperature

610. The temperature of the groundwater samples ranged 27.6 to 30.8 ºC, with two (2) cases of non-conformance with the 26-30 ºC of DENR Guidelines for Class A Water (**Figure 3.2.7**). Temperature readings in stations GW-2 (Calumpit) and GW-3 (Apalit) exceeded the 30 ºC maximum value of the DENR Guidelines for Class A Water. The lowest temperature was recorded in Station GW-8 (Bamban Spring) at 27.6 °C. The highest temperature was recorded in station GW-2 (Calumpit) at 30.8 °C.

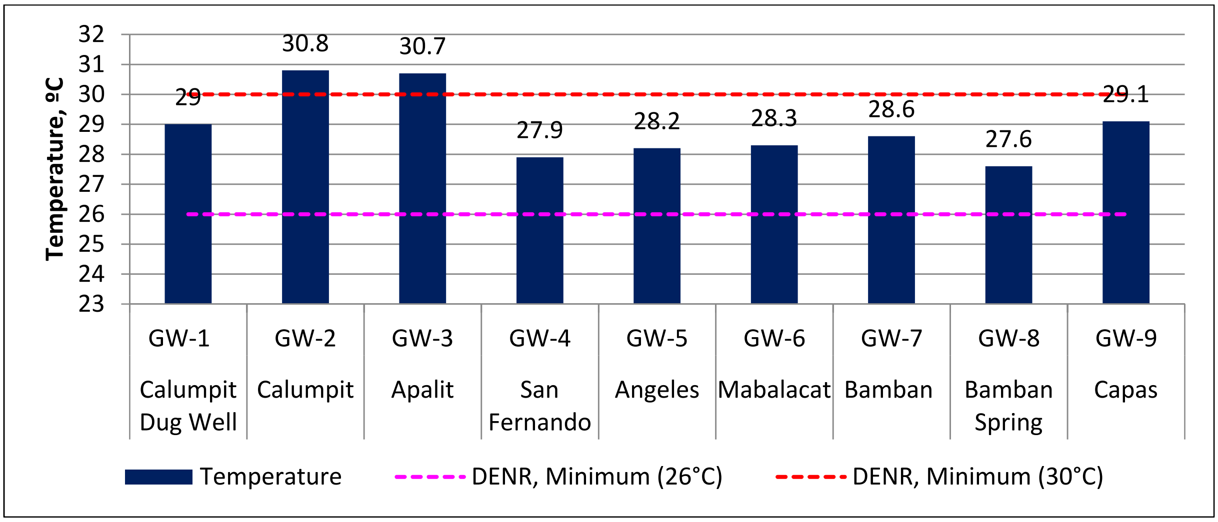


Figure 3.2.7 Results of Temperature Measurement of Groundwater Samples

pH Level

611. The pH of the groundwater samples ranged 6.35 to 7.93, with three (3) cases of non-conformance with the 6.5-8.5 range of both PNSDW and DENR Class A guideline (**Figure 3.2.8**). The pH readings in Stations GW-5 (Angeles), GW-6 (Mabalacat), and GW-8 (Bamban Spring) were below the 6.5 minimum pH value of PNSDW and DENR Guidelines for Class A Water. The lowest pH was recorded in Station GW-8 (Bamban Spring) at 6.35 and the highest pH was recorded in Station GW-3 (Apalit) at 7.93.

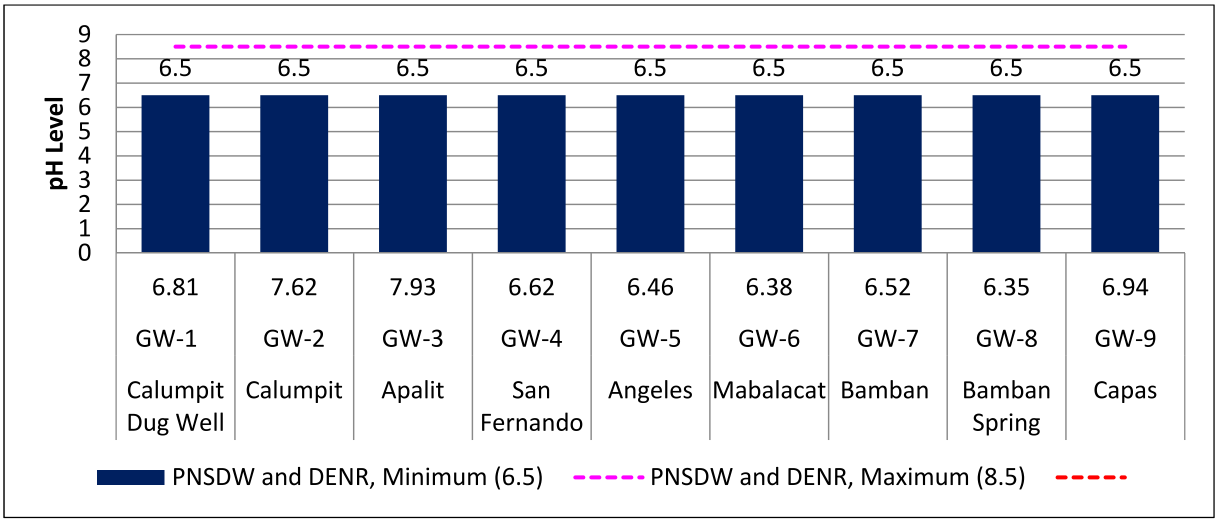


Figure 3.2.8 Results of pH Measurement of Groundwater Samples

Conductivity

612. The conductivity of the groundwater samples ranged 307-1,571 µS/cm (**Figure 3.2.9**). All the samples indicated fresh groundwater. The lowest conductivity was recorded in Station GW-9 (Capas) at 307 µS and the highest conductivity was recorded in Station GW-3 (Apalit) at 1,571 µS.

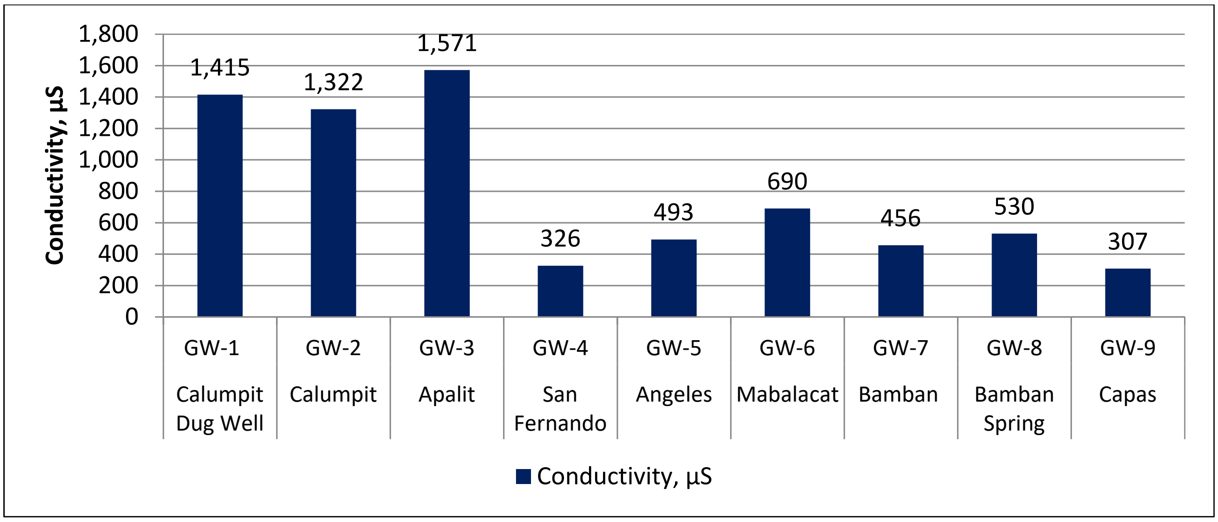


Figure 3.2.9 Results of Electrical Conductivity Measurement of Groundwater Samples

Total Dissolved Solids

613. The Total Dissolved Solids (TDS) of the groundwater samples ranged151-770 mg/L, with three (3) cases of non-conformance with the 600mg/L maximum limit of PNSDW (**Figure 3.2.10**) at Stations GW-1 (Calumpit Dug Well), GW-2 (Calumpit), and GW-3 (Apalit). The lowest TDS value was recorded at Station GW-9 (Capas) at 151 mg/L and the highest TDS value was recorded at Station GW-3 (Apalit) at 770 mg/L.

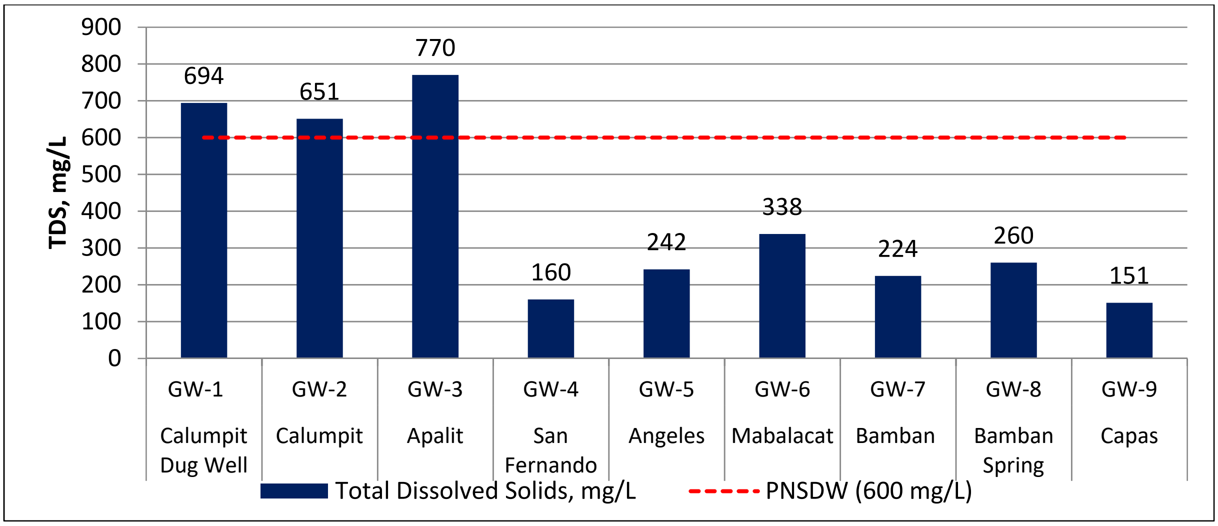


Figure 3.2.10 Results of Total Dissolved Solids Measurement of Groundwater Samples

Calcium

614. The Calcium in groundwater samples ranged 10-130mg/L (**Figure 3.2.11**). The lowest calcium concentration was recorded in Station GW-8 (Bamban Spring) at 10 mg/L and the highest calcium concentration was recorded in Station GW-2 (Calumpit) at 130 mg/L.

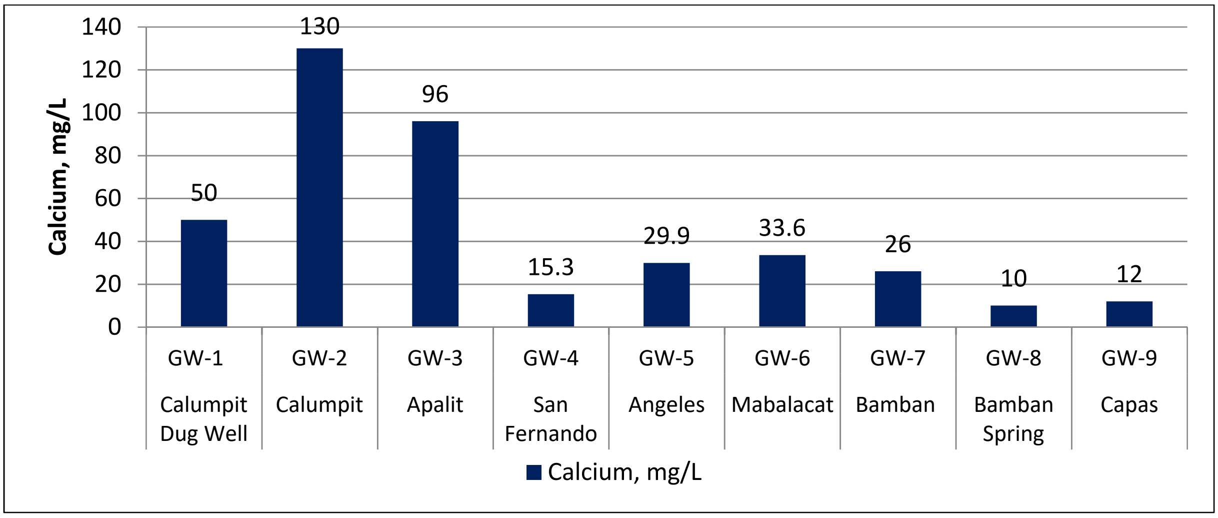


Figure 3.2.11 Results of Calcium Measurement of Groundwater Samples

Magnesium

615. The magnesium in groundwater samples ranged 5.6-43mg/L (**Figure 3.2.12**). The lowest magnesium concentration was recorded in Station GW-8 (Bamban Spring) at 5.6 mg/L and the highest magnesium concentration was recorded in Station GW-3 (Apalit) at 43 mg/L.

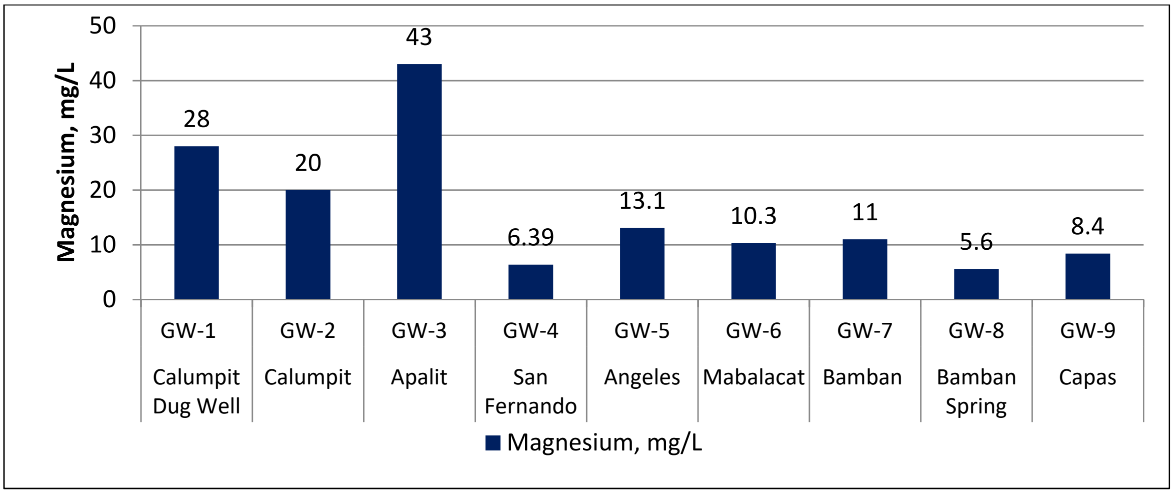


Figure 3.2.12 Results of Magnesium Measurement of Groundwater Samples

Potassium

616. The potassium in groundwater samples ranged 0.29-23mg/L (**Figure 3.3.13**). The lowest potassium concentration was recorded in Station GW-9 (Capas Spring) at 0.9 mg/L and the highest potassium concentration was recorded in Station GW-2 (Calumpit) at 23 mg/L.

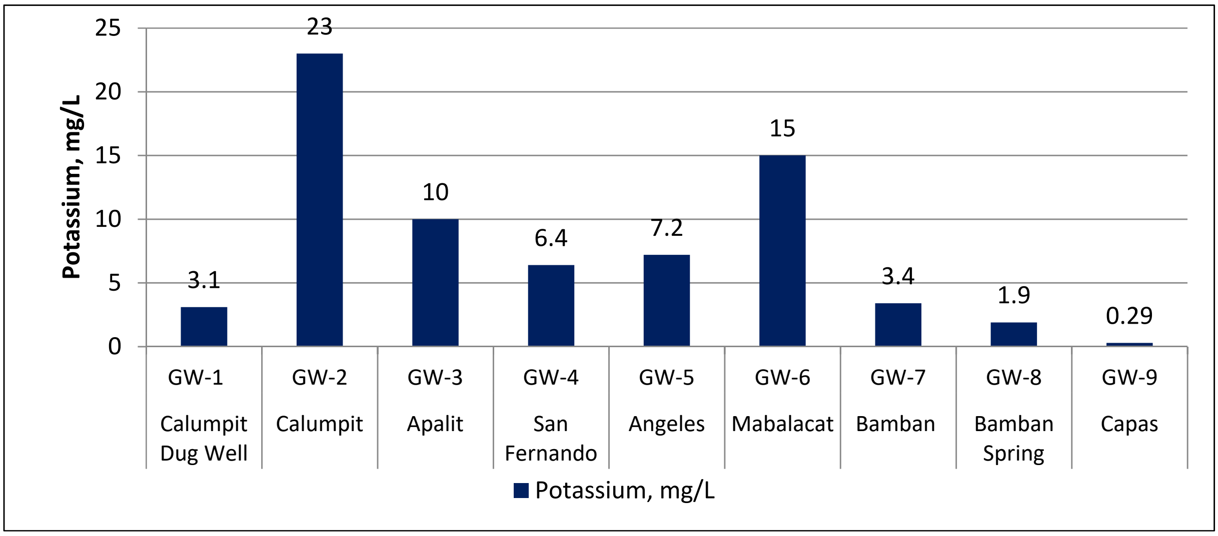


Figure 3.2.13 Results of Potassium Measurement of Groundwater Samples

Bicarbonate

617. The bicarbonate (HCO_3) in groundwater samples ranged 86.3-405mg/L (**Figure 3.2.14**). The lowest bicarbonate concentration was recorded in Station GW-4 (San Fernando) at 86.3 mg/L and the highest concentration was recorded in Station GW-2 (Calumpit) at 405 mg/L. Much higher values of HCO_3 (72-87%) were detected in Stations GW-8 (Bamban Spring) and GW-9 (Capas), an indication of low mineralized rain water.

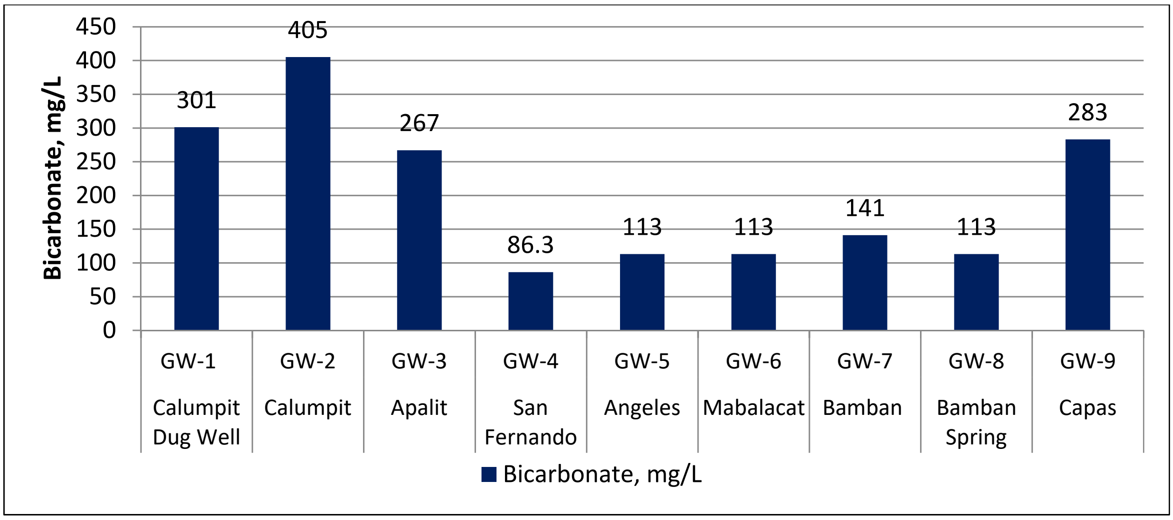


Figure 3.2.14 Results of Bicarbonate Measurement of Groundwater Samples

Sodium

618. The Sodium of the groundwater samples ranged from 3.4-160 mg/L in conformance with the 200 mg/L maximum allowable limit of PNSDW (**Figure 3.2.15**). The lowest sodium concentration of 3.4 mg/L was recorded in Station GW-9 (Capas) and the highest sodium concentration of 160 mg/L was recorded in Station GW-1 (Calumpit Dug Well).

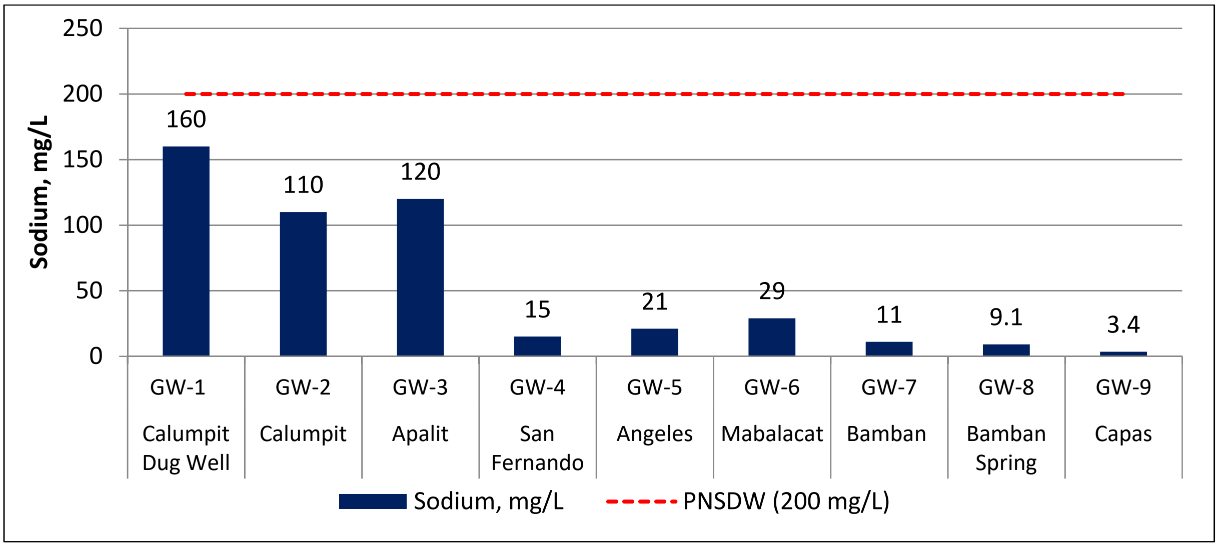


Figure 3.2.15 Results of Sodium Measurement of Groundwater Samples

Chloride

619. The Chloride in groundwater samples ranged 3.6-321 mg/L with two (2) cases of non-conformance with the maximum limit of 250 mg/L PNSDW and DENR Guidelines for Class A Water at Stations GW-1 (Calumpit Dug Well) and GW-3 (Apalit) (**Figure 3.2.16**) The lowest chloride concentration was recorded in station GW-9 (Capas) and the highest concentration was recorded in station GW-3 (Apalit). The set of high Chloride values is an indication of salt water intrusion.

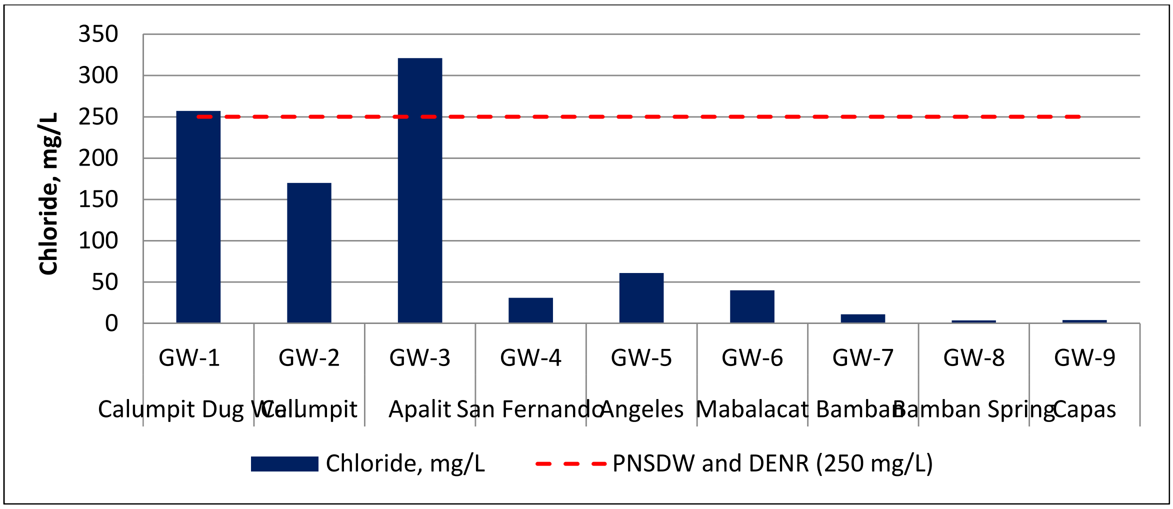


Figure 3.2.16 Results of Chloride Measurement of Groundwater Samples

Sulfate

620. The Sulfate in groundwater samples ranged 8-87 mg/L or within the 250 mg/L maximum allowable limit of PNSDW and DENR Guidelines for Class A Water (**Figure 3.2.17**). Higher values of Sulfate were noted at Stations GW-4, GW-5, GW-6 and GW-7 from San Fernando to Bamban. The high sulfate content is an indication of the effect of Mt. Pinatubo Volcano.

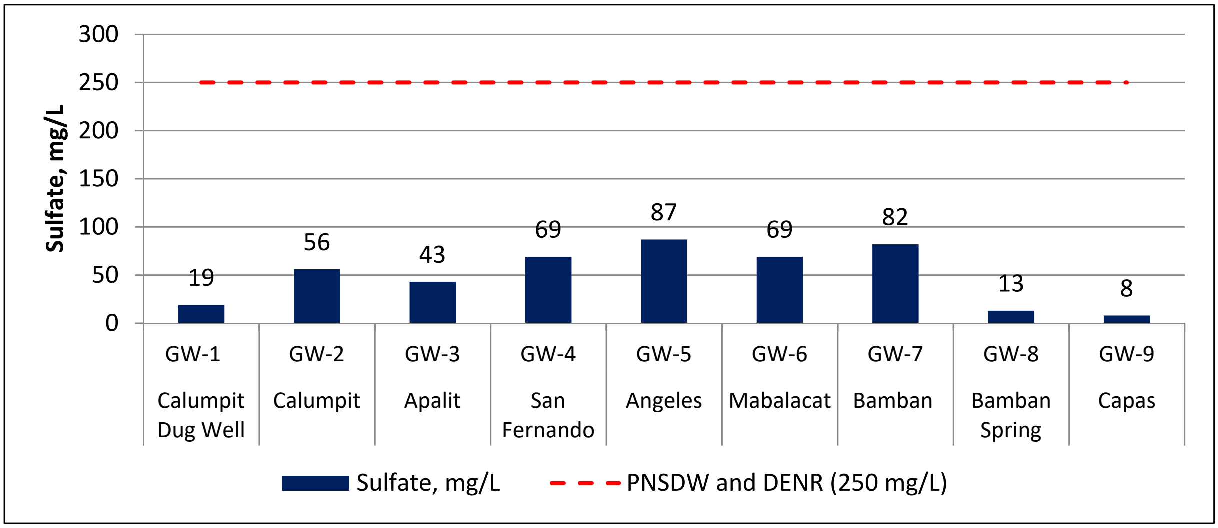


Figure 3.2.17 Results of Sulfate Measurement of Groundwater Samples

Nitrate

621. The Nitrate (as N) in groundwater samples ranged 0.13-6 mg/L or within maximum allowable limit of 50 mg/L of PNSDW and WHO Guideline (**Figure 3.2.18**). The lowest nitrate concentration of 0.13 mg/L was recorded in Station GW-3 (Apalit) and the highest concentration of 6 mg/L was recorded in Station GW-6 (Mabalacat).

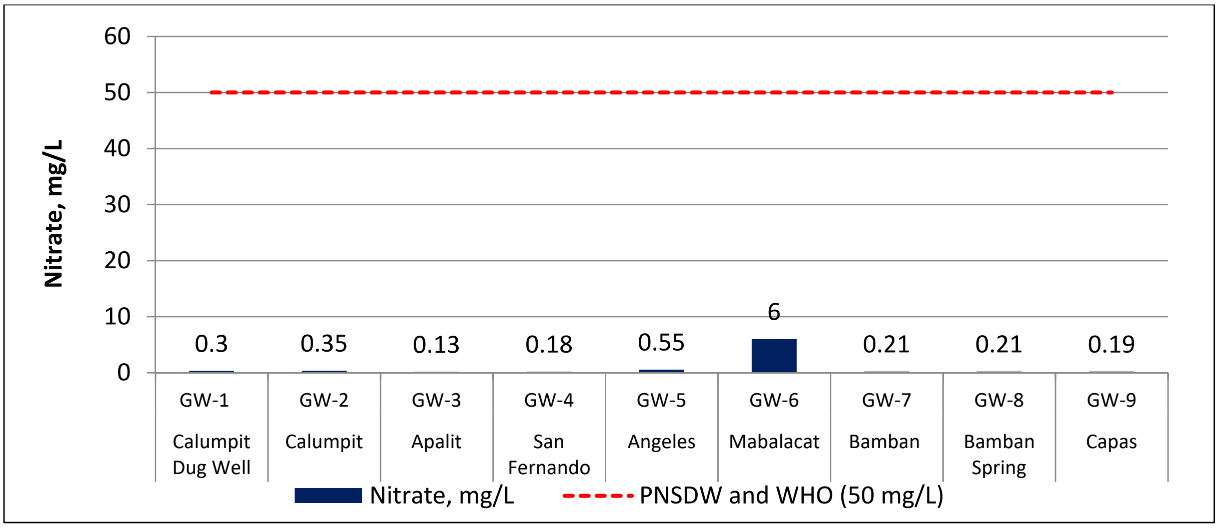


Figure 3.2.18 Results of Nitrate Measurement of Groundwater Samples

Toxic and Other Deleterious Substances

622. The Cadmium, Lead and Mercury are not detectable in all sampling stations. The concentrations of Arsenic in all sampling stations are within the 0.01 mg/L maximum limit of PNSDW and WHO Guidelines and 0.1 mg/L maximum limit of DENR Guidelines for Class A Water (**Figure 3.2.19**). The lowest Arsenic concentration of 0.0012 mg/L was recorded in Station GW-6 (Mabalacat) and the highest Arsenic concentration of 0.0016 mg/L was recorded in Station GW-4 (San Fernando). Similarly, the concentrations of Chromium Hexavalent in all sampling stations are within the 0.05 mg/L maximum limit of PNSDW and WHO Guidelines and 0.01 mg/L maximum limit of DENR Guidelines for Class A Water. The lowest Chromium Hexavalent concentration of 0.0024 mg/L was recorded in Station GW-1 (Calumpit Dug Well) and the highest Chromium Hexavalent concentration of 0.0043 mg/L was recorded in Station GW-2 (Calumpit).

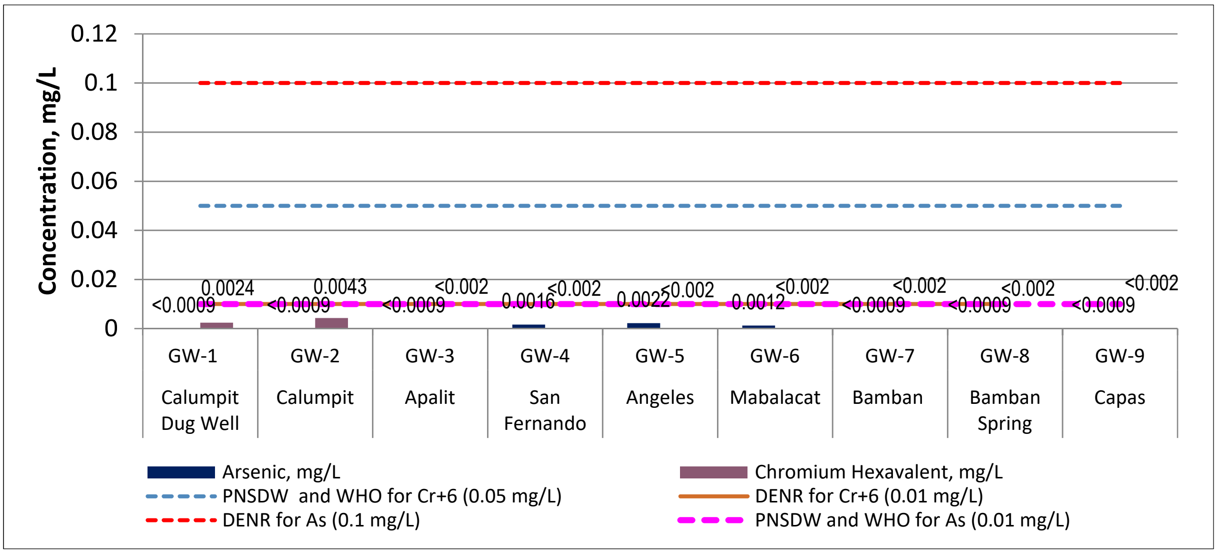


Figure 3.2.19 Results of Arsenic and Chromium Hexavalent Measurements of Groundwater Samples

Free Cyanide

623. The concentrations of free cyanide in all sampling stations were within the 0.05 mg/L maximum limit of PNSDW and 0.07 mg/L maximum limit of DENR Guidelines for Class A Water. The lowest free cyanide concentration of 0.0045 mg/L was recorded in Station GW-9 (Capas) and the highest free cyanide concentration of 0.0458 mg/L was recorded in Station GW-4 (San Fernando).

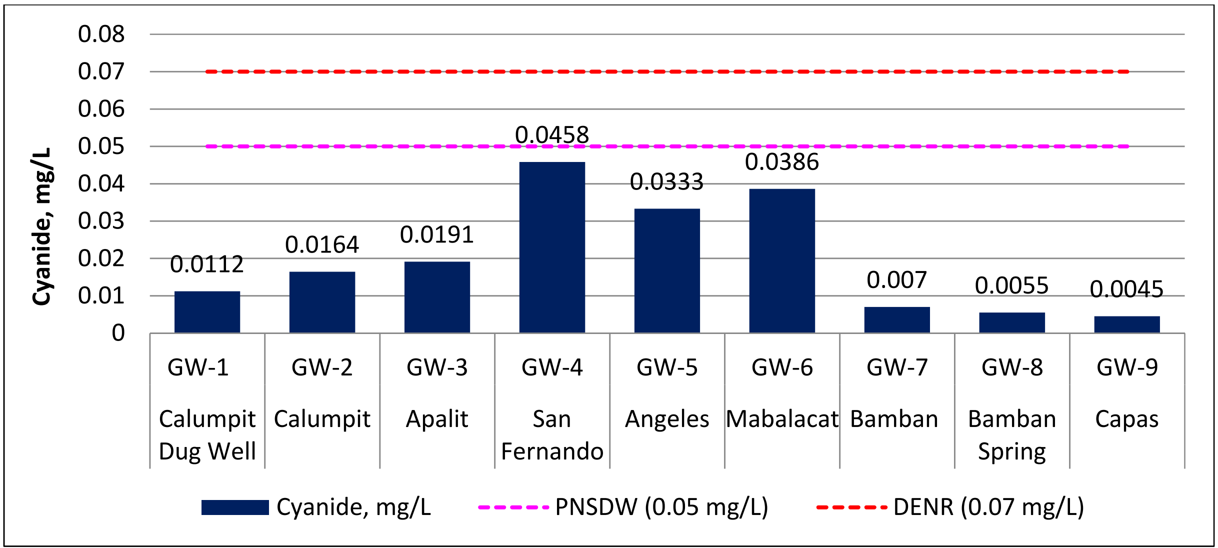


Figure 3.2.20 Results of Free Cyanide Measurement of Groundwater Samples

Fecal Coliforms and Total Coliforms

624. Fecal coliforms and total coliforms ranged from <1 to > 8 MPN/100 ml. Four (4) cases of detection, which do not pass the PNSDW and WHO Guidelines were noted in Station GW-1, GW-2, GW-7, and GW-8.

3.2.2.2 Surface Water / Freshwater Quality

625. The proposed MCRP will cross 43 rivers and/or stream, which are potential impact areas of project construction and operation. The natural waterways covered in this study were aimed at obtaining a general picture of the range of quality of surface water bodies, through various parameters, as a guide in the detailed water pollution prevention planning and implementation. For the selected sites, the data gathered would serve as part of baseline data. Surface water quality data from other water crossings would be collected prior to and during project implementation.

(1) Survey Results of EMB DENR

626. The EMB DENR conducts regular monitoring of 16 rivers draining to the Manila Bay. For Central Luzon, Pampanga River, Apalit River, and Angat River were included in the monitoring stations of EMB- DENR. Based on the results of 2014 Water Quality Monitoring of EMB (**Table 3.2.5**), the levels of Cadmium, Lead, Chromium Hexavalent, Phosphate (as Phosphorous) and TSS are below the standard limits of DENR for Class C Waters while the levels of Arsenic exceeded the standard of 0.02 mg/L.

Table 3.2.5 2014 Water Quality Monitoring Data of EMB-DENR

Parameters	Pampanga	Apalit	Angat	DENR Class C Standard Waters
	2014.11-12	2014.11-12	2014.11-12	
Arsenic (As)	0.0484	0.0798	0.069	0.02 mg/L
Cadmium (Cd)	0.00073	<LLD 0.0001	0.002	0.005 mg/L

Parameters	Pampanga	Apalit	Angat	DENR Class C Standard Waters
	2014.11-12	2014.11-12	2014.11-12	
Lead (Pb)	(LLD <0.002)	LLD (<0.002)	(LLD <0.002)	0.05 mg/L
Chromium Hexavalent	LLD (<0.0006)	0.004	LLD (<0.0006)	0.01 mg/L
Phosphate (as Phosphorous)	0.04	0.08	0.06	0.163 mg/L
TSS	0.06	0.03	0.1	80 mg/L
Coliform	16,000	16,000	16,000	-

Source: Environmental Management Bureau of Department of Environment and Natural Resources

(2) Field Survey

627. Freshwater quality survey was conducted on February 6-8, 2018 to assess the physical-chemical properties of rivers and creeks along the proposed MCRP. The freshwater samples were collected at 15 sampling sites representing small to large flow river systems within rural, agricultural, urbanized and industrialized areas in Bulacan, Pampanga and Tarlac. **Table 3.2.6** and **Figure 3.2.21** present the description of the freshwater quality sampling stations.

628. Each freshwater sampling site was characterized for 23 parameters, with reference to DAO 2016-08 Water Quality Guidelines and General Effluent Standards of 2016:

- Primary Parameters: temperature, pH, dissolved oxygen (**DO**), color, biochemical oxygendemand (**BOD**), total suspended solids (**TSS**), chloride as Cl, nitrate as nitrogen (**NO_3-N**), phosphate as phosphorus (**P**), fecal coliforms
- Secondary Parameters: Metals: arsenic (**As**), copper (dissolved copper, **Cu**), cadmium (**Cd**), chromium (hexavalent, **Cr_{+6}**), lead (**Pb**), total mercury (**Hg**)

  Organics: cyanide (**CN**), oil/grease (Petroleum Ether Extracts) (**O&G**), organophosphate, phenolic substances as phenols, surfactants (MBAS)
- Others: conductivity, total coliform

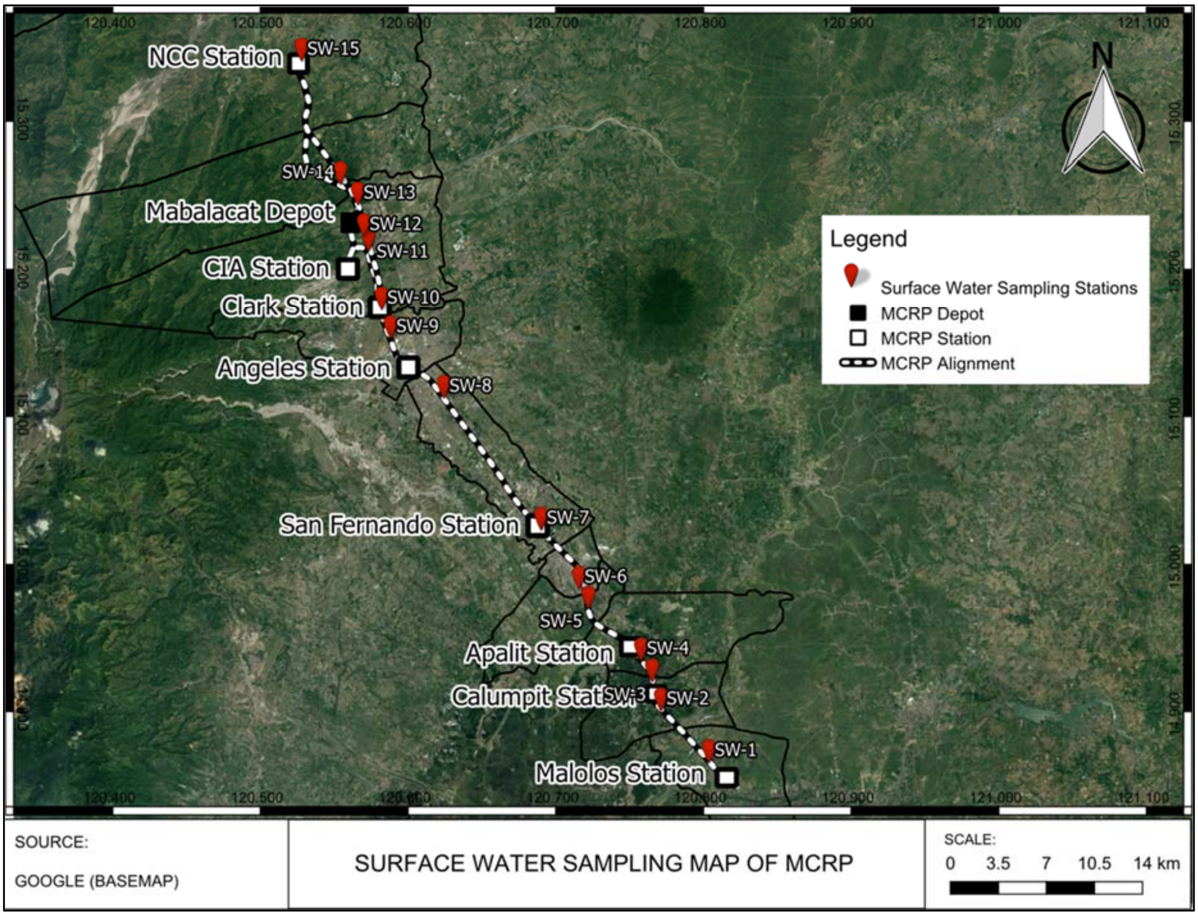
629. In-situ measurements include temperature, pH, and conductivity using Thermo Scientific Orion Start A329. DO was also measured using Trans Instruments DO meter. The water samples for microbes analysis were collected into sterilized small glass bottles and wrapped with aluminum foil; for oil and grease into wide-mouth bottles, organics into amber glass bottle; and the rest of the parameters into PET bottles. The labeled samples were stored in ice-chest and brought for laboratory analyses with a Chain-of-Custody Form within 24 hours to Mach Union Laboratory, Inc., a DENR recognized laboratory in Las Piñas City.

630. The guideline values for primary parameters are annual averages of at least 10 data sets except for coliform which is the geometric mean of at least data sets per quarter and twice WQG for maximum allowable limit; for secondary inorganic parameters, annual average of 4 data sets; for secondary metals and organics parameters, as maximum allowable limit; and for natural occurrence higher than WQG, as maximum 10% increase of the natural level.

Table 3.2.6 Surface Water / Freshwater Quality Sampling Stations

Sampling Point	Description	Coordinates	Sampling Date
SW-1	Bulihan River, Malolos, Bulacan Approximately 43m from the alignment	14° 51' 55.60"N 120° 48' 13.21"E	02/07/2018
SW-2	Labangan River, Calumpit, Bulacan (Confluence of Angat River and Bagbag River). South of Calumpit Station	14° 54' 01.53"N 120° 46'15.97"E	02/07/2018

Sampling Point	Description	Coordinates	Sampling Date
SW-3	Bagbag River, Calumpit, Bulacan North of Calumpit Station. The sampling site is in the junction of distributary of Pampanga River and Bagbag River	14° 55' 12.56"N 120° 45' 54.56"E	02/07/2018
SW-4	Pampanga River, Apalit, Pampanga	14° 56' 03.77"N 120° 45' 27.58"E	02/07/2018
SW-5	Malalam River, Minalin, Pampanga	14° 58' 11.58"N 120° 43' 19.20"E	02/07/2018
SW-6	Masaluso, Minalin, Pampanga	14° 59' 00.33"N 120° 42' 56.21"E	02/07/2018
SW-7	Sto Niño River, San Fernando, Pampanga (Confluence of San Fernando River and Mapalad River) South of San Fernando Station.	15° 01' 23.81"N 120° 41' 23.97"E	02/07/2018
SW-8	Calutcut Creek, San Fernando, Pampanga South of Angeles Station	15° 06' 44.80"N 120° 37' 26.56"E	02/08/2018
SW-9	Abacan River, Angelesy, Pampanga	15° 09' 10.26"N 120° 35' 17.25"E	02/08/2018
SW-10	Paranam Tributary, Angeles, Pampanga Creek crossing south of Clark area	15° 10' 21.13"N 120° 34' 55.23"E	02/08/2018
SW-11	Quitanguil River, Angeles, Pampanga Creek crossing middle the Clark area	15° 12' 44.90"N 120° 34' 23.32"E	02/08/2018
SW-12	Sapang Balen, Angeles, Pampanga Creek crossing north of Clark area	15° 13' 20.52"N 120° 34' 12.04"E	02/08/2018
SW-13	Sacobia River, Mabalacat, Pampanga North of the proposed depot	15° 14' 37.18"N 120° 33' 57.32"E	02/06/2018
SW-14	Bamban River, Bamban, Tarlac	15° 15' 26.91"N 120° 33' 14.65"E	02/06/2018
SW-15	Cutcut River Tributary, Capas, Tarlac Five (5) km east of north end of railway at NCC	15° 20' 26.51"N 120° 31' 40.18"E	02/06/2018



Source: Google Earth modified by GEOSPHERE, 2018

Figure 3.2.21 Map of the Surface Water Quality Monitoring Stations

(3) Applied standard

631. The DENR Administrative Order (DAO) No. 2016-08 provides water usage and classification, and quality criteria of fresh surface waters. **Table 3.2.7** shows the comparison of applicable national and international standards (Environmental Water Quality Standards for Protecting Human Health, Japan) on surface water quality. For further detail criteria to be referred to Chapter 2, 2.6.3 Surface Water Quality.

(4) Results and Analysis

632. The results of measurements for the 15 water samples for the 23 parameters were taken as baseline and examples of surface water quality along the alignment. The sampling sites represent different natural features, land use and flowrates which are factors of water quality. The sampling sites in Bulihan River (SW-1) and Labangan River (SW-2) are located in the Angat River Basin which is connected by Bagbag River (SW-3) to Pampanga River (SW-4) within the Pampanga River Basin which also includes the rest of the sampling sites to the north (SW-5 to SW-15) receiving headwaters from Mt. Pinatubo (a volcano) to the west. All drains into the north side of Manila Bay.

633. The large rivers along the alignment were covered in the study. Visually large flow rivers during the dry period, having large dilution capacities are Labangan River (SW-2), Bagbag River (SW-3), Pampanga River (SW-4), Malalam River (SW-5), Masaluso River (SW-6), and Bamban River (SW-14). They drain large agricultural areas. The waters of Malalam River (SW-5) and Masaluso River (SW-6) are mixtures with the waters of large fishpond area in Minalin Pampanga. A boat was used to take samples in these sites. Noted to have high flows during the rainy season are Abacan River (SW-9) and Sacobia River (SW-13).

634. Highly developed areas are San Fernando, Angeles and Mabalacat where low flow river waters are receiving high loadings of various types of water pollutants and scattered solid wastes. Highly polluted waters are marked by black streambeds like in Sto. Niño Creek (WS-7), Calutcut Creek (WS-8), and Paranum Creek Tributary (SW-10).

635. Only a few rivers were classified by the DENR, namely, Bamban River (SW-14) as Class A, and Pampanga River (SW-4) and Sto. Niño River (SW-7) as Class C. Angat River, which is upstream of Labangan River, and mixes with Bagbag River (SW-3) was classified as Class C water. The results of measurements for these rivers were compared with the DENR Guidelines and Japan Guidelines for Class C Water.

1) Results by Sampling Stations

636. The following is a discussion of the results by sampling site. Based on **Table 3.2.7**, 23 parameters were measured, two (2) of which (Total Coliform and Conductivity) have no DENR guidelines for Classes A and C surface waters. Japan standards cover 12 and 11 parameters for Class A and Class C waters, respectively. The results were summarized and presented in **Table 3.2.7.**

SW-1 Bulihan River

637. The sampling site is located in Barangay Bulihan, Malolos City, about 35 meters west of the proposed railway alignment and about 80 meters west of the Manila North Road (MNR) or popularly known as MacArthur Highway. Bulihan River is a small river within the Angat River Basin. Bulihan River is still unclassified.

638. The river is classified as Class C water based on its beneficial use. The result of water testing showed that fourteen (14) parameters were conformant to DENR guidelines for Class C

waters. The six (6) non-conforming parameters were DO (1.62 mg/L), BOD (10 mg/L), Fecal coliform (240 MPN/100mL), PO4-P (0.238 mg/L), Cu (0.0228 mg/L) and Pb (0.0530 mg/L). Of the eleven parameters covered by Japan standards, seven (7) were conformant to standards. The four (4) non-conforming parameters were DO, BOD, Pb and CN (0.0289 mg/L).

639. The sampling site drains and receives inputs from irrigated rice fields and growing subdivisions upstream to the north and northeast. Within the plain, the sampling site water moves slowly within the width of about 5 meters.

SW-2 Labangan River

640. The sampling site is located 90 m SW of the proposed alignment and 140 m SW of Labangan Bridge, and about 500 m SW of the confluence of Angat River (Class C water), and Bagbag River, the latter is connected with Pampanga River. Labangan River is a deep large river about 90 m wide at the sampling site, with very large dilution capacity, draining into Manila Bay. The river is used for navigation by large motor boats.

641. The result of water testing showed that fourteen (18) parameters were conformant to DENR guidelines for Class C waters. The six (3) non-conforming parameters were BOD (9 mg/L), Cl (1,623 mg/L) and Cu (0.0361 mg/L). Of the eleven parameters covered by Japan standards, eight (8) were conformant to standards. The three (3) non-conforming parameters were BOD, Pb (0.0327 mg/L) and CN (0.0243 mg/L).

642. The high chloride concentration is associated with high values of conductivity of 3,139 µS/cm and TDS of 1,540 mg/L, an indication of brackish water as a result of mixing of freshwater and marine water of Manila Bay which is about 17 km away.

SW-3 Bagbag River

643. The sampling site is located is located 30 m west of the proposed alignment, 60 m west of Calumpit Bridge, and 450 m north of Calumpit PNR Station. The river is deep with 70-meter width at the sampling site. Bagbag River is still an unclassified river.

644. Seventeen water quality parameters conformed with Class C guidelines. The four non-conforming parameters were BOD (8 mg/L), Fecal coliform (35,000 MPN/100 ml) which is the same count of total coliform, Cl (1,205 mg/L), and Cu (0.026 mg/L). The water is brackish due to high chloride, conductivity (4,190 µS/cm) TDS (2,056 mg/L).

645. The result of water testing showed that seventeen (17) parameters were conformant to DENR guidelines for Class C waters. The four (4) non-conforming parameters were BOD (8 mg/L), Fecal coliform (35x103 MPN/100mL), Cl (1,205 mg/L) and Cu (0.0257 mg/L). Of the eleven parameters covered by Japan standards, eight (8) were conformant to standards. The three (3) non-conforming parameters were BOD, Pb (0.017 mg/L) and CN (0.0368 mg/L).

SW-4 Pampanga River

646. The sampling site is located within Sulipan Channel Floodway on the side of Apalit Pampanga, 30 m west of the proposed alignment, and 80 m west of Sulipan Bridge. The channel is deep and about 100 m wide. Pampanga River is classified as Class C water.

647. Eighteen parameters conformed with DENR Class C guidelines. The three non-conforming parameters were BOD (9 mg/L), Fecal coliform (2,300 MPN/100 ml), and Cu (0.044 mg/L). Of the eleven parameters covered by Japan standards, nine (9) were conformant to standards. The two (2) non-conforming parameters were Pb (0.0282 mg/L) and CN (0.0399 mg/L).

648. Monitoring in 2003-2006 by EMB Region 3 showed the following annual values of a few parameters for San Pampanga River: 4.3 mg/L BOD; 5.7 mg/L DO; 429 mg/L 282 mg/L TDS; and 142 mg/L TSS (NWRB, 2011).

SW-5 Malalam River

649. The sampling site is located in large fishpond areas in Minalin, Pampanga, accessible by motor boats. Malalam River is large and is not yet classified.

650. Fifteen parameters conformed with DENR Class C guidelines. The six non-conforming parameters were TSS (86 mg/L), DO (4.22 mg/L), BOD (49 mg/L), fecal coliform (17,000 MPN/100 ml), PO4-P (2.88 mg/L) and Oil and Grease (19.7mg/L). Of the eleven parameters covered by Japan standards, seven (7) were conformant to standards. The four (4) non-conforming parameters were TSS, DO, BOD and CN (0.0619 mg/L). The sample from Malalam River exhibited brackish water with conductivity of 2,037 µS/cm) and TDS of 1,000 mg/L. The elevated oil and grease may be coming from the hydrocarbon discharges from motorized boats.

SW-6 Masaluso River

651. The sampling site is located in large fishpond areas at the boundary of Minalin, and Sto. Tomas, Pampanga, accessible by motor boats. The large river is not yet classified.

652. Sixteen water quality parameters conform with DENR Class C guidelines. The five (5) non-conforming parameters were DO (1.0 mg/L), BOD (21 mg/L), fecal coliform (17,000 MPN/100 ml), PO4-P (1.79 mg/L) and O&G (2.2 mg/L). Of the eleven parameters covered by Japan standards, seven (7) were conformant to standards. The four (4) non-conforming parameters were DO, BOD, Pb (0.0157 mg/L) and CN (0.0714 mg/L). The elevated oil and grease may be coming from the hydrocarbon discharges from motorized boats.

SW-7 Sto. Niño Creek

653. The sampling site is located just 10 east of the proposed alignment in San Fernando. Water appeared stagnant and the river bed is muddy black caused by anaerobic decomposition of accumulated wastes. The creek joins downstream to the northeast with San Fernando River which is classified as Class C water.

654. Seventeen parameters were found conforming with DENR Class C guidelines. The four (4) non-conforming parameters were DO (1.55 mg/L), BOD (154 mg/L), fecal coliform (2.4 million MPN/100 ml), and PO4-P (1.52 mg/L). Of the eleven parameters covered by Japan standards, eight (8) were conformant to standards. The three (3) non-conforming parameters were DO, BOD and CN (0.0521 mg/L).

655. San Fernando River is drained by Mapalad Creek and Matulid Creek. As the lowest point in the city, San Fernando River absorbs surface water runoff and flood water coming from neighboring Angeles and Mexico through feeder creeks. The flood water in water way is subject to back flow because of lahar and the construction of Tail Dike west, (De Leon, E.M. 2008). Monitoring in 2007-2008 by EMB Region 3 showed the following annual values of a few parameters for San Fernando River: 13 mg/L BOD, 5 mg/L DO, 429 mg/L TDS, and 48 mg/L TSS (NWRB, 2011).

SW-8 Calutcut Creek

656. The sampling site is just 10 m west of the proposed alignment in Barangay Baliti, San Fernando. Piles of solid wastes were found in the area and upstream appeared to be dumpsite of solid waste. Water flowed fast at depth of 9 cm and width of 3 m. The creek is not yet classified by DENR.

657. Seventeen parameters were conforming with DENR Class C guidelines. The four (4) non-conforming parameters were DO (3.8 mg/L), BOD (25 mg/L), fecal coliform (1.6 million MPN/100 ml) with corresponding total coliform of 1.6 million MPN/100 ml, and PO4-P (2.62 mg/L). Of the eleven parameters covered by Japan standards, eight (8) were conformant to standards. The three (3) non-conforming parameters were DO, BOD and CN (0.0516 mg/L).

SW-9 Abacan River

658. The sampling site is within the proposed alignment. Stockpiles of garbage were seen just upstream to the west. The river was fast flowing at depth of 30 cm and width of 2 m.

659. Fifteen water quality parameters were found conforming with DENR Class C guidelines. The six non-conforming parameters were DO (3.93 mg/L), BOD (9 mg/L), fecal coliform (920 MPN/100 ml) with corresponding total coliform of 2,400 MPN/100 ml, PO4-P (0.998 mg/L), Cu (0.0267 mg/L), and O&G (3.2 mg/L). Of the eleven parameters covered by Japan standards, seven (7) were conformant to standards. The four (4) non-conforming parameters were DO, BOD, Pb (0.0241 mg/L) and CN (0.0274 mg/L).

SW-10 Paranum Creek Tributary

660. The sampling site is within east side of Clark, about 300 m north of SM City Clark. Black smelly water was observed, as coming from Clark facility beside the airport. The water was fast flowing along the cemented canal.

661. Sixteen water quality parameters conformed with the DENR Class C guidelines. The five (5) non-conforming parameters with Class C guidelines were DO (2.18 mg/L), BOD (271 mg/L), fecal coliform (3.4 million MPN/100 ml), PO4-P (1.04 mg/L) and Cu (0.0416 mg/L). Of the eleven parameters covered by Japan standards, seven (7) were conformant to standards. The four (4) non-conforming parameters were DO, BOD, Pb (0.0137 mg/L) and CN (0.0269 mg/L).

SW-11 Quitanguil River

662. The sampling site in Quitanguil River is located in the east side of Clark just about 10 m west of the elevated SCTEX road. The water in river during sampling was fast flowing at 11 cm deep and 3.5 m width. The river is not yet classified.

663. Eighteen water quality parameters conformed with the DENR Class C guidelines. The three (3) non-conforming parameters with Class C guidelines were pH (5.99), BOD (12 mg/L) and Cu (0.0234 mg/L). Of the eleven parameters covered by Japan standards, seven (7) were conformant to standards. The four (4) non-conforming parameters were pH, BOD, Pb (0.0327 mg/L) and CN (0.0261 mg/L). The site appeared to be the cleanest of the all the sampling sites.

SW-12 Sapang Balen

664. The sampling site is in the east side of Clark just about 50 m west of the elevated SCTEX road. Water was fast flowing at 30 cm deep and 2.5 m width.

665. Sixteen parameters were found to conform with DENR Class C guidelines. The five non-conforming parameters were temperature (31.7°C), BOD (10 mg/L), fecal coliform (350 MPN/100 ml) with total coliform of 920 MPN/100 ml, PO4-P (0.516 mg/L) and Cu (0.0343 mg/L). Of the eleven parameters covered by Japan standards, nine (9) were conformant to standards. The two (2) non-conforming parameters were BOD and CN (0.0389 mg/L).

SW-13 Sacobia River

666. The sampling site is just 20 m downstream east of the proposed alignment, and 90 m upstream of the Sacobia Bridge. The river water moderately flowed at 10 cm deep and 2 m wide. The river is not yet classified.

667. Sixteen parameters conformed with DENR Class C guidelines. The five (5) non-conforming parameters were TSS (93 mg/L), pH (6.17), BOD (28 mg/L), fecal coliform (7,900 MPN/100 ml) with total coliform of 24,000 MPN/100 ml, and PO4-P (0.853 mg/L). Of the eleven parameters covered by Japan standards, seven (7) were conformant to standards. The four (4) non-conforming parameters were TSS, pH, BOD and CN (0.0328 mg/L).

SW-14 Bamban River

668. The sampling site is located within the proposed alignment and 660 m west of Bamban Bridge. Water was turbid and fast flowing at varying widths of the irregular channel. The river is classified as Class A water.

669. Thirteen parameters were found conforming with Class A guidelines. The eight (8) non-conforming parameters were temperature (31.2ºC), BOD (12 mg/L), fecal coliform (24,000 MPN/100 ml) with total coliform 24,000 MPN/100 ml), PO4-P (0.235 mg/L), Cd (0.0084 mg/L), O&G (1.44 mg/L), phenols, (0.03 mg/L) and surfactants (0.227mg/L). Of the eleven parameters covered by Japan standards, eight (8) were conformant to standards. The three (3) non-conforming parameters were BOD, total coliform and CN (0.00962 mg/L).

SW-15 Cutcut River Tributary

670. The sampling site is located about 140 m downstream of the proposed alignment or 1.5 km south to the national road in Barangay Cristo Rey, Capas, Tarlac. The small creek is fast flowing at 18 cm deep and 1.75 m wide at the sampling point. The river is not yet classified.

671. Sixteen parameters were found conforming with DENR Class C guidelines. The five (5) non-conforming parameters were TSS (1,100 mg/L), BOD (144 mg/L), fecal coliform (920 MPN/100 ml) with total coliform of 920 MPN/100 ml, Cl (531 mg/L), and PO_4-P (3.72 mg/L).

672. Of the eleven parameters covered by Japan standards, eight (8) were conformant to standards. The three (3) non-conforming parameters were TSS, BOD and CN (0.0564 mg/L). The high TSS can be attributed to the eroded soil particles from the newly open road for the Clark Green City, and the high phosphate from the agricultural fertilizer inputs.

Table 3.2.7 Results of Freshwater Quality Sampling

Parameters	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10	SW-11	SW-12	SW-13	SW-14	SW-15	Reference Values [a] DENR AO 2016-08		Japan Standards	
																Class A	Class C	Class A	Class C
Date	2/7/18	2/7/18	2/7/18	2/7/18	2/7/18	2/7/18	2/7/18	2/7/18	2/6/18	2/6/18	2/6/18	2/6/18	2/6/18	2/6/18	2/6/18				
Time	1830H	1735H	1620H	1515H	1155H	1300H	0925H	0830H	1715H	1630H	1530H	1445H	1230H	1120H	0945H				
Depth, cm	25	200	213.33	200	1.7	100	45	10	20.67	7.5	20	16.67	19.33	18.33	17.5	-	-	-	
Width, m	5	>100	>100m	>100	26.67	10	7.33	4.63	8.3	3	4.67	5.33	7.97	8.5	1.88	-	-	-	
Flowrate, m/s	5	>100	>100m	>100	26.67	10	7.33	4.63	8.3	3	4.67	5.33	7.97	8.5	1.88	-	-	-	
Color (TCU)	5	5	10	10	42	33	20	14	10	10	10	20	<5	10	<5	50	75	-	
TSS, mg/L	21.2	31.0	37.8	37.3	86	27.0	20.5	17	13.5	32.5	3.0	33.0	93.0	5.0	1100	50	80	≤25	≤50
Temperature, °C	26	29.8	28.6	30.2	28.9	28.8	28.3	26	29.7	29.6	29.1	31.7	30.2	31.2	26.2	26-30	25-31	-	--
pH	6.7	7.26	7.09	7.3	7.2	6.87	6.76	6.95	6.48	6.53	5.99	6.75	6.17	7.13	6.95	6.5-8.5	6.5-9.0	6.5-8.5	6.5-8.5
DO, mg/L	1.62	10.95	6.08	7.94	4.22	1.04	1.55	3.8	3.93	2.18	9.17	8.76	15.98	11.22	11.13	5 (min)	5	≥7.5	≥5
BOD, mg/L	10	9	8	9	49	21	154	25	9	271	12	10	28	12	144	3 (max)	7	≤2	≤5
Fecal Coliform, MPN/100mL	240	34	35,000	2300	17,000	17,000	24x10^{5}	16x10^{5}	920	34x10^{5}	<1.8	350	79x10^{2}	24x10^{3}	920	1.1	200	-	-
Total Coliform, MPN/100mL	240	240	35,000	13,000	92,000	17,000	24x10^{5}	16x10^{5}	2400	17x10^{6}	<1.8	920	24x10^{3}	24x10^{3}	920	-	-	≤1,000	-
Conductivity, uS/cm	510	3,139	4,190	322	2,037	877	654	677	500	436	340	884	1,398	387	220	-	-	-	-
Cl, mg/L	69	1623	1205	41	220	110	43	48	34	87	13	160	47	2.9	531	250	350	-	-
Nitrate as N, mg/L	0.109	0.655	0.391	0.207	0.0686	0.0594	0.0605	0.0763	0.171	0.61	0.162	0.163	0.0738	0.065	0.137	7	7	<10	<10
Phosphate as P, mg/L	0.238	0.0723	0.123	0.0938	2.88	1.79	1.52	2.62	0.998	1.04	0.081	0.516	0.853	0.235	3.72	0.163[b]	0.163[b]	-	-
Cu, mg/L	0.0228	0.0361	0.0257	0.0441	<0.005	<0.005	<0.005	<0.005	0.0267	0.0416	0.0234	0.0343	0.0109	<0.005	0.0158	0.02	0.02	-	-
As, mg/L	0.0018	0.003	<0.0009	0.0018	0.004	0.0031	0.0045	0.0031	0.0029	0.002	0.0022	<0.0009	0.0044	0.0034	0.0053	0.01	0.02	≤0.01	≤0.01
Cd, mg/L	0.0041	0.0041	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0041	<0.002	<0.002	<0.002	0.0041	0.00840	<0.002	0.003	0.005	≤0.01	≤0.01
Cr, mg/L	<0.002	<0.002	<0.002	<0.002	0.004	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0021	0.0025	0.01	0.01	≤0.05	≤0.05
Pb, mg/L	0.0530	0.0327	0.017	0.0282	<0.006	0.0157	<0.006	<0.006	0.0241	0.0137	0.0327	<0.006	<0.006	<0.006	<0.006	0.01	0.05	≤0.01	≤0.01
Hg, mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001	0.002	≤0.0005	≤0.0005
CN, mg/L	0.0289	0.0243	0.0368	0.0399	0.0619	0.0714	0.0521	0.0516	0.0274	0.0269	0.0261	0.0389	0.0328	0.00962	0.0564	0.07	0.1	Not detectable	Not detectable
O&G, mg/L	1.6	1.1	<0.5	1.1	19.7	2.19	1.34	1.65	3.2	1.7	<0.5	1.1	0.816	1.44	<0.5	1	2	-	-
Organophosphate, mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.001	0.003	-	-
Phenol, mg/L	0.03	0.02	0.02	0.02	0.02	0.03	0.05	0.03	0.03	0.02	0.01	0.02	0.02	0.03	0.05	<0.001	0.05	-	-
Surfactant, mg/L	0.0443	0.0407	0.0492	0.07	0.0679	0.0282	1.05	0.0671	0.0827	1.07	<0.007	0.0999	0.189	0.227	0.835	0.2	1.5	-	-

Note: The highlighted cells are the results that exceed the standard
[a] Reference values are maximum allowable limits unless specified as range or minimum (min).
[b] The reference values under the column of PO_4-P are conversions (0.3261) of the 0.5 mg/L and 5 mg/L PO_4 values in DAO 2016-08

2) Results by Parameter

673. Below is the discussion of the results per parameter of surface water quality sampling along the proposed MCRP, as compared with the relevant national and international guidelines.

Color

674. All stations categorized under Class C waters were within the 75 TCU maximum allowable limit of DENR guidelines (**Figure 3.2.22**). The highest level of color (42 TCU) was recorded in Stations SW-5 (Malalam River) while SW-13 (Sacobia River) and SW-15 (Cutcut River Tributary) had the lowest (<5 TCU). For SW-14 (Bamban River), the color was also within the 50 TCU maximum allowable limit of DENR guidelines for Class A waters. Japan has no water quality standard for color.

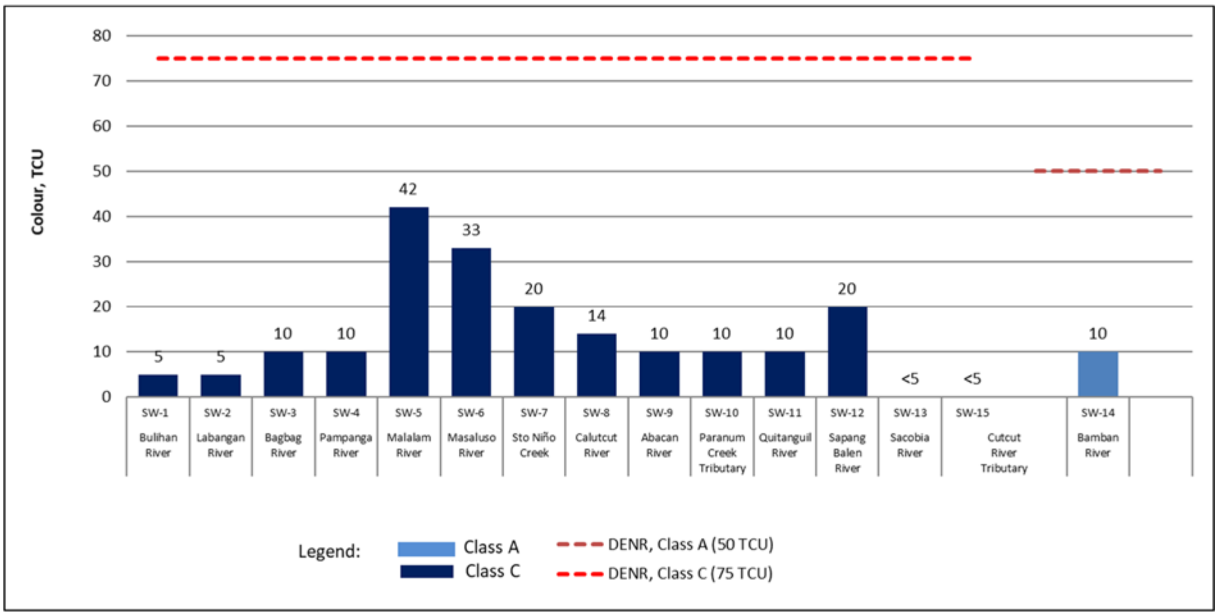


Figure 3.2.22 Results of Color Measurement of Surface Water Samples

Total Suspended Solids

675. All stations categorized under Class C waters were within the 80 mg/L and 50 mg/L maximum allowable limits of DENR guidelines and Japan standards, respectively, for TSS except for stations SW-5 (Malalam River), SW-13 (Sacobia River), and SW-15 (Cutcut River Tributary) (**Figure 3.2.23**). The highest recorded TSS concentration of 1,100 mg/L was recorded in SW-15 (Cutcut River Tributary) and the lowest concentration of 3 mg/L was recorded in Station SW-11 (Quitanguil River). For SW-14 (Bamban River), the TSS was within the maximum allowable limits of 50 mg/L and ≤ 25 mg/L for DENR guidelines and Japan standards, respectively, for Class A waters.

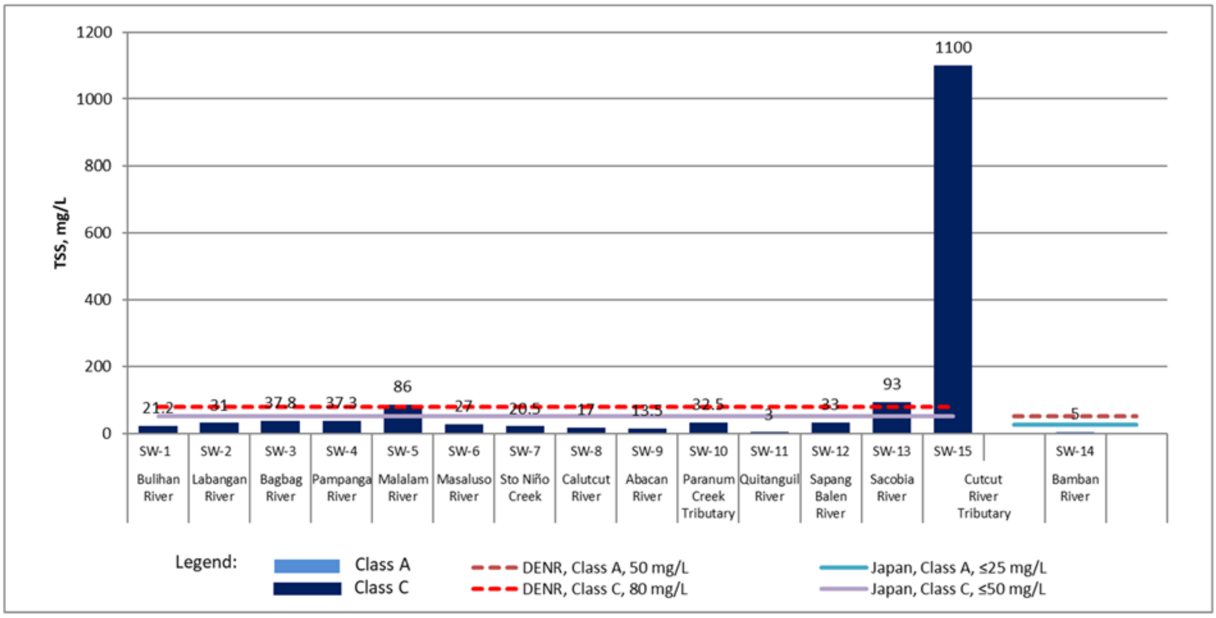


Figure 3.2.23 Results of Total Suspended Solids Measurement of Surface Water Samples

Temperature

676. All stations categorized under Class C waters were within the acceptable range of 25°C to 31°C of the DENR guidelines, except for SW-13 (Sapang Balen Creek), which slightly exceeded the range at 31°C. The lowest temperature readings were recorded in Stations SW-1 (Bulihan River) and SW-8 (Calutcut River) at 26°C. For SW-14 (Bamban River), the temperature was within the acceptable range of 26°C to 30°C of DENR guidelines for Class A waters. Japan has no water quality standard for temperature.

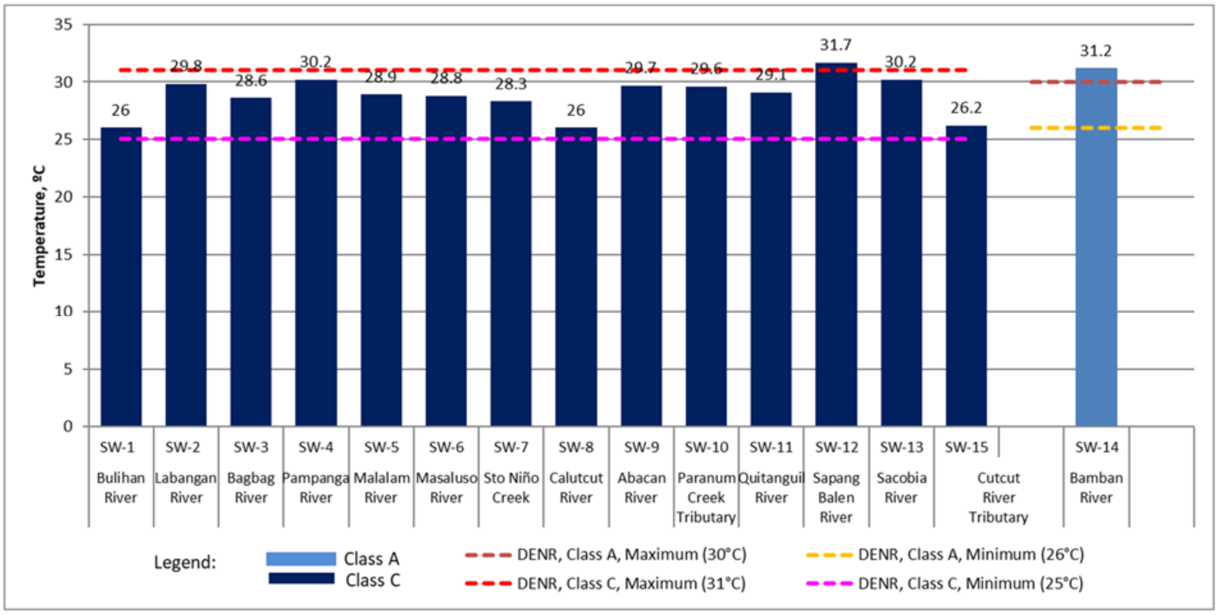


Figure 3.2.24 Results of Temperature Measurement of Surface Water Samples

pH

677. As shown in **Figure 3.2.25**, all stations categorized under Class C waters were within the acceptable pH range of 6.5 to 9.0 of the DENR guidelines and pH range of 6.5 to 8.5 of the Japan standards, except for SW-11 (Quitanguil River) and SW-13 (Sapang Balen), which were at pH 5.99 and pH 6.17, respectively. The highest pH recorded was in Station SW- (Pampanga River) at pH 7.3. For SW-14 (Bamban River), the pH was within the acceptable range of pH 6.5 to 8.5 of both DENR guidelines and Japan standards for Class A waters.

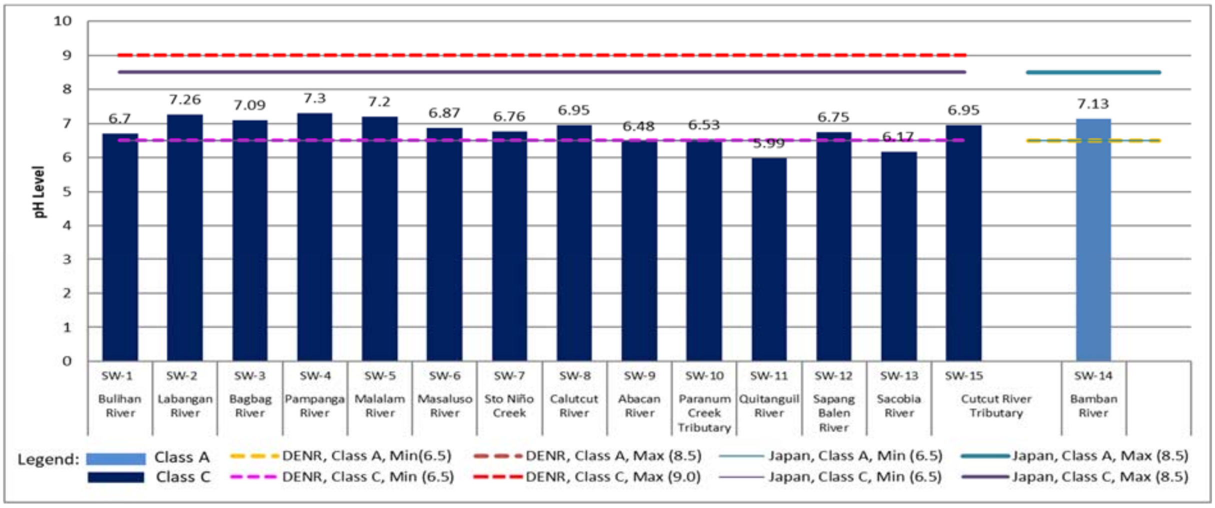


Figure 3.2.25 Results of pH Measurement of Surface Water Samples

Dissolved Oxygen

678. **Figure 3.2.26** shows that for the fourteen (14) stations categorized as Class C waters, half of the stations have DO concentrations below the minimum acceptable value of 5 mg/L of both DENR guidelines and Japan standards. The lowest DO was 1.04 mg/L measured at SW-6 (Masaluso River), while the highest DO was 15.98 mg/L, measured at SW-13 (Sacobia River). For SW-14 (Bamban River), the DO was higher than the minimum acceptable range of 5 mg/L and 7.5 mg/L for DENR guidelines and Japan standards, respectively, for Class A waters.

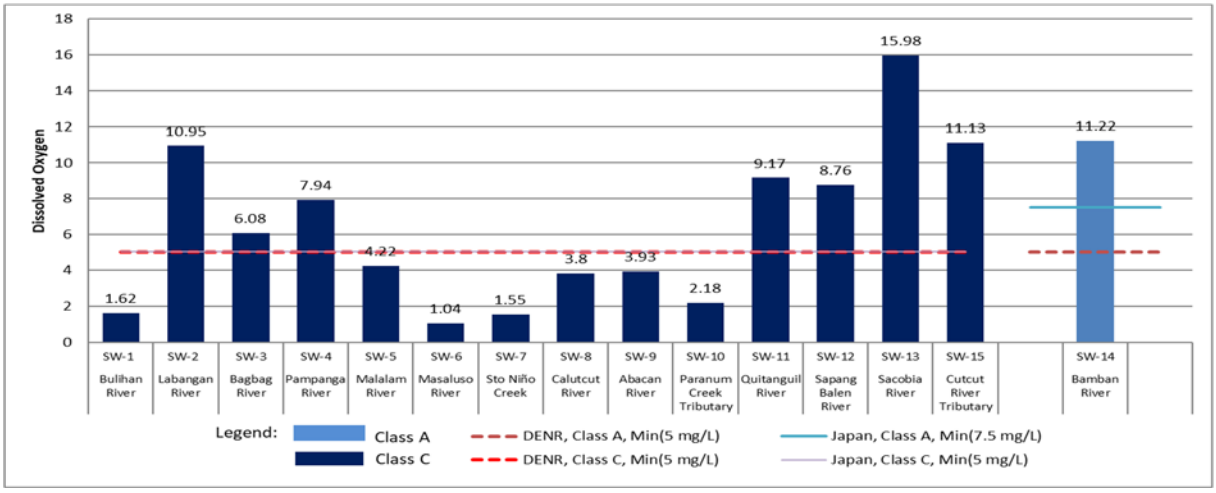


Figure 3.2.26 Results of Dissolved Oxygen Measurement of Surface Water Samples

Biochemical Oxygen Demand

679. **Figure 3.2.27** shows that all stations categorized as Class C waters have BOD higher than the maximum acceptable value of 7 mg/L and 5 mg/L for DENR guidance and Japan standards, respectively. The highest BOD of 271 mg/L was measured at SW-10 (Paranum Creek Tributary), while the lowest was 8 mg/L measured at SW-3 (Bagbag River). For SW-14 (Bamban River), the BOD was higher than the minimum acceptable ranges of 3 mg/L and 2 mg/L for DENR guidelines and Japan standards, respectively, for Class A waters.

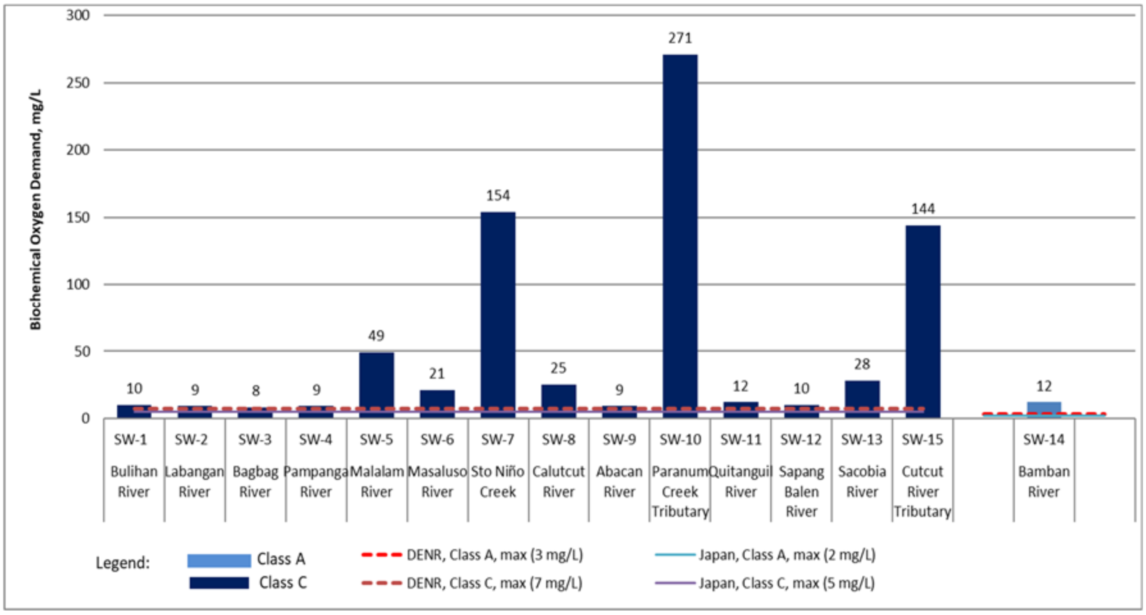


Figure 3.2.27 Results of Biochemical Oxygen Demand Measurement of Surface Water Samples

Fecal Coliform and Total Coliform

680. As shown in **Figure 3.2.28**, all stations categorized under Class C waters have fecal coliform count higher than the maximum acceptable limit of 200 MPN/100mL of the DENR guidelines, except for SW-2 (Labangan River, 34 MPN/100mL) and SW-11 (Quitanguil River, <1.8 MPN/100mL). The highest fecal coliform count of 3.4 million MPN/100mL was measured at SW-10 (Paranum Creek Tributary). For SW-14 (Bamban River), the fecal coliform count was higher than the maximum acceptable value of 1.1 MPN/100mL for DENR guidelines for Class A waters.

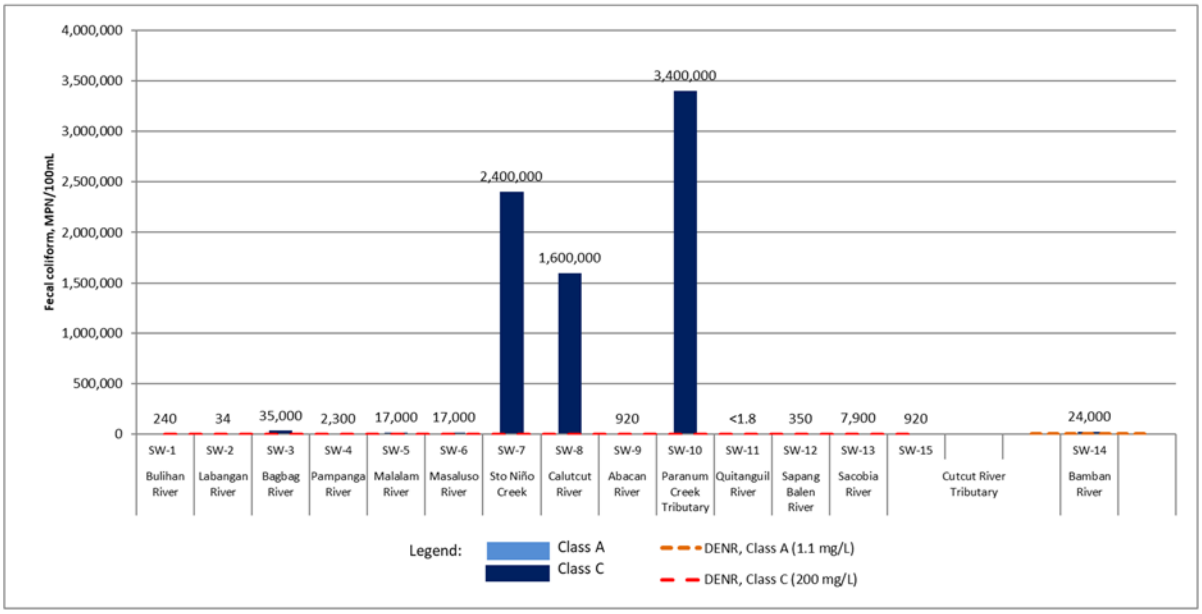


Figure 3.2.28 Results of Fecal Coliform by Surface Water Samples

Total Coliform

681. **Figure 3.2.29** shows a graphical presentation of the total coliform measurements in fifteen (15) surface water sampling stations. For stations categorized under Class C waters, the highest total coliform was 17 million MPN/100mL measured at SW-10 (Paranum Creek Tributary), while the lowest total coliform was <1.8 MPN/100ml recorded at SW-11 (Quitanguil River). There is no DENR guideline for total coliform. For SW-14 (Bamban River), the total coliform was higher than the maximum acceptable level of 1,000 MPN/100mL based on Japan standard for Class A waters.

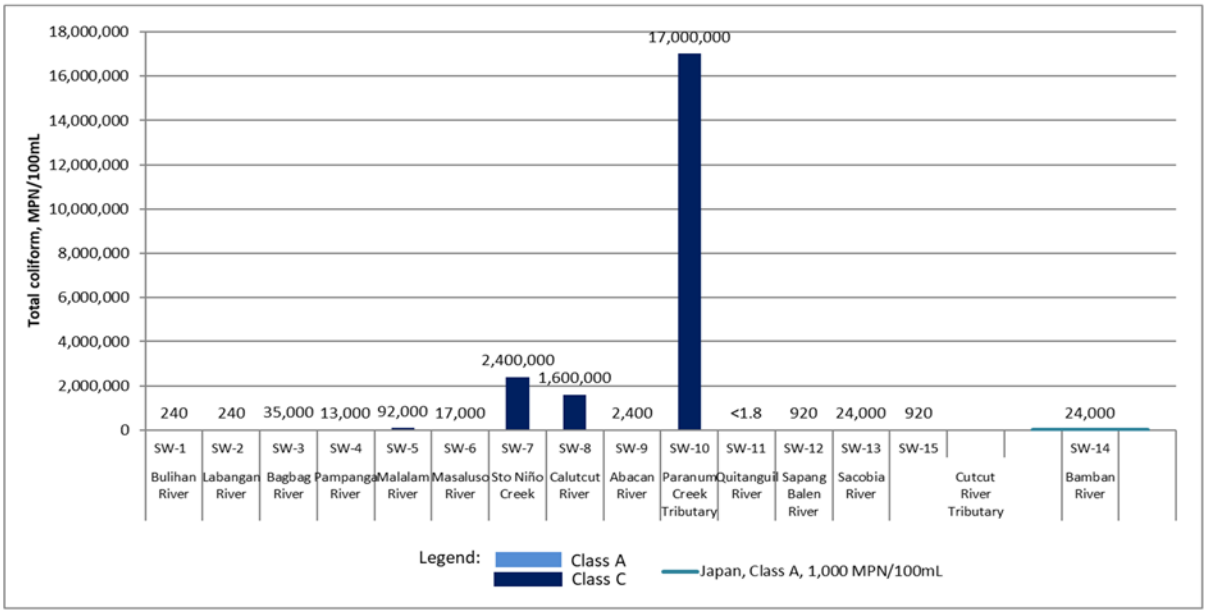


Figure 3.2.29 Results of Total Coliform by Surface Water Samples

Conductivity

682. **Figure 3.2.30** shows a graphical presentation of the conductivity measurements in fifteen (15) surface water sampling stations. Conductivity measurements ranged from 220 to 4,190 µS. The lowest conductivity (220 µS) was recorded on SW-15 (Cutcut River Tributary). The highest

conductivity (4,190 µS) was found on SW-3 (Bagbag River). Both DENR guidelines and Japan standards have no standard for conductivity.

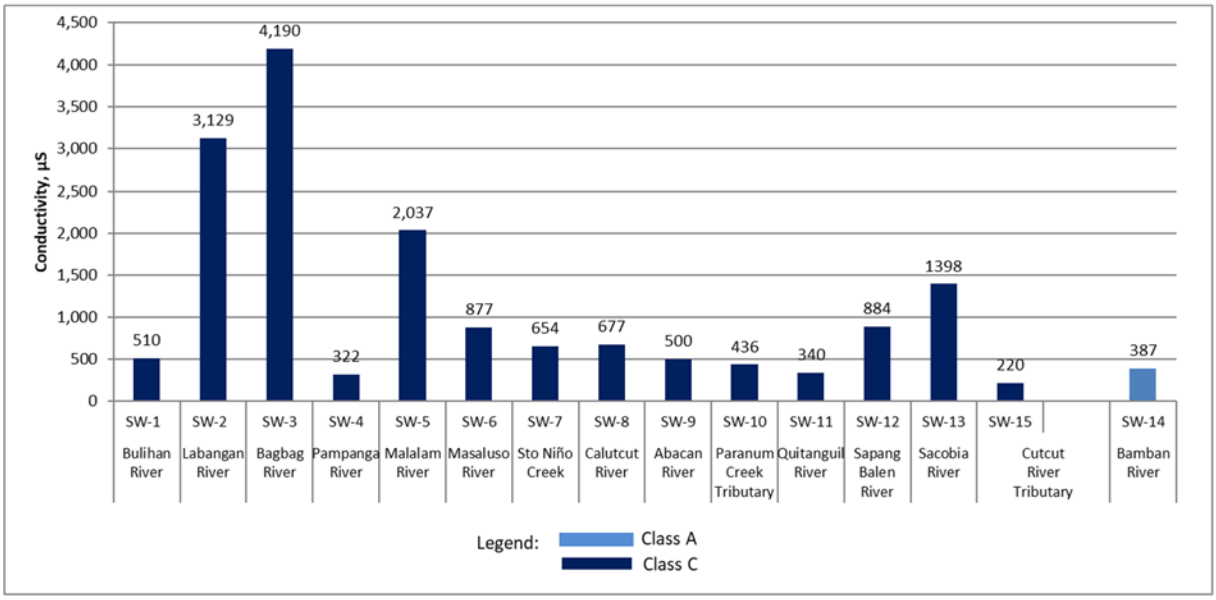


Figure 3.2.30 Results of Conductivity Measurement of Surface Water Samples

Chloride

683. As shown in **Figure 3.2.31**, all stations categorized under Class C waters have chloride concentrations lower than the maximum acceptable limit of 350 mg/L of the DENR guidelines, except for SW-3 (Bagbag River), SW-2 (Labangan River) and SW-15 (Cutcut River Tributary). The highest chloride concentration of 1,623 mg/L was measured at SW-2 (Labangan River), while the lowest concentration of 13 mg/L was measured at SW-11 (Quitanguil River). For SW-14 (Bamban River), the chloride concentration was lower than the maximum acceptable value of 250 mg/L for DENR guidelines for Class A waters.

684. The values in the last two sites with large water flow could be attributed to salt water intrusion, supported by the high conductivity.

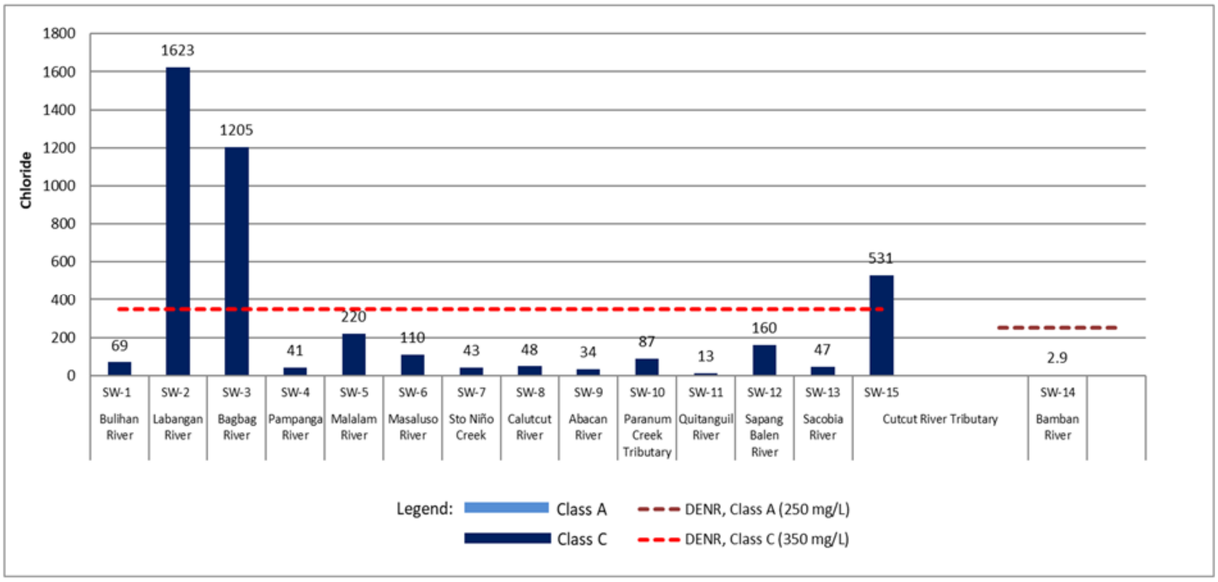


Figure 3.2.31 Results of Chloride Measurement of Surface Water Samples

Nitrate

685. As shown in **Figure 3.2.32**, all stations have nitrate concentrations below the maximum acceptable values for both the DENR guidelines (7 mg/L) and Japan Standard (10 mg/L) for Classes A and C waters. Nitrate concentrations ranged from 0.059 to 0.655 mg/L. The lowest nitrate concentration (0.0594 mg/L) was recorded on station SW-6 Masaluso River). The highest nitrate concentration (0.655 mg/L) was recorded on SW-2 (Labangan River).

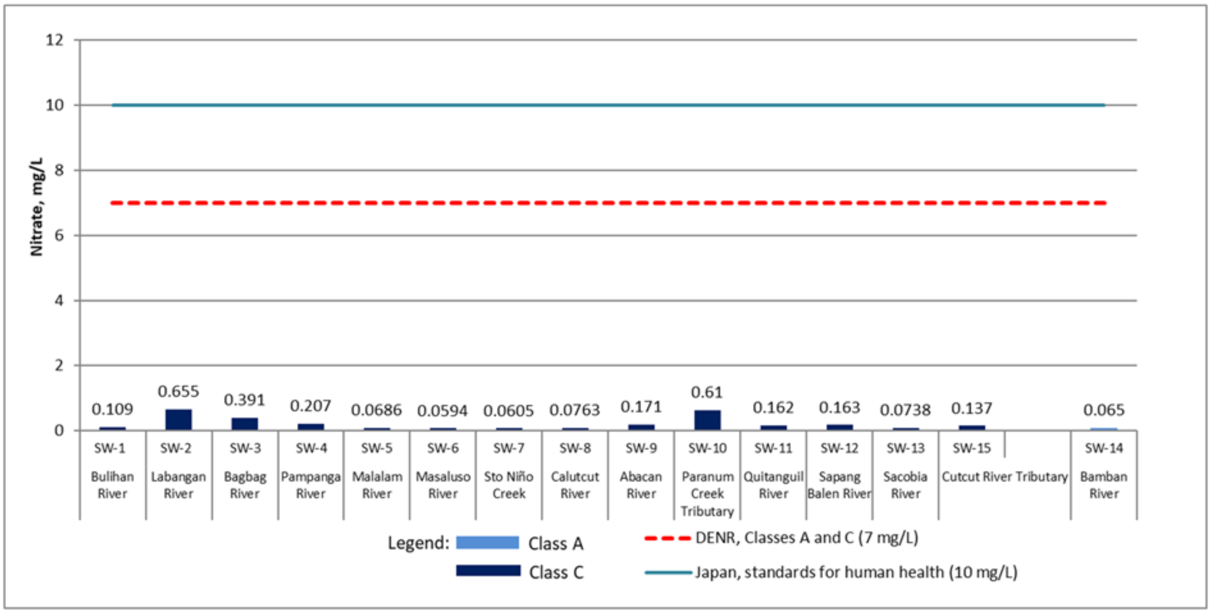


Figure 3.2.32 Results of Nitrate Measurement of Surface Water Samples

Phosphate and Organo-phosphates

686. As shown in **Figure 3.2.33**, all stations have phosphate concentrations above the maximum acceptable limit of 0.163 mg/L of DENR guidelines for Classes A and C waters, except for SW-2 (Labangan River), SW-3 (Bagbag River), SW-4 (Pampanga River), and SW-11 (Quitanguil River). The lowest phosphate concentration (<0.123 mg/L) was recorded on SW-3 (Bagbag River). The highest phosphate concentration (3.72 mg/L) was recorded on SW-15 (Cutcut River Tributary).

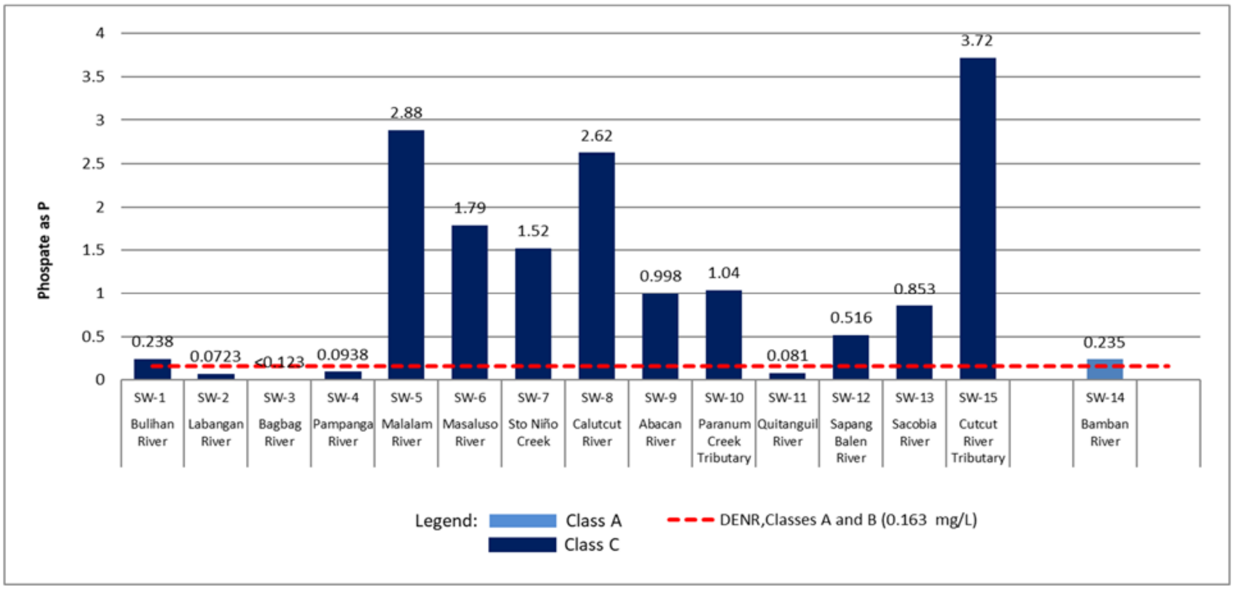


Figure 3.2.33 Results of Phosphate Measurement of Surface Water Samples

Organo-Phosphate

687. **Figure 3.2.34** shows a graphical presentation of the organophosphate concentration in fifteen (15) surface water sampling stations. The organophosphate concentration of all the samples was <0.00001 mg/L and was below the 0.003 mg/L and 0.001 mg/L DENR Standards for Class C and Class A waters, respectively.

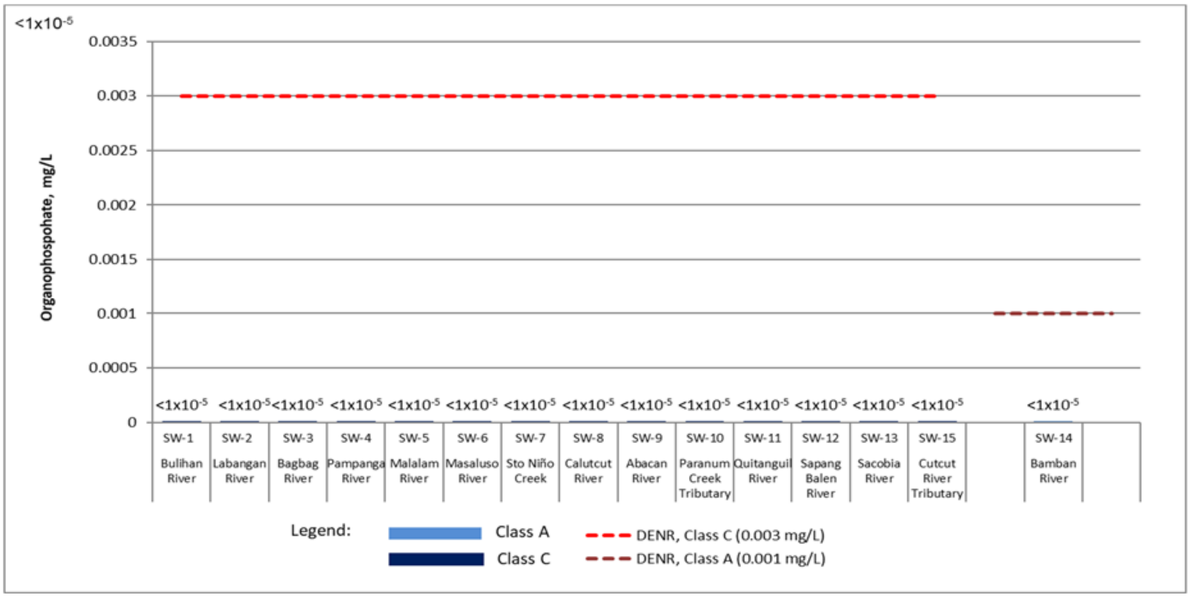


Figure 3.2.34 Results of Organo-Phosphate Measurement of Surface Water Samples

Copper

688. **Figure 3.2.35** shows a graphical presentation of the copper concentration in fifteen (15) surface water sampling stations. Eight (8) stations have copper concentrations above the maximum acceptable limit of 0.02 mg/L of the DENR guidelines for both Classes A and C waters. The highest copper concentration (0.0441 mg/L) was recorded on SW-4 (Pampanga River) while the lowest copper concentration of <0.005 mg/L was measured on SW-5 (Malalam River), SW-6 (Masaluso River), SW-7 (Sto. Niño Creek),SW-8 (Calutcut River), SW-13 (Sacobia River) and SW-15 (Cutcut River Tributary).

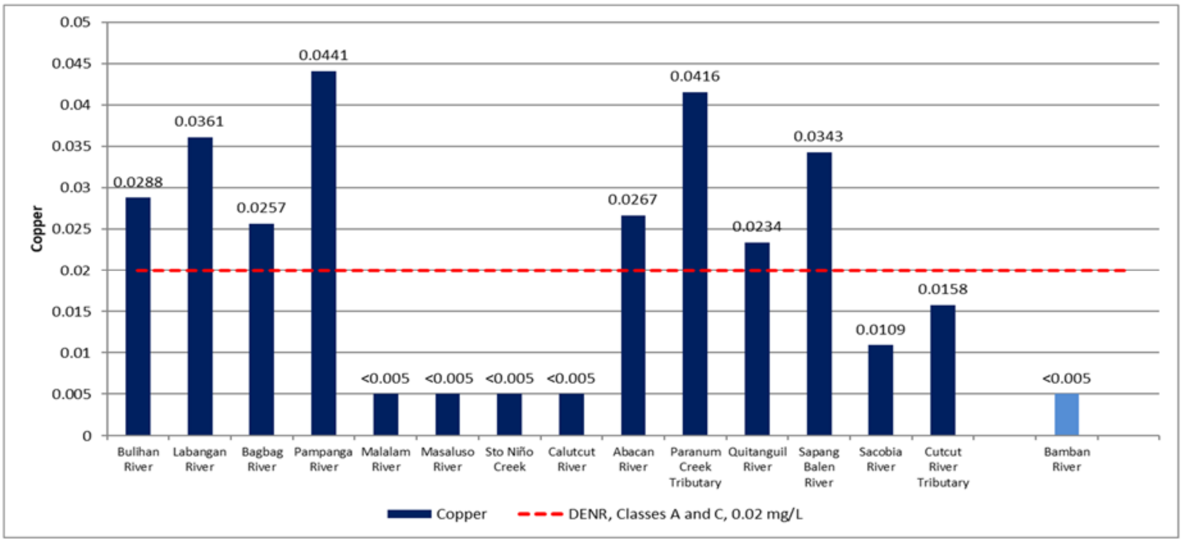


Figure 3.2.35 Results of Copper Measurement of Surface Water Samples

Arsenic

689. As shown in **Figure 3.2.36**, all stations categorized as Class C waters have arsenic concentrations below DENR guidelines and Japan standards of 0.02 mg/L and 0.01 mg/L, respectively. The lowest arsenic concentrations (<0.0009 mg/L) were found on SW-3 (Bagbag River) and SW-12 (Sapang Balen River). The highest arsenic concentration (0.0053 mg/L) was recorded on SW-15 (Cutcut River Sanctuary). Arsenic concentration at SW-14 (Bamban River) measured at 0.0034 mg/L was below the maximum acceptable limit of 0.01 mg/L of both DENR guidelines and Japan standards.

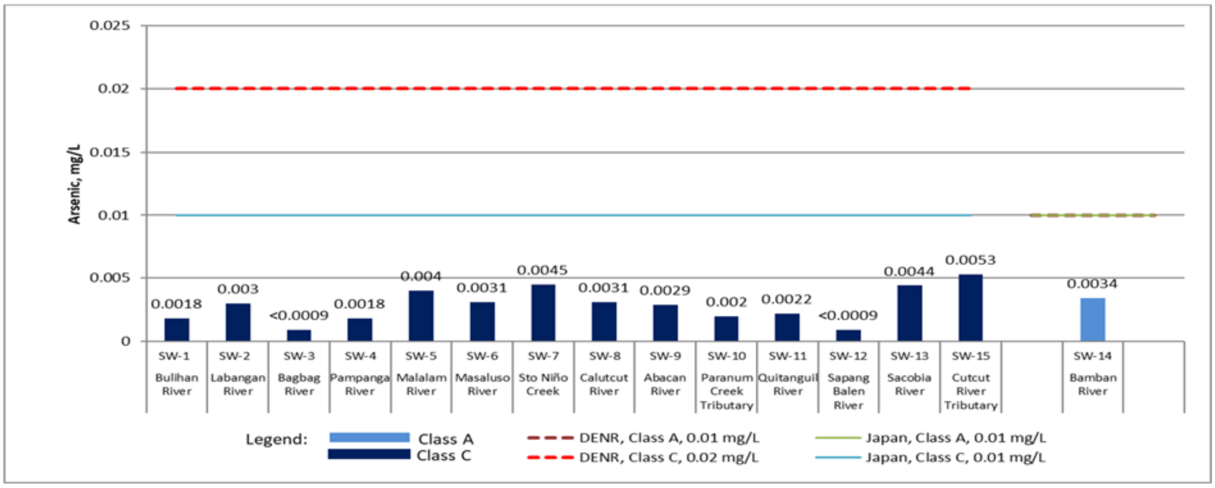


Figure 3.2.36 Results of Arsenic Measurement of Surface Water Samples

Cadmium

690. As shown in **Figure 3.2.37**, all stations categorized as Class C waters have cadmium concentrations below the DENR guidelines and Japan standards of 0.005 mg/L and 0.01 mg/L, respectively. For SW-14, the cadmium concentration of 0.0084 mg/L was higher than the DENR guideline value for Class A waters, set at 0.003 mg/L, but lower than the Japanese standard of 0.01 mg/L.

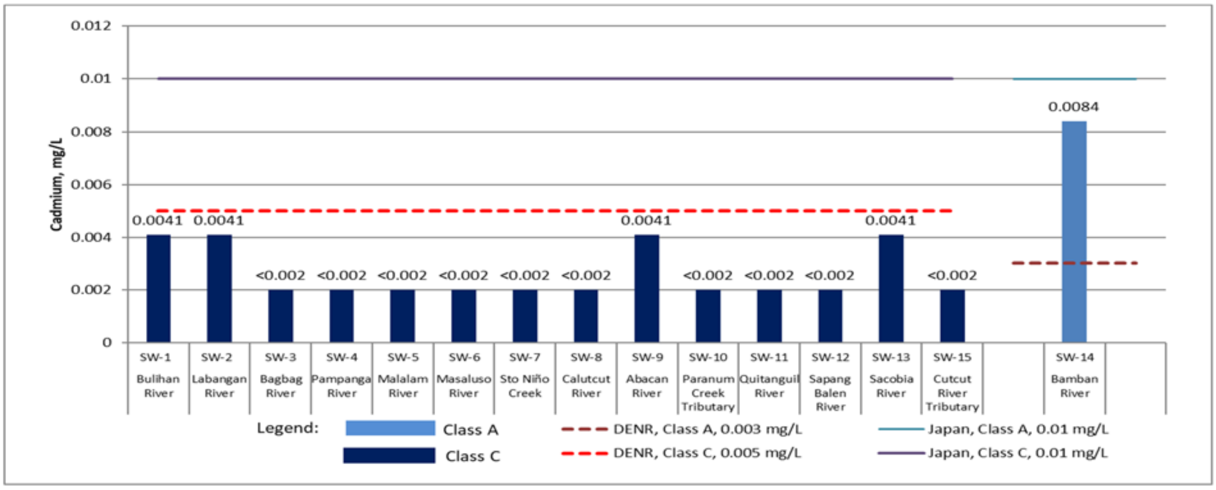


Figure 3.2.37 Results of Cadmium Measurement of Surface Water Samples

Chromium Hexavalent

691. **Figure 3.2.38** shows a graphical presentation of the chromium concentration in fifteen (15) surface water sampling stations. The chromium hexavalent concentrations ranged from <0.002 to 0.004 mg/L. The highest cadmium concentration (0.004 mg/L) was recorded on SW-5 (Malalam River). The chromium concentrations of all samples were below the 0.01 mg/L DENR Standard and ≤0.05 mg/L Japan Standard for both Classes A and C waters.

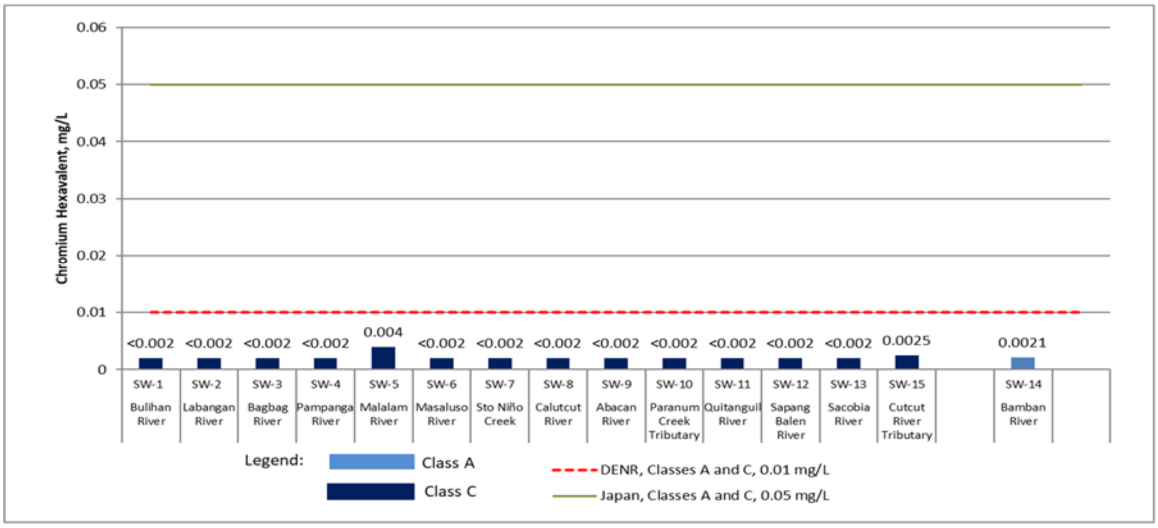


Figure 3.2.38 Results of Chromium Hexavalent Measurement of Surface Water Samples

Lead

692. As shown in **Figure 3.2.39**, all stations categorized as Class C waters have lead concentrations below the DENR guideline of 0.05 mg/L except for SW-1 (Bulihan River). Compared to Japan standards of 0.01 mg/L, however, eight (8) stations were above the standard. The highest lead concentration of 0.053 mg/L was measured at SW-1 (Bulihan River), while the lowest concentration of <0.006 mg/L, was measured at SW-5 (Malalam River), SW-7 (Sto. Niño Creek), SW-8 (Calutcut River), SW-12 (Sapang Balen), SW-13 (Sacobia River) and SW-15 (Cutcut River Tributary). For SW-14, the cadmium concentration of <0.006 mg/L was lower than the DENR guideline and Japan standard value for Class A waters, both set at 0.01 mg/L.

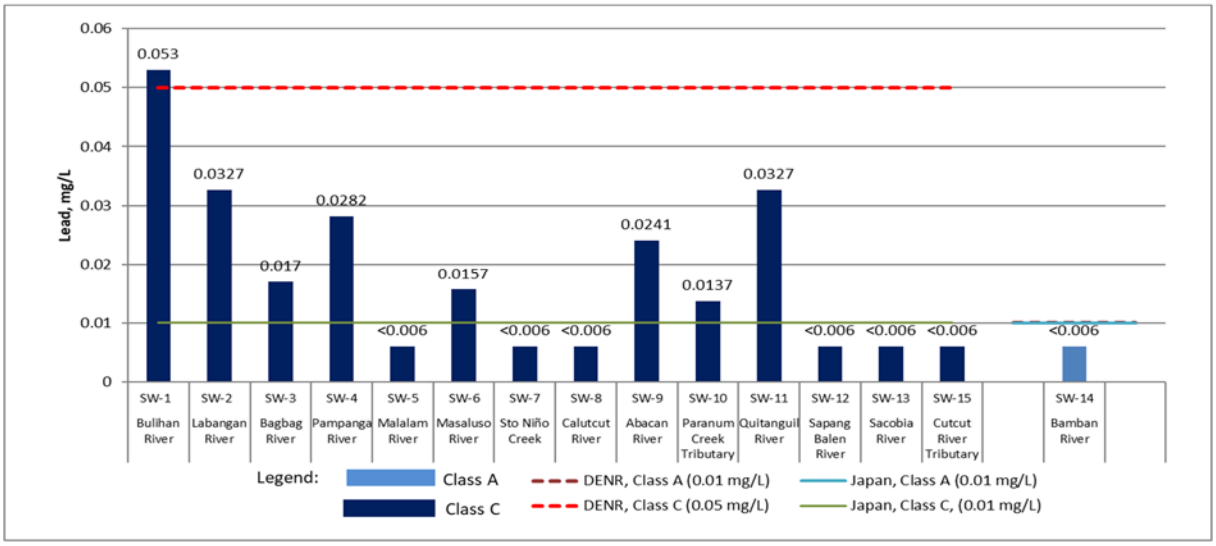


Figure 3.2.39 Results of Lead Measurement of Surface Water Samples

Mercury

693. **Figure 3.2.40** shows a graphical presentation of the mercury concentration in fifteen (15) surface water sampling stations. Mercury concentration for all samples was ≤0.0001 mg/L. Mercury concentration for all samples was below the 0.002 mg/L DENR Standard and ≤0.0005 mg/L Japan Standard for Class C waters, and also below the 0.001 mg/L DENR Standard and ≤0.0005 mg/L Japan Standard for Class A waters.

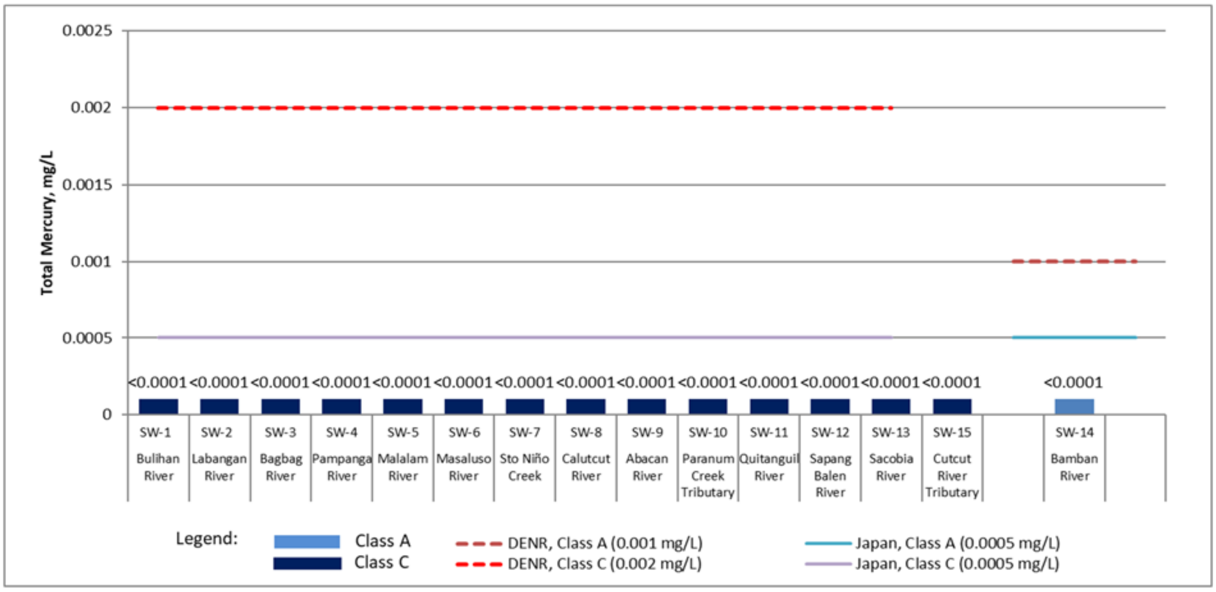


Figure 3.2.40 Results of Mercury Measurement of Surface Water Samples

Oil and grease

694. As shown in **Figure 3.2.41**, all stations categorized under Class C waters have oil and grease concentrations lower than the maximum acceptable limit of 2 mg/L of the DENR guidelines, except for SW-5 (Malalam River), SW-6 (Masaluso River) and SW-9 (Abacan River). The highest oil and grease concentration of 19.7 mg/L was measured at SW-5 (Malalam River), while the lowest concentration of <0.5 mg/L was measured at SW-3 (Bagbag River), SW-11 (Quitanguil River), and SW-15 (Cutcut River Tributary). For SW-14 (Bamban River), the oil and grease concentration was higher than the maximum acceptable value of 1 mg/L for DENR guidelines for Class A waters.

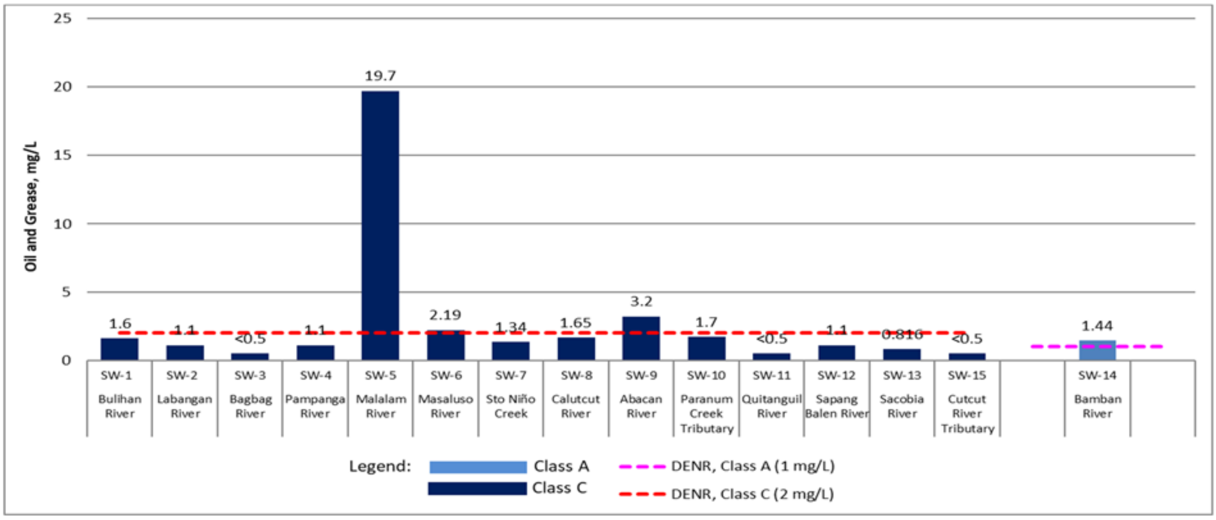


Figure 3.2.41 Results of Oil and Grease Measurement of Surface Water Samples

Free Cyanide

695. **Figure 3.2.42** shows a graphical presentation of the free cyanide concentration in fifteen (15) surface water sampling stations. Free cyanide concentrations ranged from 0.00962.-0.0714 mg/L. The lowest free cyanide concentration (0.00962 mg/L) was recorded on SW-14 (Bamban River). The highest cyanide concentration (0.0714 mg/L) was recorded on SW-6 (Masaluso River). Free cyanide concentrations of all samples were within the DENR guideline values of 0.1 mg/L and 0.07 mg/L for Classes C and A, respectively.

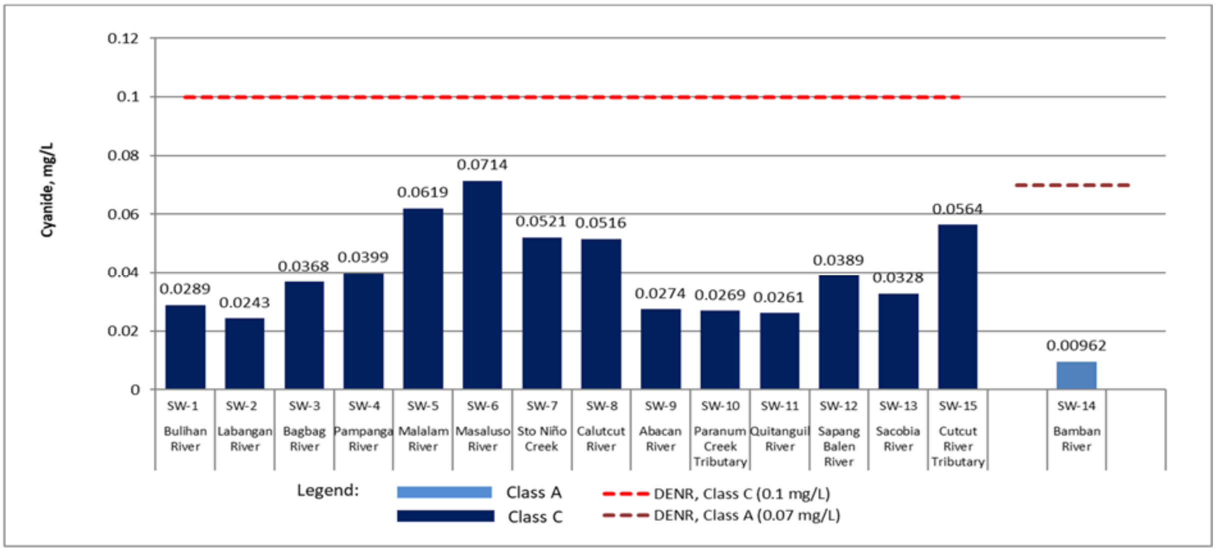


Figure 3.2.42 Results of Free Cyanide Measurement of Surface Water Samples

Phenol

696. As shown in **Figure 3.2.43**, all stations categorized under Class C waters have phenol concentrations within the maximum acceptable limit of 0.05 mg/L of the DENR guidelines. The highest phenol concentration of 0.05 mg/L was measured at SW-7 (Sto. Niño Creek) and SW-15 (Cutcut River Tributary), while the lowest concentration of 0.01 mg/L was measured at SW-11 (Quitanguil River). For SW-14 (Bamban River), the phenol concentration was higher than the maximum acceptable value of <0.001 mg/L of DENR guidelines for Class A waters.

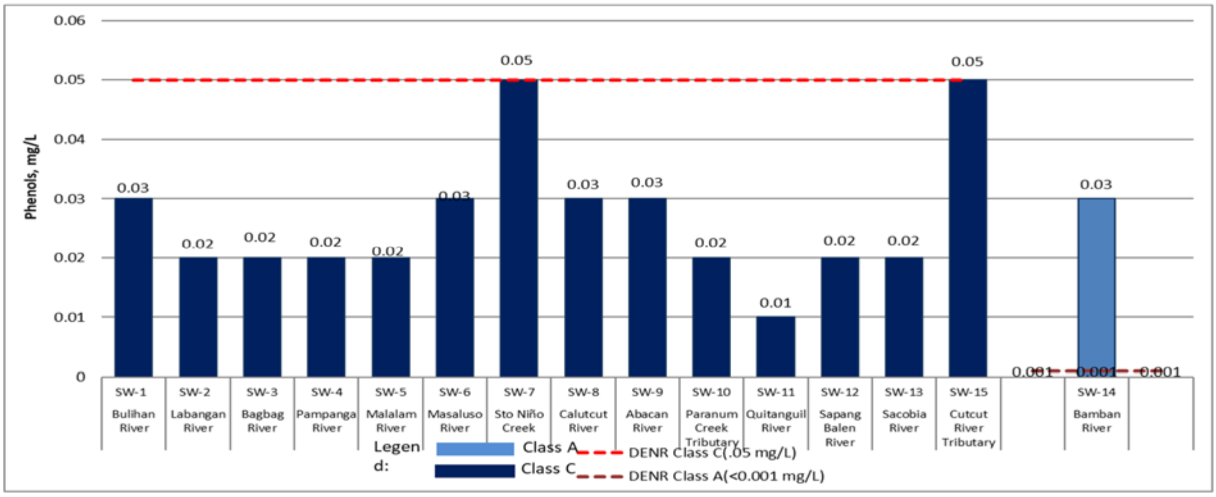


Figure 3.2.43 Results of Phenol Measurement of Surface Water Samples

Surfactants

697. As shown in **Figure 3.2.44**, all stations categorized under Class C waters have surfactant concentrations within the maximum acceptable limit of 1.5 mg/L of the DENR guidelines. The highest phenol concentration of 1.07 mg/L was measured at SW-10 (Paranum Creek), while the lowest concentration of <0.007 mg/L was measured at SW-11 (Quitanguil River). For SW-14 (Bamban River), the surfactand concentration was slightly higher than the maximum acceptable value of 0.20 mg/L of DENR guidelines for Class A waters.

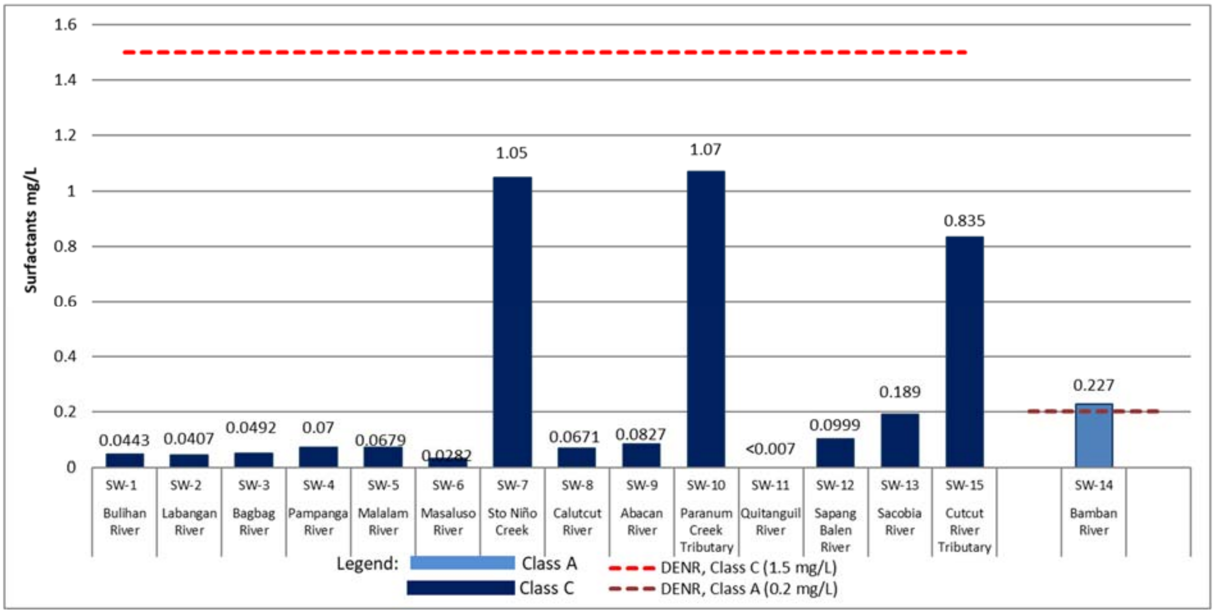


Figure 3.2.44 Results of Surfactants Measurement of Surface Water Samples

3.2.2.3 Impact Identification, Prediction, Assessment and Mitigation

(1) Pre-construction and Construction

1) Degradation of Groundwater Quality

698. During construction, activities can change the direction of groundwater flow and cause environmental impacts on groundwater chemistry. Additionally, water flows in the springs and where the water naturally comes out, may be decreased due to groundwater discharge from drainage of surrounding grounds of the tunnel site. Based on this, appropriate design, planning and methods of excavation, backfilling and stockpiling based on the geological and geotechnical investigations will be used and regular monitoring of groundwater quality will be conducted to comply with the appropriate standards.

699. To ensure groundwater quality, sedimentation and filtration ponds at tunnel construction sites will be adopted. Strict implementation of Solid and Hazardous Wastes Management Plan, which include waste minimization, segregation re-use, recycle, and proper disposal of residuals. Any disposal of residuals will be removed by a DENR accredited transporter and disposal of excavated materials will entail an adequate containment dumpsite or spoils area Also, water discharges will be limited and shield tunneling method will be adopted to reduce the possibility of groundwater inflow into the tunnel structures.

700. Further, spill containment structures will be provided with oil and fuel storage tanks to prevent or minimize accidental spills. Proper chemical storage with appropriate secondary

containment in impermeable areas will be complied with to prevent chemical leakages. In case of spills, Emergency Response Plan and Health and Safety Management Plan will be applied.

2) Degradation of Freshwater Quality

701. There may be short-term slight increase in sediments and turbidity of rivers and/or streams along the proposed MCRP due to excavation activities and piling work for installation of bridge piers particularly during rainy periods. Installation of geomembrane and/or silt curtain around the bridge piers to minimize disturbance of river bed will be utilized if necessary. The same soil erosion control measures to mitigate flooding will also be used to reduce the amount of suspended solids in water to permissible levels before discharge into the receiving water bodies. Appropriate study and planning will be undertaken and the design and use of suitable construction materials for the bridge pierswill be based on the hydrogeological studies for the proposed MCRP.

702. In the construction of railway bridges and piers in waterways, the DOTr will coordinate with and/or secure necessary permits from the NWRB, DPWH and concerned LGUs. At this stage, water quality management protocols will be implemented to minimize water quality degradation based on applicable freshwater quality standards.

703. Waste water generated by the increased number of workers will cause deterioration of the existing water quality if inadequate portable toilets are not provided at the construction site. Fuel, lubricant and hydraulic oil discharges from poorly maintained construction equipment, machineries and heavy vehicles will also impact on water quality. During repair of equipment and machinery, containers/drip trays will be used to collect leakage. Any spilled or spent oil will be collected and disposed by an accredited waste hauler and transporter.

704. Scheduling of excavation activities during dry season and tide consideration whenever possible will be applied to reduce impact of soil erosion and sedminetaiton of waterways. During construction, a surface water and effluent quality monitoring will be conducted.

(2) Operation Phase

1) Degradation of Groundwater Quality

705. The significant impact on groundwater quality during operation is the long-term overland discharge of untreated wastewaters from the proposed train stations and depot may cause degradation of quality of nearby groundwater. Wastewater would typically contain wash water and used oil. As a mitigation measure, each station and depot will have a sewage treatment plant (STP) and a separate treatment facility for non-sewage wastewater such as wastewater from maintenance works and other wastes at the Depot to meet the applicable effluent standards and in compliance to the Sanitation code of the Philippines. Storage, transport, treatment and disposal of hazardous wastes generated will be in compliance to RA 6969.

2) Degradation of Freshwater Quality

706. During operation of the proposed MCRP, long term overland discharge of untreated wastewaters from commuter station and depot may cause deterioration in nearby surface water. Wastewater would typically contain wash water and used oil. Each commuter station and depot will have a sewage treatment facility and a separate treatment facility for non-sewage wastewaters such as wastewater from maintenance works and other wastes at the Depot to meet the applicable effluent standards.

707. Service areas are the most likely locations where such contamination occurs because of the concentration of parked vehicles and fuel stands. Depot will therefore be equipped with an interceptor tank to remove oil and fuel grease from surface water before discharge. A wastewater

treatment facility with oil removal will be constructed at the Depot. Treatment facilities such as septic tanks designed to appropriate standards will be installed from every station to treat domestic sewage. All kinds of wastewater with oil will be stored and treated at Depot's wastewater treatment facility. The DOTr will conduct regular surface water quality monitoring activities in order to check the quality of the surface water from time to time. DOTr will also secure a discharge permit from DENR for the disposal of treated wastewater to the water bodies. An effluent quality monitoring will be conducted as required.

3.2.3 Freshwater Ecology

708. This section discusses the results of freshwater ecology survey conducted for the proposed MCRP. The freshwater ecology survey was conducted in order to provide information on general conditions of the freshwater environment and determine how the proposed Project would affect the general use and ecology of the rivers. The survey includes an assessment of in-situ water quality and aquatic communities, which include phytoplankton, zooplankton, macrobenthos and fish. This study is an essential component in any project as it serves as important basis for effective management and evaluation of impacts on freshwater ecosystems.

(1) Field Survey

709. The freshwater ecology along the alignment of the proposed MCRP were assess by collecting biological samples at the same 15 stations established for surface water quality assessment on February 6-7, 2018, as presented in **Table 3.2.8** and **Figure 3.2.45**.

Table 3.2.8 Surface/Freshwater Water Quality Sampling Stations

Sampling Point	Description	Coordinates	Sampling Date
SW-1	Bulihan River, Malolos, Bulacan Approximately 43m from the alignment Near bridge; water with foul odor; banks heavily inhabited; open canopy; highly decomposing environment; receives garbage and all types of wastes from houses along banks	14° 51' 55.60"N 120° 48' 13.21"E	02/06/2018
SW-2	Labangan River, Calumpit, Bulacan (Confluence of Angat River and Bagbag River). South of Calumpit Station Concrete banks; open canopy; green opaque water; wide river; experience tidal backflow; near bridge; houses along banks	14° 54' 01.53"N 120° 46'15.97"E	02/06/2018
SW-3	Bagbag River, Calumpit, Bulacan North of Calumpit Station. The sampling site is in the junction of distributary of Pampanga River and Bagbag River Open canopy; near bridge; turbid water; houses along banks; hard substrate near banks	14° 55' 12.56"N 120° 45' 54.56"E	02/06/2018
SW-4	Pampanga River, Apalit, Pampanga Open canopy; near bridge; wide river; turbid water; facing upstream, grassland and shrub area at left bank and several houses along right bank; patches of water hyacinth along river margin as well as instream areas	14° 56' 03.77"N 120° 45' 27.58"E	02/06/2018
SW-5	Malalam River, Minalin, Pampanga Receives tidal backflow; water hyacinth along river margins; opaque water greenish; open canopy; fishponds around the river; muddy, silty sediments with leaf litter; aquaculture ponds around the site	14° 58' 11.58"N 120° 43' 19.20"E	02/06/2018
SW-6	Masaluso, Minalin, Pampanga Has "paktang" or fish trap along river margins; with house along bank; water hyacinth along river margins occupying 20-30% of river width; aquaculture ponds around the site	14° 59' 00.33"N 120° 42' 56.21"E	02/06/2018
SW-7	Sto. Niño River, San Fernando, Pampanga (Confluence of San Fernando River and Mapalad River)	15° 01' 23.81"N 120° 41' 23.97"E	02/06/2018

Sampling Point	Description	Coordinates	Sampling Date
	South of San Fernando Station. Industrial area; receives water effluents from soy sauce industry and Angeles wastewater; domestic disturbance-dumping ground for garbage or all types of l wastes; concrete banks; foul odor; lots of bubbles instream- sign of heavy decomposition; smells like rotten eggs; gets flooded during heavy rains (overflow in banks)		
SW-8	Calutcut Creek, San Fernando City, Pampanga South of Angeles Station Open canopy; grassland banks; near subdivision; black, silty, muddy substrate; banks heavily inhabited; clear but dirty/ foul smelling water; garbage along banks	15° 06' 44.80"N 120° 37' 26.56"E	02/07/2018
SW-9	Abacan River, Angeles, Pampanga Narrow shallow stream; open canopy; facing upstream left bank with highly disturbed sandy, muddy banks with houses and huge garbage dump area while the right side with concrete banks with numerous houses (slum area)	15° 09' 10.26"N 120° 35' 17.25"E	02/07/2018
SW-10	Paranam Tributary, Angeles, Pampanga Creek crossing south of Clark area Receives mall effluents/ sewage; sewage (estero) canal; foul odor; black substrate; muddy, silty sediments; near road and airport; grassland banks	15° 10' 21.13"N 120° 34' 55.23"E	02/07/2018
SW-11	Quitanguil River, Angeles, Pampanga Creek crossing middle the Clark area Near bridge; shallow narrow river with clear water; grasslands on both banks; private property	15° 12' 44.90"N 120° 34' 23.32"E	02/07/2018
SW-12	Sapang Balen, Angeles, Pampanga Creek crossing north of Clark area Quarrying upstream near bridge; clear to green opaque water; sand and pebbles instream; grasslands along banks; open canopy	15° 13' 20.52"N 120° 34' 12.04"E	02/07/2018
SW-13	Sacobia River, Mabalacat, Pampanga North of the proposed depot Near bridge; Lahar area; muddy, silty banks and instream areas; foul smelling water; algal scum and garbage instream; green opaque to turbid waters; both banks inhabited	15° 14' 37.18"N 120° 33' 57.32"E	02/07/2018
SW-14	Bamban River, Bamban, Tarlac Open canopy; turbid water; lahar area with few houses; sandy banks; pebbles instream	15° 15' 26.91"N 120° 33' 14.65"E	02/07/2018
SW-15	Cutcut River Tributary, Capas, Tarlac Five (5) km east of north end of railway at NCC Road construction upstream of small bridge; 100 m upstream of site with culvert; 25% or less overhanging vegetation; no natural vegetation with solid wastes instream (i.e. diapers); Fast water flow downstream of culvert while pool or minimal water movement upstream of culvert; clear to opaque water	15° 20' 26.51"N 120° 31' 40.18"E	02/07/2018

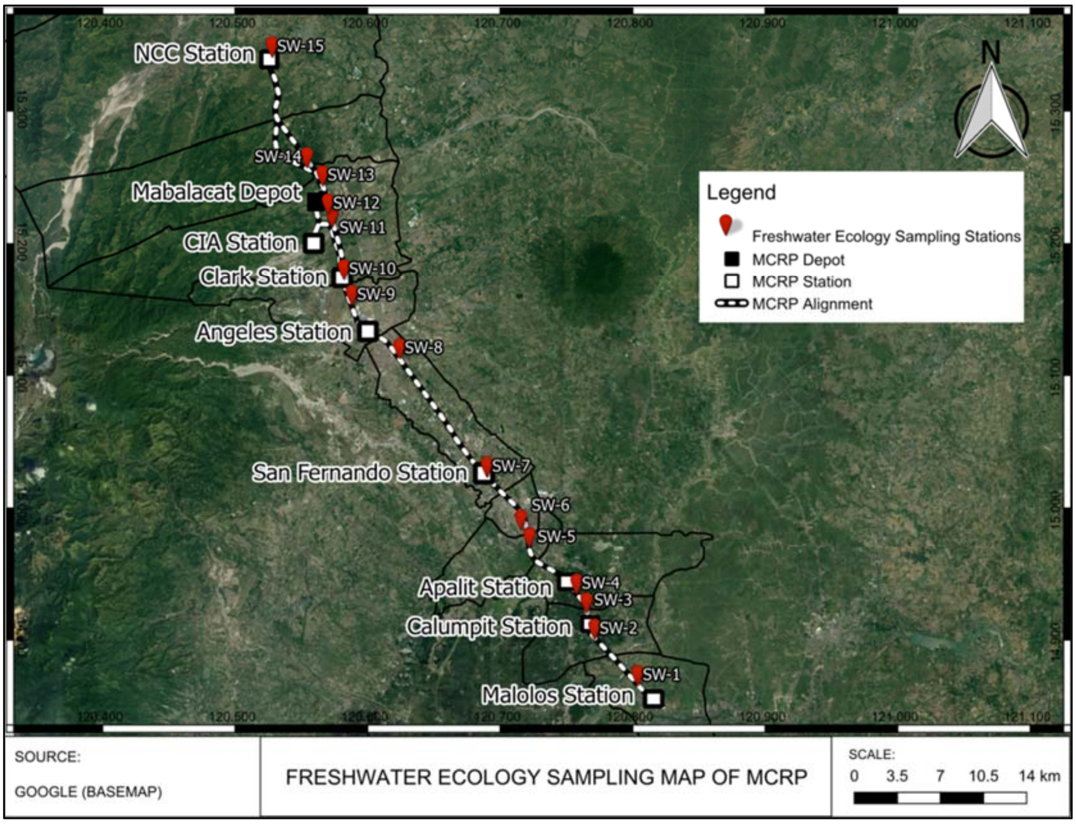


Figure 3.2.45 Freshwater Ecology Sampling Station

710. Plankton samples was collected in reached with open or partly open canopies (>50%); riffles not pools, with moderate water velocity (between 10cm/s to 60cm/s). Three (3) replicate samples of zooplankton and phytoplankton were obtained by passing 100L of water through a plankton net, with mesh size of 64µ and a mouth diameter of 0.3m. The collected samples were placed in properly labelled, 500mL plastic containers, immediately fixed in formalin (5% by volume) and brought to the laboratory for processing and further analysis. Plankton enumeration was done using the Sedgewick counting chamber observed under a binocular microscope. Plankton were identified to the lowest possible taxa using taxonomic keys such as those of Mamaril et al. (1986), Segers (2004; 2007) and Bellinger and Sigee (2010).

711. A total of 45 sediment samples were collected for the macrobenthos study. Collections were undertaken at three (3) replicate zones at each station. For each station, ten (10) trowels of sediments were obtained from each replicate zone, which covered an area of about $1m^2$. The underside of rocks and stones were also checked for the presence of macrobenthos, and when present were hand-picked. Collected macrobenthos and sediment samples were placed in properly-labeled Ziploc plastic bags and preserved in 5% formalin. Samples were brought to the laboratory for further processing. In the laboratory, sediment samples were passed through a 1-mm mesh-sized sieve and all animals retained in the sieve were collected and sorted. Macrobenthos were transferred in plastic containers and preserved with 5% formalin and identified to the lowest possible taxa using Haynes (2001) and Gapud and Raros (1986). Their abundances were recorded and expressed as number of animals/m^2. Methods of macrobenthos collection, preservation, and processing generally followed Barbour *et al.* (1999).

712. Locals were interviewed regarding general river-use and fishes and other aquatic animals caught in the area.

(2) Survey Result and Analysis

713. The biological community data at the established sampling stations generally reflected good to poor conditions. The dominance and occurrence of bioindicator species of phytoplankton, zooplankton and macrobenthos suggestive of polluted/ poor conditions, support this observation. Green algal species such as *Pediastrum*, blue-green algae *Microcystis* and diatom *Melosira* dominated at most stations. Zooplankton communities at majority of the surveyed stations were dominated by Rotifera, particularly of several species of *Brachionus*. Chironomidae and algal-grazing gastropod *Melanoides* were recorded at high densities at most sites. Overall composition and abundances of biological communities seem to reflect disturbed conditions, possibly due to domestic and industrial activities.

1) Species Diversity

c. Plankton Community

Phytoplankton

714. At least 17 taxa representing three algal divisions comprised the phytoplankton community at 15 stations combined, at the vicinity of the proposed MCRP. Chlorophyta (green algae) was the most abundant phytoplankton division representing 592% of the total count, followed by Bacillariophyta (diatoms) comprising 35.7% of the total phytoplankton. Cyanophyta (blue-green algae) had low mean density, representing 5.1% of the total phytoplankton. Of the 17 identified phytoplankton taxa, eight belong to Chlorophyta, six taxa to Bacillariophyta, while three taxa to Cyanophyta (**Table 3.2.9**).

715. Mean phytoplankton densities were variable among surveyed stations, with values ranging from 4 cells/l to 248 cells/l. The highest mean phytoplankton mean abundance was recorded at SW-5 (248 cells/l), followed by those recorded at SW-4 and SW-6 (186 cells/l and 184 cells/l, respectively). The lowest mean phytoplankton density was recorded at SW-7 and SW-8 (4 cells/l each). High algal densities were also observed at SW-2, SW-9, SW-10, SW-12 and SW-13, with values ranging from 105 cells/l to 165 cells/l. Meanwhile, low phytoplankton mean densities were recorded at SW-1, SW-3, SW-11, SW-14 and SW-15 (16-51 cells/l). Phytoplankton taxa richness ranged from 2 taxa to 12 taxa, with the highest recorded at SW-6, and the lowest at SW-7 and SW-8 (2 taxa each). The number of phytoplankton taxa at the rest of the surveyed stations ranged from 3-9 taxa.

716. *Fragilaria* was the most abundant algal taxon at SW-1 (13 cells/l), SW-4 (42 cells) and at SW-11 (22cell/l). *Aphanocapsa* dominated at SW-2 (52 cells/l), followed by *Mougeotia* (24 cells/l) and *Microcystsis* (21 cells/l). *Pediastrum* had the highest mean density at SW-3 with a value of 15 cells/l, followed by *Mougeotia* with 12 cells/l. *Pandorina* and *Spirogyra* were also recorded at moderate densities SW-4 with a mean density of 41 cells/l and 39 cells/l, respectively. *Mougeotia* dominated at SW-5 (124 cells/l) and at SW-6 (72 cells/l). Two diatom taxa, *Melosira* and *Rhizosolenia*, dominated the phytoplankton community at SW-7 and SW-8, respectively, although low counts were recorded for each, at 3 cells/l. *Ulothrix* was the most abundant taxon at SW-9 and SW-10 (51 cells/l and 54 cells/l, respectively). *Cladophora* was recorded at high density at SW-12 (74 cells/l), followed by *Ulothrix* (46 cells/l). *Spirogyra* dominated at SW-13, while *Melosira* at SW-14 and *Surirella* at SW-15. Phytoplankton taxa composition observed in most sites are indicative of eutrophic (nutrient-rich) conditions. The abundance and occurrence of *Fragilaria, Pediastrum and Melosira* at majority of the surveyed stations which are known to frequent eutrophic waters support this observation. Some taxa such as *Microcystis* spp. are known to produce toxins and produce unwanted odour and taste in drinking water. *Pediastrum* spp. which are abundant in slow, stagnant and nutrient-rich rivers also impart unwanted odour (Bellinger and Sigee, 2010).

Table 3.2.9 Mean (no. of units/ l) and Relative Mean Density (%) of Algae Recorded at Sampling Stations within the Vicinity of the Proposed MCRP (February 6-7, 2018)

Taxa	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10	SW-11	SW-12	SW-13	SW-14	SW-15	Overall Mean Density	Relative Mean Density
	Bulihan River	Labangan River	Bagbag River	Pampanga River	Maalam River	Masaluso Creek	Sto Niño River	Calutcut Creek	Abacan River	Paranam Tributary	Quitanguil River	Sapang Balen Creek	Sacobia River	Bamban River	Cutcut River Tributary		
Bacillariophyta	13	17	18	66	99	67	4	4	60	32	34	23	45	25	37	36	35.7
Fragilaria	11	0	0	42	27	21	0	0	39	13	22	2	24	5	18	15	14.8
Melosira	0	9	7	0	11	10	3	0	8	6	6	20	12	20	0	7	7.3
Navicula	0	0	6	0	30	16	0	0	0	0	4	1	3	0	0	4	4.0
Rhizosolenia	1	2	5	0	20	5	0	3	0	0	0	0	0	0	0	2	2.4
Surirella	0	6	0	0	12	6	0	0	13	13	0	0	1	0	20	5	4.5
Synedra	1	0	0	24	0	9	0	0	0	0	2	1	5	0	0	3	2.7
Chlorophyta	0	46	34	120	149	117	0	0	106	74	9	120	115	0	8	60	59.2
Actinastrum	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0.1
Cladophora	0	0	0	0	0	0	0	0	37	14	0	74	0	0	0	8	8.2
Mougeotia	0	24	12	12	124	72	0	0	0	0	0	0	0	0	0	16	16.1
Pandorina	0	14	0	41	8	15	0	0	0	0	0	0	0	0	0	5	5.1
Pediastrum	0	5	15	16	0	4	0	0	0	0	0	0	0	0	0	3	2.6
Scenedesmus	0	0	7	0	0	5	0	0	0	0	0	0	0	0	0	1	0.8
Spirogyra	0	3	0	39	0	3	0	0	18	15	9	0	113	0	8	14	13.6
Ulothrix	0	0	0	13	17	19	0	0	51	45	0	46	0	0	0	13	12.6
Cyanophyta	2	73	0	0	0	0	0	0	0	0	0	0	0	0	2	5	5.1
Aphanocapsa	0	52	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3.4
Microcystis	0	21	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.4
Spirulina	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0.3
Mean Density	16	136	51	186	248	184	4	4	165	105	42	142	159	25	47	101	100.0
SD	4	9	10	11	35	38	1	1	29	31	7	7	50	0	6		
Number of Taxa	5	9	7	7	8	12	2	2	6	6	5	6	7	3	4	17	

Note: The highlighted cells are the results that exceed the standard

Zooplankton

717. The zooplankton community at 15 surveyed stations combined at the vicinity of the proposed MCRP, comprised a total of 28 taxa representing three animal phyla. The community was largely dominated by Rotifera, comprising 90.3% of the total count, while low proportions were recorded for Arthropoda (9.5%) and Protozoa (0.1%). Rotifera had the highest taxa richness comprising 22 taxa, while only five taxa were recorded for Arthropoda, and a single taxon for Protozoa (**Table 3.2.10**).

718. On the average, zooplankton mean abundances were high at SW-5 and SW-6, with values of 2,712 inds./l and 1,151 inds./l, respectively. Moderate zooplankton mean densities were recorded at four (SW-2, SW-3, SW-10 and SW-11) of the 15 surveyed stations, with values ranging from 17 inds./l to 68 inds./l. Meanwhile low mean densities of zooplankton were observed at the rest of the sampling stations (mean density ranged from 1 ind./l to 7 inds./l).

719. SW-6 had the highest zooplankton taxa richness (25 taxa), dominated by *Brachionus caudatus* (197 inds./l), followed by *Keratella tropica* (141 inds./l). SW-5 ranked second in terms of zooplankton taxa richness with a total of 20 taxa, 18 taxa of which belong to Rotifera. The zooplankton community at this station was largely dominated by three species of *Brachionus*, *B. urceolaris* (330 inds./l), *B. caudatus* (300 inds./l)and *B. calyciflorus* (258 inds./l). *Brachiounus urceolaris* was also the most abundant taxon at SW-2 (6 inds./l) and at SW-10 (6 inds,/l). Copepoda nauplius co-dominated with *B. urceolaris* at SW-10. *Brachionus caudatus* and *Keratella tropica* co-dominated at SW-3, although low densities were recorded (11 and 10 inds./l, respectively). SW-11 was dominated by *Brachionus calyciflorus* (15 inds./l) while SW-2 by *B. urceolaris* (6 inds./l).

720. The dominance of Rotifera at majority of the surveyed stations is indicative of polluted, nutrient-enriched (eutrophic) waters. Several species of *Brachionus* such as *B. caudatus,B. urceolaris*, and *B. calyciflorus* as well as *Keratella tropica*, which were recorded at high densities in most sites are known bioindicators of eutrophic or organically-enriched conditions (Hra, 2011; Marneffe et al., 1998).

Table 3.2.10 Mean (no. of inds./ l) and Relative Mean Density (%) of Zooplankton Recorded at Sampling Stations (Feb. 6-7, 2018)

Taxa	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10	SW-11	SW-12	SW-13	SW-14	SW-15	Mean Density	
																Overall	Relative
Arthropoda	3	4	13	3	215	135	0	0	0	10	0	0	0	0	1	26	9.5
Calanoida copepodite	1	3	4	1	115	64	0	0	0	2	0	0	0	0	0	13	4.7
Calanoida female	0	0	0	1	0	30	0	0	0	1	0	0	0	0	0	2	0.8
Copepoda nauplius	1	0	9	1	100	21	0	0	0	7	0	0	0	0	1	9	3.5
Cyclopoida copepodite	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	1	0.3
Cyclopoida female	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	1	0.2
Protozoa	0	0	0	0	0	0	0	0	3	0	0	0	0	3	0	0	0.1
Centropyxis	0	0	0	0	0	0	0	0	3	0	0	0	0	3	0	0	0.1
Rotifera	1	14	55	5	2497	1016	1	1	0	13	20	6	1	0	0	242	90.3
Ascomorpha	1	0	2	0	173	95	0	1	0	0	0	3	0	0	0	18	6.8
Brachionus bidentatus	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Brachionus calyciflorus	0	2	0	0	258	23	0	0	0	0	15	1	0	0	0	20	7.4
Brachionus caudatus	0	0	11	0	300	197	0	0	0	0	0	0	0	0	0	34	12.6
Brachionus diversicornis	0	0	2	0	120	24	0	0	0	0	0	0	0	0	0	10	3.6
Brachionus falcatus	0	3	6	0	133	72	0	0	0	0	0	0	0	0	0	14	5.3
Brachionus forficula	0	1	3	0	181	88	0	0	0	0	0	0	0	0	0	18	6.8
Brachionus leydigi	0	0	6	0	190	77	0	0	0	1	1	1	0	0	0	18	6.9
Brachionus quadridentatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Brachionus rubens	0	0	0	0	53	38	0	0	0	0	1	0	0	0	0	6	2.3
Brachionus urceolaris	0	6	4	1	330	53	0	0	0	6	3	1	0	0	0	27	10.1
Filinia	0	0	3	0	95	32	0	0	0	4	0	0	0	0	0	9	3.3
Hexarthra	0	0	5	0	130	25	0	0	0	2	1	0	0	0	0	11	4.1
Keratella cochlearis	0	0	0	0	19	11	0	0	0	0	0	0	0	0	0	2	0.7
Keratella procurva	0	0	0	0	40	11	0	0	0	0	0	0	0	0	0	3	1.3
Keratella tropica	0	0	10	3	173	141	0	0	0	0	0	0	0	0	0	22	8.1
Lecane	0	1	0	0	98	31	0	0	0	0	0	0	0	0	0	9	3.2
Lepadella	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0.2
Mytilina	0	0	1	0	35	12	0	0	0	0	0	0	0	0	0	3	1.2
Plationus	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0.1
Polyarthra	0	1	3	0	143	53	0	0	0	0	0	0	0	0	0	13	5.0
Trichocerca	0	0	0	0	30	23	0	0	0	0	0	0	0	0	0	4	1.3
Mean Density	4	17	68	7	2712	1151	1	1	3	23	20	6	1	3	1	268	100.0
SD	1	1	5	1	227	57	0	0	2	2	23	3	0	1	1		
Number of Taxa	5	11	15	7	20	25	2	3	1	7	5	5	2	1	2	28	

Note: The highlighted cells are the results that exceed the standard

d. Macrobenthos Community

721. The freshwater macrobenthos community at 15 stations combined at the vicinity of the proposed MCRP comprised at least 14 taxa representing three animal phyla. Arthropoda, particularly Insecta, largely dominated the macrobenthos community representing 68.1% of the total count, followed by Mollusca with an overall relative abundance of 31.6%. Meanwhile, Annelida was recorded at low proportion (0.3%). Macrobenthos was not observed at three sites namely, SW-4, SW-7 and SW-11 (**Table 3.2.11**).

722. High densities of macrobenthos were recorded at three (SW-5, SW-8 and SW-9) of the 15 surveyed sites, ranging from 279 inds./m^2 to 307 inds./m^2. Meanwhile, moderate abundances of macrobenthos were observed at SW-6, SW-12 and SW-13. Mean macrobenthos abudances at these stations ranged from 23 inds./m^2 -38 inds./m^2. Low macrobenthos densities were recorded at six remaining stations (1-3 inds./m^2). Macrobenthos taxa richness was generally low at surveyed stations with values ranging from 1-8 taxa, although a relatively higher number of macrobenthos taxa was recorded at SW-5 (8 taxa), compared with that recorded at remaining stations (1-5 taxa).

723. *Melanoides* of Family Thiaridae largely dominated at SW-5 with a mean density of 273 inds./m^2. Family Chironomidae of Order Diptera solely dominated the macrobenthos communities at WSN8 and SW-9, and was consistently recorded at high densities (279 inds./m^2 and 307 inds./m^2, respectively) at these sites. Chironomidae was also the most abundant taxon at SW-12 and SW-13 (36 inds./m^2 and 15 inds./m^2). Family Ceratopoginidae ranked second in terms of mean density at SW-13, with a value of 9 inds./m^2.

724. The dominance of *Melanoides*, an algal-grazing gastropod as well as of Chironomidae at most surveyed stations are suggestive of polluted conditions (**Photo 3.2.1**). These taxa are known bioindicators of eutrophic, nutrient-rich condition/ poor water quality (Barbour et al., 1999). Domestic (such as aquatic bodies serving as convenient dumping grounds of all types of wastes) and industrial activities (effluents from industries) could serve as possible sources of organic matter and nutrients, and all types of pollutants.

Photo 3.2.1 Chironomidae (Midge Larvae), the Dominant Taxon at Majority of the Surveyed Stations

Table 3.2.11 Mean (no. of animals/ m2) and Relative Mean Density (%) of Macrobenthos Recorded at 15 Sampling Stations within the Vicinity of the Proposed MCRP (February 6-7, 2018)

Taxa	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10	SW-11	SW-12	SW-13	SW-14	SW-15	Overall Mean Density	Relative Mean Density
ANNELIDA	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	3	0.3
Hirudinea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Oligochaeta	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	2	0.2
Polychaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Nereididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
ARTHROPODA	0	0	1	0	2	0	0	279	307	2	0	37	24	3	2	658	68.1
Insecta	0	0	1	0	2	0	0	279	307	2	0	37	24	3	2	658	68.1
Order Diptera	0	0	1	0	2	0	0	279	307	2	0	36	24	3	2	656	67.9
Ceratopogonidae	0	0	0	0	0	0	0	0	0	0	0	0	9	1	0	10	1.1
Chironomidae	0	0	1	0	2	0	0	279	307	2	0	36	15	1	2	646	66.8
Order Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Leptophlebiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Order Trichoptera	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0.2
Hydropsychidae	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0.2
MOLLUSCA	3	0	0	0	279	23	0	0	0	0	0	0	0	0	0	306	31.6
Bivalvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Corbicula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Gastropoda	3	0	0	0	279	23	0	0	0	0	0	0	0	0	0	305	31.6
Ampullaridae	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0.4
Pomacea	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0.4
Physidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1
Planorbidae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0.2
Thiaridae	1	0	0	0	273	20	0	0	0	0	0	0	0	0	0	295	30.5
Melanoides	1	0	0	0	273	20	0	0	0	0	0	0	0	0	0	295	30.5
Viviparidae	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	5	0.5
NEMATODA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Rhabditifom larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Mean Density	3	1	2	0	282	23	0	279	307	2	0	38	24	3	3	967	100.0
SD	2		3	0	59	20	0	238	42	3	0	23	19	3	4		
Number of Taxa	5	1	2	0	8	2	0	1	1	1	0	4	2	2	3	14	

Note: The highlighted cells are the results that exceed the standard

e. Fish and Other Aquatic Animals

725. Based from interviews, only Stations SW-2, SW-4, SW-5, SW-6 and SW-8 were reported as fishing area (minor fishing activity) by the locals. The fish caught are used for domestic consumption only.

726. The locals reported a total of 12 fish and other aquatic animals that can be caught at the abovementioned stations. Tilapia, Bangus, Dalag Shrimps, Crabs and Turtles have been reported as frequent catch at the site. Eight (8) taxa of fish and aquatic animals were reported at SW-2, while three (3) taxa each at the remaining stations (**Table 3.2.12**). Fishnets and traps were also observed at Stations SW2 and SW-6, respectively (**Photo 3.2.2**).

Table 3.2.12 Fish and Other Animals Reportedly Caught at Five Surveyed Stations

Station	Fish and Other Aquatic Animals
SW-2	*Oreochromis niloticus* (tilapia), *Cyprinus carpio* (karpa), torsilio, crabs(ulang), Gobiidae (biya), *Chanos chanos* (bangus), *Hypophthalmichthys nobilis* (Imelda or bighead carp), *Arius* (kanduli)
SW-4	shrimps (hipon), *Chanos chanos* (bangus), *Oreochromis niloticus* (tilapia)
SW-5	*Channa* sp. (dalag), *Oreochromis niloticus* (tilapia), shrimps (hipon)
SW-6	pawikan or freshwater turtle, *Channa* sp. (dalag), *Clarias* sp. (hito)
SW-8	*Channa* sp. ("bulig" ; dalag), *Clarias* sp. (hito), freshwater turtle (pagong)

Photo 3.2.2 Fish Nets and Traps Observed at Station SW-2 and SW-6

2) Biodiversity Value

727. Phytoplankton communities at Stations FW-6, FW-2, FW-3, FW-4, FW-5, FW-9 and FW-10 were relatively more diverse than that observed at the rest of the stations. The former stations had phytoplankton communities with Shannon's Index of diversity values ranging from 1.59 to 2.02, while the rest of the stations had values ranging from 0.50 to 1.31. The same trend was observed for zooplankton communities. Meanwhile, the macrobenthos communities at 15 surveyed stations had low Shannon's Index of diversity values, ranging from 0.17 to 0.69 (**Table 3.2.13**).

Table 3.2.13 Shannon's Diversity Index Values of Freshwater Communities

Freshwater Communities	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10	SW-11	SW-12	SW-13	SW-14	SW-15
Phytoplankton	0.86	1.78	1.71	1.83	1.62	2.02	0.00	0.00	1.62	1.59	1.31	1.11	0.99	0.50	1.16
Zooplankton	1.10	1.85	2.46	1.48	2.80	2.83	0.00	0.00	0.00	1.71	0.95	1.24	0.00	0.00	0.00
Macrobenthos	0.69	0.00	0.00	0.00	0.17	0.39	0.00	0.00	0.00	0.00	0.00	0.21	0.66	0.69	0.64

3.2.3.2 Impact Identification, prediction and assessment and mitigation

(1) Pre-construction and Construction

1) Threat to Existence and/or Loss of Important Local Species and Habitat

728. The proposed MCRP will have little or minimal impacts on aquatic bodies as most sampling stations are already heavily polluted as a result of domestic and industrial activities in the area. Nevertheless, there may be some impacts on freshwater communities particularly at sites, which are relatively less affected by human activities, such as Station SW-5 (Masaluso River) and SW-15 (Cutcut River Tributary).

729. Wastes or contaminants generated during construction, as well as domestic wastes generated may adversely affect water and sediment quality. A sound wastewater and solid waste management plan will be in place and strictly implemented. Vehicles carrying construction materials will be covered and speed limits will be implemented to minimize spills of dust which may be transported to the rivers during rainy days. Regular monitoring of diversity of aquatic fauna and in-situ water quality will also be conducted.

2) Threat to Abundance, Frequency and Distribution of Species

730. The adverse effects which would contribute to the decrease in freshwater biota will mainly be attributed to the construction works to be carried out at the vicinity of rivers and streams. This will include:

1. Disruption of water flow in waterways for the construction of drainage structures and earth-moving activities related to the railway construction (such as excavation of earth, stones and rocks and filling with construction materials) may destroy aquatic habitats which serve as shelter, spawning and nursery grounds for aquatic animals such as fishes and macroinvertebrates.
2. Erosion of sediments produced from land clearing activities and stockpiles of sediment may end up as runoff to nearby sections especially during storm and heavy rains. These may adversely affect plankton and macrobenthos fauna. Sediment erosion in freshwater bodies may bury macrobenthos fauna and may cause localized mortality of gastropods, and polychaetes. This may also impair feeding apparatus of macroinvertebrates. Siltation may increase water turbidity, resulting in decreased light penetration. This may decrease photosynthetic rate of primary producers such as phytoplankton and benthic algae, which are dependent on light to manufacture their food. Consequently, zooplankters which rely on phytoplankton for food may potentially decrease in type and number. If this would persist, an overall decrease in both primary and secondary productivity may occur in the area.
3. Water pollution from spills of vehicles.
4. Water pollution from domestic sewage of workers may give rise to eutrophication, changes in composition of aquatic fauna (such as increase in abundances of pollution-tolerant aquatic species), and mortality of highly sensitive species of fish and aquatic insects.
5. Illegal fishing by workers.

731. The overall magnitude of the impact decrease in abundances of aquatic organisms during construction is considered low since these are not expected to adversely affect their integrity. These impacts will occur for a short period and aquatic populations will have the capability to recover their numbers once the construction phase ends.

732. The main mitigation measures during the construction phase to prevent soil erosion and contamination of water bodies which may directly or indirectly affect aquatic organisms will be

contained in the Sedimentation and Erosion control Plan; Plan for the safe management of hazardous materials and spill prevention program, including emergency response measures in case of accidental spills; and a Waste Management Plan.

733. The extent of the construction area next to water courses should be limited. No occupation of the stream bed or the banks will be allowed, unless there is no other reasonable alternative to carry out the construction work. Stockpiles will be covered to prevent sediment from being washed into nearby rivers and creeks The construction drainage will be directed to retention basins or grassed filter zones to trap sediments and other contaminants, rather than discharging directly to the water courses. These sediment and contaminant retention structures will be constructed in areas where habitats of very high or high sensitivity are located along the alignment or in a close location downstream of the effluent discharge point. Sewage or domestic wastewater generated in the construction camps will not be allowed to be discharged untreated into natural water courses. The construction camps will be provided with STP to treat sewage to admissible levels for discharge in the water body. The construction sites will be provided with chemical portable toilets and other wastes will be adequately managed. Railway construction activities at the vicinity of water bodies will be carried out during the dry season.

(2) Operation phase

1) Threat to Existence and/or Loss of Species of Important Local and Habitat and Threat to Abundance, Frequency and Distribution

734. During operation, negative impacts on aquatic animals could be attributed to spills from trains during normal operations and occasionally due to accidental spills. Degradation of habitat quality due to storm water discharges and alterations in stream hydrology can degrade habitats ranging up to several hundred meters from railways. Finally, an increase of the local population induced by the railroad could result in an undesirable increase of domestic wastes which may pollute freshwater bodies and adversely affect aquatic organisms.

735. Regular control and maintenance of drainage structures and retention basins will be conducted to ensure that they do not become clogged with debris or sediments. Domestic wastewater generated at the stations will be treated according to the relevant national legislation and standards. Untreated wastewater will not be allowed to be discharged into natural water courses. In the event that connection of the sewage system of the station to the municipal collector is not feasible, the station will be provided with STP to treat sewage to admissible levels for discharge in the water body. The wastewater generated by the washing of the trains will be treated as well unless it can be discharged under permit issued by the LGUs (municipal/city office or the DENR). Additional measures are as follows:

- Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969;
- Strictly implement solid waste / soil management plan, which include minimization of waste/soil generation, segregation, and proper disposal in accordance to RA 9003;
- Comply with RA 9275 including but not limited to securing a Discharge Permit;
- Undertake proper inspection and regular maintenance of drainage system and treatment facility.

Table 3.2.14 Summary of Impact Identification, Prediction, Assessment and Mitigation for Water

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
PRE-CONSTRUCTION / CONSTRUCTION				
• Site preparation, land clearing, removal of vegetation • Excavation • Construction activities	Hydrology	Flooding and inundation by sediment run off, siltation, drainage overflow, clogging	B-	[Pre-Construction/ Construction] • Design and install sufficient drainage system including temporary drainage system during construction to accommodate the surface water runoff from the project and avoid any flooding in the area caused by the project, in consideration to the existing drainage system and flood storage capacity. • Based on the hydrological, geological study and local climate change data from PAGASA, design and install train system in robust to flood and related extreme events including temporary construction drainage, train structure to be above the flood level, installation of drainage pumping system, etc. • Based on the result of hydrological study, design and install viaduct piers • Coordinate with DPWH and LGUs on the integration of proposed drainage plan to the project area. [Construction] • Minimise the removal of vegetation and alteration of topography as much as possible. • Install soil erosion control such as protection of slope and bank silt traps to minimize siltation of waterways as required. • Strictly implement construction plan, operating instructions and solid waste / soil management plan, which include minimization of waste/soil generation, segregation, and proper disposal by contractor in accordance to RA 9003 • Regular inspection and prompt maintenance of the drainage system, all installed structures and facilities and improve/ enhance capacity when possible.
	Hydrogeology	Depletion of water resource/ competition in water use	C-	[Construction] • Utilize surface water from the local water service provider/s • Conduct regular monitoring of water consumption • Implement water conservation program such as use of rain harvested/ recycled water at construction yard/ camp.
Earthworks, (excavation, backfilling, stockpiling, tunneling/underground)	Water Quality	Degradation of groundwater quality	C-	[Pre-Construction/ Construction] • Plan and Implement appropriate construction methods (i.e. excavation, backfilling, stockpiling) based on geological and geotechnical investigations. • Install sedimentation/filtration pond at tunnel construction area [Construction] • Comply with environmental permitting requirements for the storage, transport, handling, treatment, and disposal of hazardous material/ wastes and contaminated soil in accordance with RA 6969, and solid waste / soil management plan, in accordance to RA 9003.
Earthworks, (excavation, backfilling, stockpiling)	Water Quality	• Disturbance on bottom sediment and degradation of surface water • Siltation • Induce of turbidity	B-	[Pre-Construction] • Based on the hydrological and geodetic surveys, design bridge piers that will minimise installation within the rivers and select appropriate construction materials to be used. • Minimize the removal of vegetation cover, alternation of topography as much as possible. • Plan and implement construction activities in consideration to the water course, embankment, and dry season. • Coordinate with NWRB, DPWH and LGUs for necessary permit [Construction] Install protection measures for soil erosion and bottom sediment around the bridge piers if necessary. • Place excavated material in temporary staging area with provision for silt traps/ siltation pond to avoid silt draining to
	Freshwater Ecology	Threat to abundance, frequency and	C-	

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
		distribution of species		waterways, degradation of surface water quality and clogging of waterways, if necessary. • Conduct regular surface water quality monitoring.
• Discharge of wastewater, from construction sites/ yards • Accidental spills of fuels and lubricants from construction vehicles and machineries, as well as other hazardous chemicals like paints and solvents. • Generation and improper handling and disposal of construction, domestic and hazardous wastes.	Water Quality	Degradation of surface water quality	B-	[Pre-Construction/ Construction] • Design and implement the temporary drainage of waste water from construction yard/ facilities/ camp, surface water runoff drainage systems to minimise discharge. • Design and install sewage treatment facility and separate non-sewage wastewater for stations and Depot in compliance to the Sanitation Code of the Philippines. In addition, depot will have interceptor tank to remove oil and fuel from surface water. • Compliance with RA 9275, secure discharge permit. [Construction] • Install wastewater treatment, portable sanitary facilities at construction sites/yards • Conduct proper inspection and regular maintenance of construction machineries, equipment, vehicles and wastewater treatment equipment and facilities with appropriate measure to collect any leakage • Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969 and solid waste / soil management plan, which include minimization of waste/soil generation, segregation, and proper disposal including the temporary storage by contractor in accordance with RA 9003 • Implement material handling program or a site protection program. • Conduct of effluent quality monitoring at discharge point
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-	
OPERATION				
Operation of train	Hydrology	Increase of flood occurrence and worse the impact	C-	Conduct proper inspection and prompt maintenance of the installed drainage system, and improve/ enhance capacity when possible
Operation of passenger facilities, depot.	Water Quality	Degradation of groundwater quality	C-	• Comply with environmental permitting requirements for the storage, transport, handling, and treatment and disposal of hazardous material/ wastes and contaminated soil in accordance with RA 6969. • Conduct proper inspection and prompt maintenance of the installed wastewater treatment facilities. • Compliance to RA 9275 including but not limited to securing of discharge permit. • Conduct proper inspection and regular maintenance of drainage system and treatment facility. • Conduct of regular effluent quality monitoring
• Discharge of waste water, from passenger facilities, depot. • Accidental spills of fuels and lubricants from service vehicles and machineries, at depot • Generation and improper handling and disposal of domestic and hazardous wastes.		Degradation of surface water quality	B-	
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-	

Note:

A+/-: Significant positive/negative impact is expected.

B+/-: Moderate positive/negative impact is expected to some extent.

C+/-: Minor / Negligible positive/negative impact is expected to some extent.

D: Extent of impact is unknown.

3.3 AIR

3.3.1 Climatology and Meteorology

736. The Climate at the proposed MCRP area was described in **Table 3.3.1** based on the Climate Map of the Philippines. While the meteorological considerations at the project site were described using the meteorological data from CIA Station, the nearest PAGASA Synoptic Station located at 15°11'7.77" N and 120°32'56.05" E in Clark, Pampanga with an elevation of 151.564m.

Table 3.3.1 Meteorological Data Recorded at CIA Synoptic Station (1997-2010)

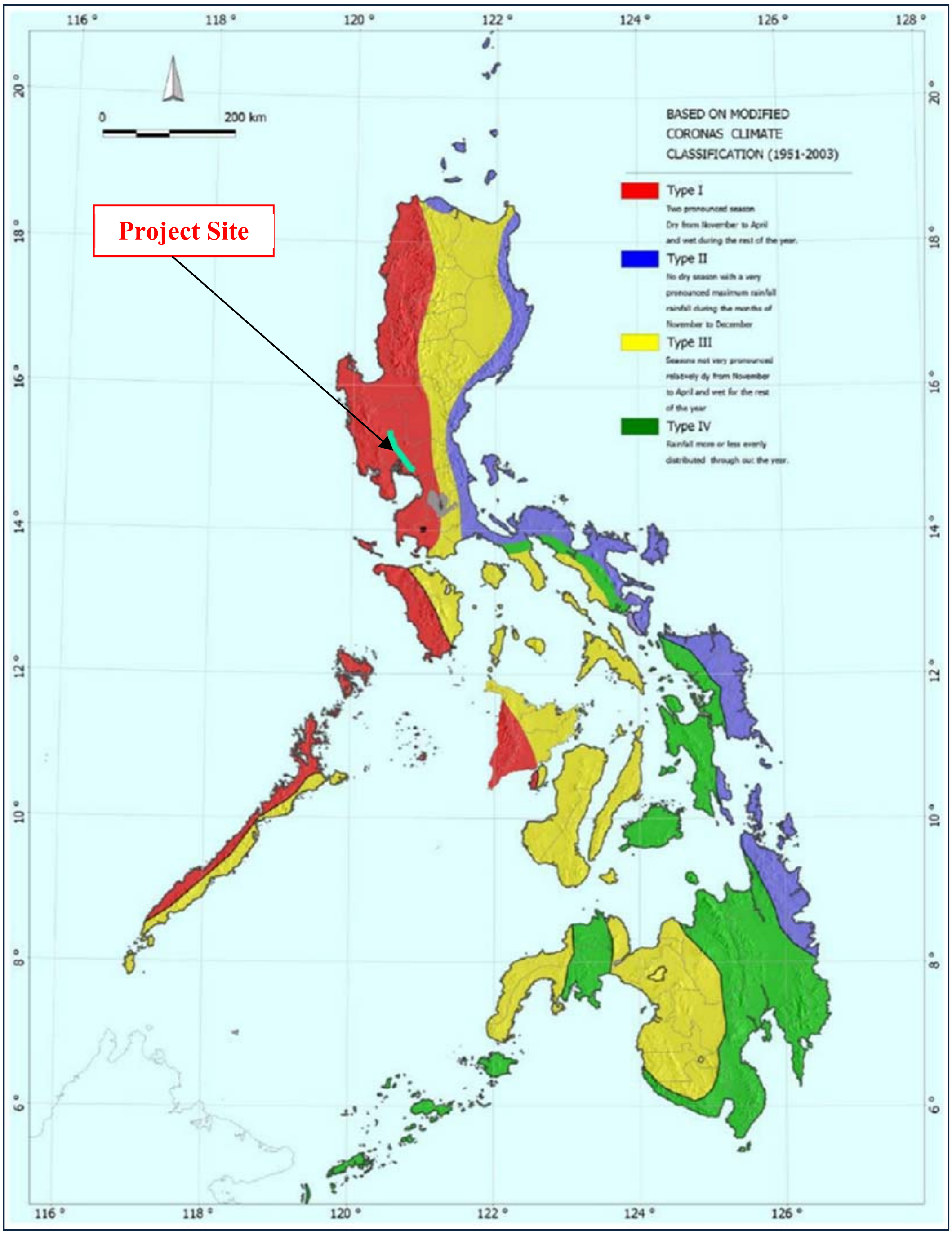
Month	Rainfall Data		Temperature						Relative Humidity (%)	Wind Direction/velocity	
	Amount (mm)	No. of Rainy Days	Max (°C)	Min (°C)	Mean (°C)	Dry Bulb (°C)	Wet Bulb (°C)	Dew Point (°C)		Wind Direction (16 pt)	Wind Velocity (mps)
January	17.4	3	30.1	20.5	25.3	24.8	20.8	19	70	NW	3
February	18.6	3	31	20.7	25.9	25.4	21.1	19.2	68	ENE	3
March	28.4	4	32.6	21.8	27.2	26.8	22	20	66	NE	3
April	65	7	34	23.2	28.6	28.2	23.2	21.2	65	E	3
May	221.8	10	32.7	23.9	28.3	27.7	24	22.6	73	SE	2
June	241.2	18	31.5	23.6	27.6	27	24.3	23.3	80	S	3
July	422.6	22	30.6	23.5	27	26.3	24.2	23.4	84	S	3
August	429.4	24	30.1	23.5	26.8	26	24.2	23.5	86	S	2
September	293.1	21	30.5	23.2	26.9	26	24	23.2	85	S	2
October	177	12	31.1	23	27	26.5	23.6	22.5	78	NW	3
November	78	8	31	22.4	26.7	26.2	22.8	21.5	75	N	3
December	34.2	6	30.2	21.3	25.8	25.2	21.5	19.9	72	NW	3
Annual	2026.8	143	31.3	22.6	26.9	26.3	23	21.6	75	S	3

Source: Clark International Airport Station, PAGASA (1997-2010)

3.3.1.1 Local Climate

737. Based on the Modified Coronas Climate Classification System, Bulacan, Pampanga, and Tarlac where the proposed MCRP is to be located fall under a Type I climate classification as indicated in the Climate Map of the Philippines (**Figure 3.3.1**). Type I climate is characterized by two (2) pronounced seasons, dry season from November to April and wet season from May to October with maximum rain period from June to September. Areas under this type of climate are generally exposed to the southwest monsoon during rainy season and get a fair share of rainfall brought about by the tropical cyclones occurring during the maximum rainy period.

Classification	Description
Type I	Dry from November to April and wet during the rest of the year. The highest rainfall is from June to September.
Type II	No dry season with a pronounced rainfall from November to February. March to May has the lowest rainfall.
Type III	Seasons are not very pronounced, relatively dry from November to April, and wet during the rest of the year.
Type IV	Rainfall is more or less evenly distributed throughout the year

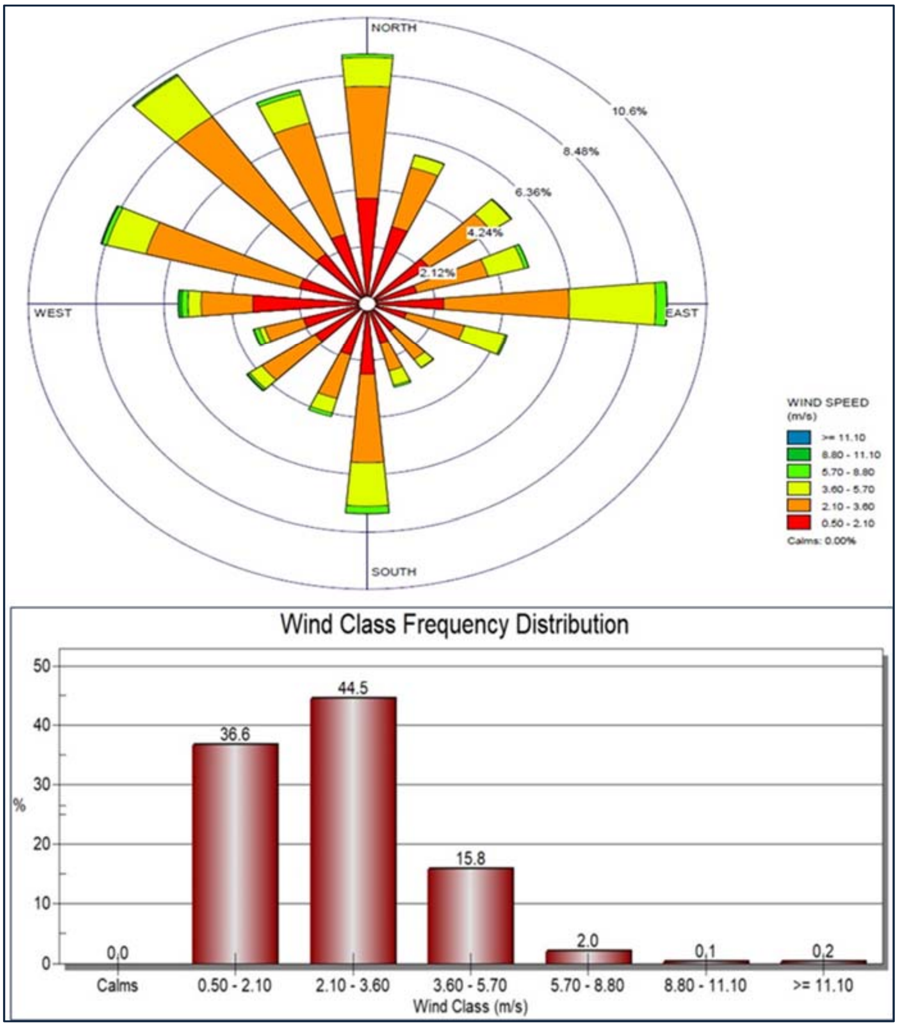


Source: PAGASA

Figure 3.3.1 The Philippine Climate Map

(1) Wind Regime

738. The meteorological data recorded at Clark Airport Station from January 1 to December 31, 2016 show that the prevailing wind at the project sites is from Northwest, East, and North, which comprise 10%, 9% and 8%, respectively (**Figure 3.3.2**). The average hourly wind speed is 2.39 m/s and majority of winds occupy 44.5% with speed of 2.10 m/s to 3.60 m/s. Strongest winds with speed >11 m/s came from Northwest and West-Northwest occupy 0.2 % of the time.



Source: Plotted in AERMET View Version 9.5.0

Figure 3.3.2 Windrose Diagram for Bulacan, Pampanga and Tarlac based from the Data Recorded at Clark Airport Station

(2) Relative Humidity

739. Relative humidity refers to the amount of water vapour in the air, expressed as a percentage of the maximum amount that the air could hold at the given temperature. The mean annual relative humidity recorded at the PAGASA Stations in Clark Airport is 75% as presented in **Table 3.3.1**. The months of July to September are the most humid. Factors affecting humidity are changes in temperature and atmospheric circulation. The air is said to be saturated when it contains the maximum amount of water vapour possible at a given temperature. When the temperature of the air falls below the dew point, some of the water vapour contained in the air condenses, clouds form, and precipitation can result in the form of rain.

(3) Rainfall

740. The monthly average rainfall at the project site ranges from 17.4 mm to 429.4 mm, with an annual average of 2026.8 mm (**Table 3.3.2**). Least number of rainy days per month occurs in November to April; while the highest number or rainy days per month occur in May to October, which cause flooding in low-lying areas. The heaviest precipitation occurred in August with an average of 429.4 mm.

(4) Temperature

741. The annual mean average temperature recorded at CIA Station is 26.9 °C with January being the coldest month having an average temperature of 25.3°C, while the month of April is the warmest with an average temperature 28.6 °C (**Table 3.3.2**). The highest and lowest temperatures occur in the months of April and January, respectively. The mean maximum and minimum temperatures range from 30.1–34.0 °C and 20.5–23.9 °C, respectively.

(5) Frequency of Extreme Events

742. Climatological extreme values recorded from Clark Station are the monthly and annual summaries of temperature, rainfall, and wind speed in **Table 3.3.2**. The recorded annual extreme high temperature is 37.0°C occurred in April 23, 2010 and May 10, 2002 while the lowest temperature is 15.8 °C occurred in January 15, 2009. The amount of annual average extreme greatest rainfall is 274.5 mm occurred in July 22, 2012 while the annual average extreme highest wind is 47 meters per second westerly direction occurred in June 13, 2010.

Table 3.3.2 Climatological Extreme Recorded at CIA Station as of 2016

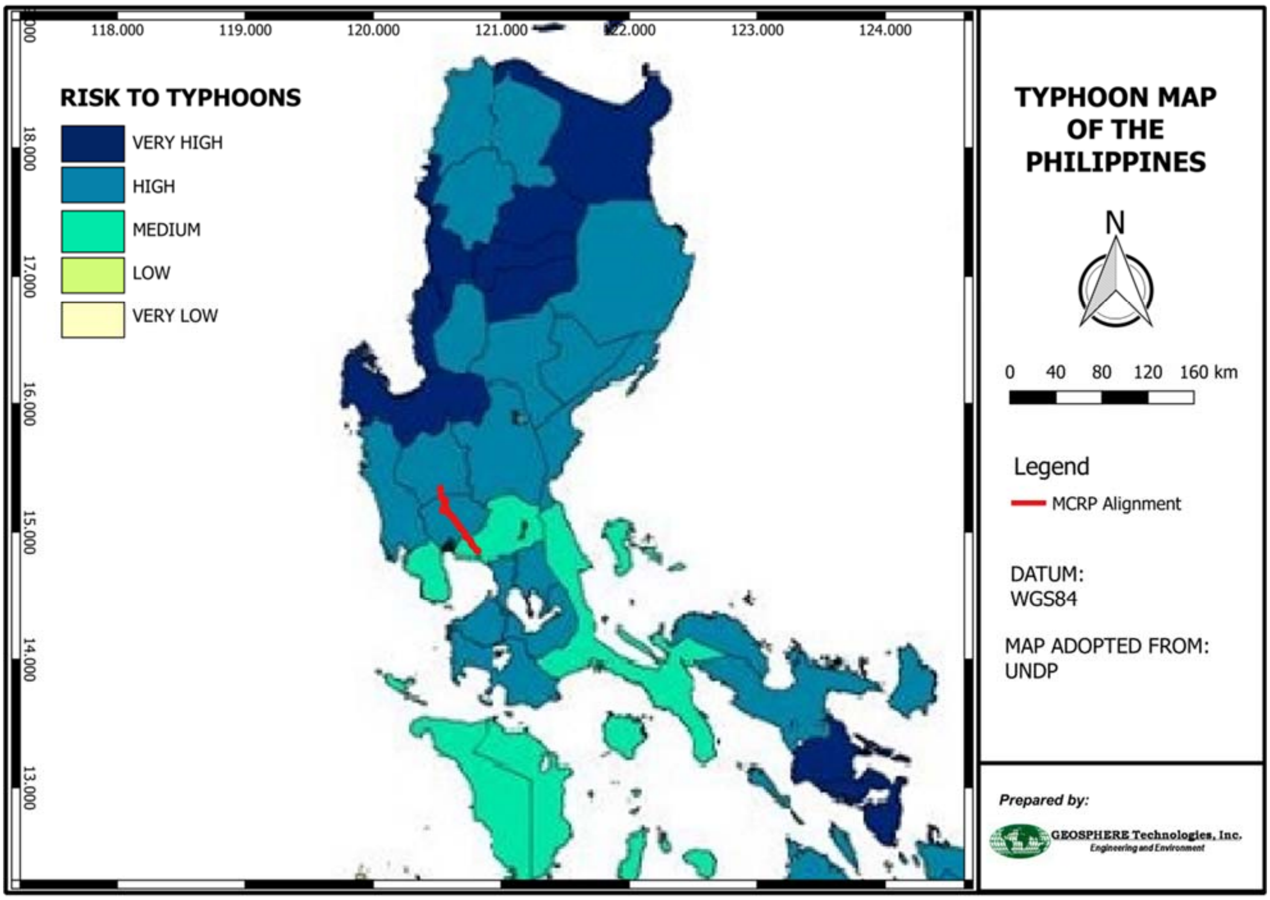
Month	Temperature (°C)				Greatest Daily RF (mm)		Strongest Winds (m/s)		
	High	Date	Low	Date	Amount	Date	Speed	Dir	Date
Jan	33.5	01-29-2012	15.8	01-15-2009	75.2	01-25-2006	17	NE	01-02-2009
Feb	34.9	02-11-1998	16.9	02-16-2004	36.8	02-07-2000	17	E	02-17-2013
Mar	36.5	03-25-2010	17.9	03-08-2002	37.0	03-14-2013	18	W	03-07-2011
Apr	37.0	04-23-2010	19.5	04-17-2012	66.4	04-10-1999	30	NNW	04-10-1999
May	37.0	05-10-2002	19.8	05-01-1997	91.6	05-17-2000	23	W	05-25-2007
Jun	35.6	06-30-2002	20.8	06-10-2003	135.0	06-06-2004	47	W	06-13-2010
Jul	35.1	07-27-2016	21.1	07-08-1997	274.5	07-22-2012	26	N	07-13-2010
Aug	34.6	08-15-2009	21.7	08-14-2005	186.8	08-08-2007	24	WSW	08-06-2011
Sep	34.9	09-16-2015	20.0	09-19-1998	208.0	09-27-2011	23	N	09-28-2006
Oct	33.9	10-31-2003	18.1	10-05-2013	188.6	10-30-2000	32	S	10-23-1998
Nov	33.8	11-21-2002	17.4	11-30-2007	119.6	11-10-2010	28	NW	11-21-2009
Dec	34.0	12-09-2012	17.0	12-27-2001	112.2	12-16-2015	21	NNE	12-10-1998
Annual	37.0	05-10-2002	15.8	01-15-2009	274.5	07-22-2012	47	W	06-13-2010
	37.0	04-23-2010							

Source: PAGASA, Climatological Extremes at CIA Synoptic Station as of 2016

(6) Cyclone Frequency

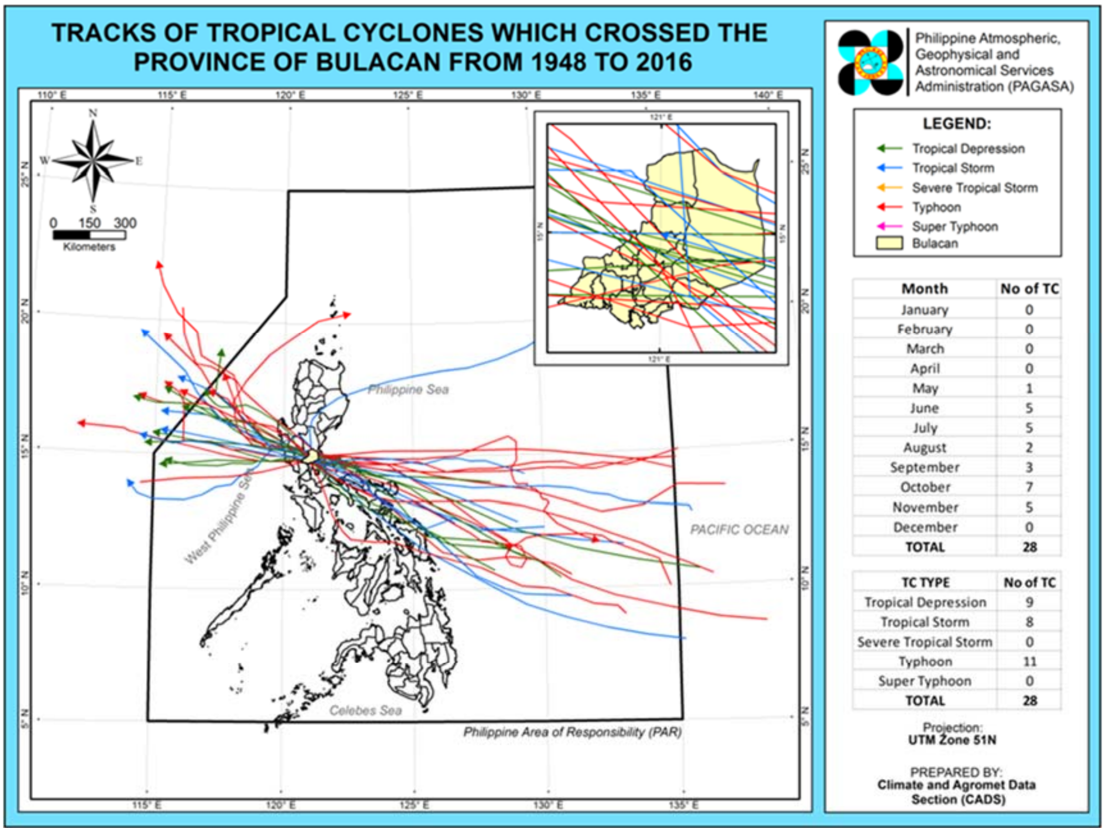
743. The most number of cyclones occur during the months of June to December. These tropical cyclones are associated with the occurrence of low pressure areas (LPA) normally originating from the North Western Pacific Ocean of the Philippine Area of Responsibility (PAR) and generally moving northwestward. 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). PAGASA categorized these cyclones as tropical depressions (TD), with wind speeds up to 63 kph; tropical storm (TS) with wind speeds from 64-117 kph, and tropical typhoon (TY), with wind speeds over 117 kph. **Figure 3.3.3** shows that the proposed MCRP site is under high and medium typhoon risk

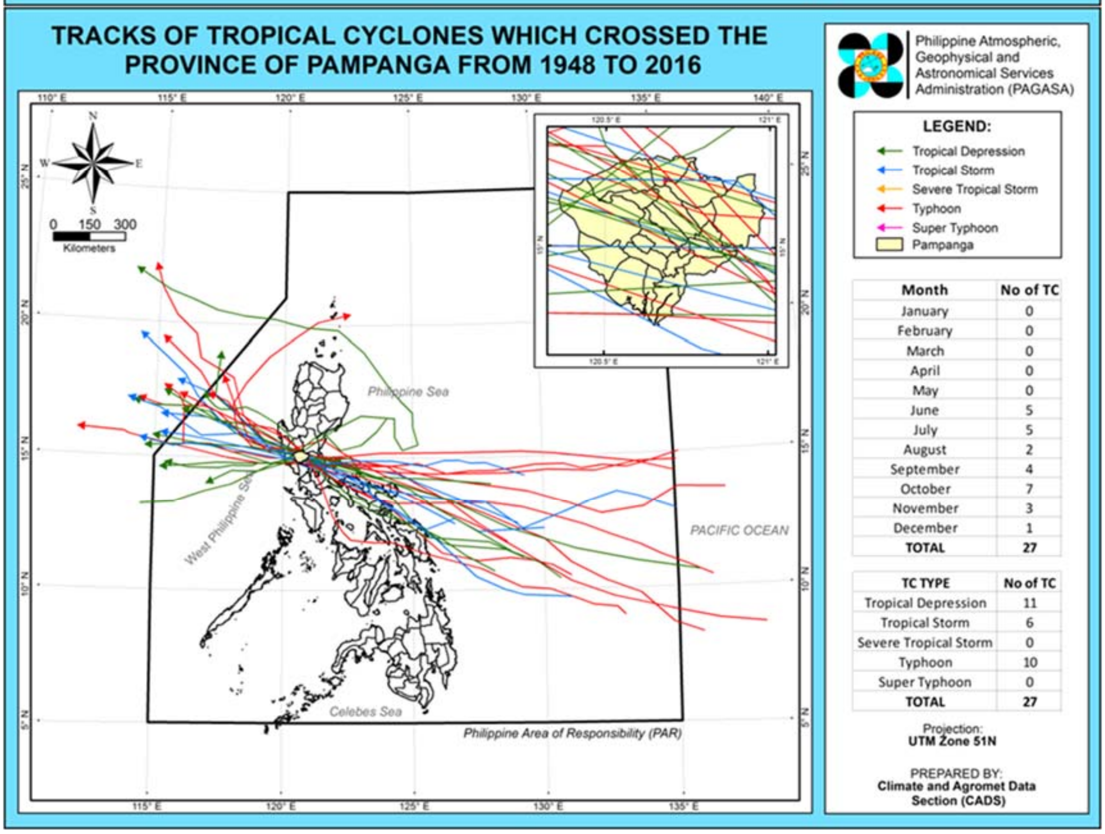
744. From 1948-2016 (period of 68 years) PAGASA determined an annual average of 20 tropical cyclones in the PAR with nine of these passing through the Philippine landmasses. PAGASA had tracked 28 tropical cyclones that crossed in the Province of Bulacan while 27 tropical cyclones that crossed the Province of Pampanga from 1948-2016 (**Figure 3.3.4**). The month of October has the most number of tropical cyclones for both Bulacan and Pampanga.



Source: Manila Observatory, 2005

Figure 3.3.3. Philippine Typhoon Map





Source: PAGASA

Figure 3.3.4 Tracks of Tropical Cyclones, which Crosses the Province of Bulacan and Pampanga from 1948 to 2016

3.3.1.2 Contribution in Terms of Greenhouse Gas Emission

745. Majority of greenhouse gas (GHG) emissions that the proposed project may generate are expected to come from activities associated with the construction (fuel/ electricity use for the operation of construction vehicles and equipment), maintenance (fuel use for rail-related maintenance activities) and operation (electricity use for rail and facility operations) of the project. These fuel combustion and electricity consumption activities release three (3) out of seven (7) GHGs, namely: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Of these gases, the major gas emitted is CO_2, the bulk of the GHG emissions calculations involve determining the amount of CO_2 emissions as CH_4, and N_2O emissions have a very low share in terms of emissions. As such, this report only focused on CO_2 emissions.

(1) Methodology

746. The CO_2 were calculated using emission factor-based estimation method. The CO_2 emissions were estimated by multiplying a level of activity data (AD) by an emission factor (EF). Activity data is a quantified measure of activity resulting in emissions during a given period of time (e.g. data on fuel consumption (liters/km) and purchased electricity (kWh reading) while emission factor is the average emission rate of a given GHG for a given source, relative to units of activity. The general equation is shown below. This is based on The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, Revised Edition, World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI), 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories and 2014 IPCC Assessment Report.

Equation : **GHG Emissions = AD x EF**

(2) Results and analysis

747. The emissions associated with the project are categorized into direct and indirect emissions. Direct GHG emissions of Scope 1 are from sources that are owned and/or controlled by the proponent. This is usually applicable during the operational phase (e.g. use of generator set and equipment owned by the proponent). Indirect emissions, on the other hand, are further categorized into Scope 2 and Scope 3. Scope 2 emissions are a consequence of the project's operations at sources owned and/or controlled by another entity, which include purchased electricity consumption. Scope 3 emissions are a consequence of the proponent's activities but to which the proponent has no direct control over which include tailpipe emissions from contracted equipment/vehicles during construction. In the case of this project, the type of emissions are Scope 2 and Scope 3.

Table 3.3.3 Items to consider for each Scope

Scope	Construction	Operation
1	1. Stationary combustion Emissions from fuel use of entity-owned/ controlled stationary equipment (e.g. standby genset) 2. Mobile combustion Tailpipe emissions from entity-owned/ controlled vehicles (e.g. service van)	1. Stationary combustion Emissions from fuel use of entity-owned/ controlled stationary equipment (e.g. genset) 2. Mobile combustion Tailpipe emissions from entity-owned/ controlled vehicles (e.g. service van)
2	1. Stationary combustion Emissions from the consumption of purchased electricity for construction works	1. Stationary combustion Emissions from the use of purchased electricity for train, stations and depot operations
3	1. Stationary combustion Emissions from fuel use of contracted construction equipment (e.g. standby genset) 2. Mobile combustion Emissions from transportation of purchased construction	1. Mobile combustion Emissions from fuel use of contracted vehicles (e.g. service vans)

Scope	Construction	Operation
	materials/ construction wastes using contracted vehicles (e.g. trucks, pickup)	

1) CO_2 emissions during construction

748. In calculating Scope 3 emissions, fuel consumption for the use of construction equipment, service vehicles as well as transport of construction materials were estimated as presented in Table 3.3.4. Since these construction equipment/ vehicles are diesel-powered, the emission factor for diesel from US EPA Emission Factor for Greenhouse Gas Inventories which was last modified on 19 November 2015. Presented below are the activity data, emission factor as well as the results of the computation. The total CO2 emissions during construction are estimated at 691.5 MT CO2/yr.

Table 3.3.4. CO2 Emission Source

Emission Sources	No. of Units	Fuel Type	[1]Fuel Consumption (L/km)	Assumed distance travelled (km/yr)	Fuel Consumption (L/yr)	[2]Emission Factor (kg/L)	Calculated CO_2 Emission (MT/yr)
Heavy Equipment	20	Diesel	31.6	5,000	31,600	2.7	85.30
30-tonner Truck	50	Diesel	20.9	15,000	156,750	2.7	423.2
Pick-up	30	Diesel	12.1	12,000	43,560	2.7	117.6
Service Van	20	Diesel	12.1	10,000	24,200	2.7	65.3
						Total CO_2 Emission	691.5

[1]Source: 2017 Fuel Consumption Guide, Natural Resources Canada
[2] Source: Emission Factors for Greenhouse Gas Inventories (last modified: 11-19-2015), US EPA

2) CO_2 Emissions during Operation

749. In calculating Scope 2 emissions, the electricity consumption during project operation was estimated at 420,118,650 kWh/yr. The assumption is based on the daily power requirements for the operation of the train, stations and facility depot. GHG Protocol's Purchased Electricity Calculation Tool with default emission factor from the GWP values of the 2014 IPCC Fifth Assessment Report was utilized to automatically calculate the total CO_2 emissions. Presented below are the activity data as well as the results of the computation. The total CO_2 emissions during operation are estimated at 211,056.52 MT CO_2/yr.

Table 3.3.5. Emission by Railway Operation

Emission Sources	Annual Electricity Consumption (kWh)	Calculated CO_2 Emission (MT/yr)
Railway Operation (train, stations and depot)	420,118,650	211,056.52

750. The Philippines Second National Communication (SNC) on Climate Change has projected 100,402,000 MT of CO_2 for 2020. Using the projection of SNC, the proposed MCRP is expected to contribute approximately 0.00069% during the construction phase and approximately 0.21% during the operation phase. When such a comparison is made, this total emerges as a small contribution to the total anthropogenic CO_2 load. If this total load is a measure of responsibility for global warming, on an absolute magnitude, the project can still be considered to be on the low-end greenhouse gas emitters.

3.3.1.3 Climate Risk/ Climate Change

(1) Climate Change Policy in the Philippines

751. According to PAGASA, future climate changes in the Philippines are likely in terms of trends in seasonal values of temperature, rainfall and extreme events. Climate data shows an increasing trend in the number of hot days and warm nights but a decreasing trend in the number of cold days and cool nights. Both maximum and minimum temperatures are generally getting warmer. From 1951 to 2010, there was a 0.65°C increase in the mean temperature.

752. In terms of rainfall, it is becoming more frequent and its intensity is increasing based on trend comparisons of extreme daily rainfall intensity and frequency between 1951-2010 and 1961-1990 mean values. Least number of rainy days per month occurs in November to April; while the highest number or rainy days per month occur in May to October, which causes flooding in low-lying areas.

753. On the average, twenty (20) tropical cyclones visit the PAR with nine (9) of these passing through the Philippine landmasses every year based on 1948-2016 data. The location of the project is situated on a path where, at least, one (1) tropical cyclone annually frequents.

754. Relative to this, there is an increasing trend in the annual total cost of damage due to the occurrence of tropical cyclones based on 1970-2012 data. The damage cost during this period amounted to PhP 337.67 Billion in 43 years according to the Office of Civil Defence (OCD). The last five (5) years (2008-2012) of the OCD data indicated an exponential trend, which has taken a considerable toll in the economic outlook of the country.

755. These trends and scenarios, which are further discussed below, indicate that the country will not be spared by the impacts of climate change given its geographical location, archipelagic formation, biophysical characteristics and population distribution. Additionally, even if GHG emissions are drastically reduced, the magnitude of their presence in the atmosphere is irreversible. Stabilizing these GHGs will take time and climate change impacts will continue for the years to come.

756. In the urgency for local climate action, the Climate Change Act (Republic Act 9729) was passed in 2009, which creates the Climate Change Commission (CCC), mainstreaming climate change into government policy formulations and establishes framework strategies and actions towards adaptation and mitigation. In 2010, the National Framework Strategy on Climate Change (NFSCC) was adopted to serve as reference point to steer national mitigation and adaptation strategies. In line with the NFSCC, the Philippine Strategy on Climate Change Adaptation (PSCCA) was prepared to guide the country's climate change adaptation actions. In 2011, the National Climate Change Action Plan (NCCAP) was prepared which outlines the priority areas for adaptation and mitigation. In 2012, the People's Survival Fund (RA 10174) was passed for financing adaptation programs and projects based on the NFSCC. Other key policies on climate change are presented in Chapter 2, 2.7.3.

(2) Change in Local Climate

1) Rainfall

757. The climate change scenario for the Philippines as published by PAGASA in February 2011 indicates that the provinces of Bulacan, Pampanga and Tarlac will have periods of increased and decreased rainfall in 2020 and 2050 (**Table 3.3.6**)

758. In Bulacan, it is projected that the average monthly rainfall for the period of 2006-2035 will increase by a range of 4.2% to 12.8% and will decrease by 2.9% 23.0%, while the rainfall for the period of 2036-2065 will increase by 23.6% and will decrease by 3.3% to 36.4%. In Pampanga, it is projected that the average monthly rainfall for the period of 2006-2035 will increase by 4.4% to 16.3% and will decrease by 5.1% to 18.8%, while the rainfall for the period of 2036-2065 will increase by 13.9% and will decrease by 7.2% to 26.4%. In Tarlac, it is projected that the average monthly rainfall for the period of 2006-2035 will increase by 26.0% and will decrease by 1.6% to 13.7%, while the rainfall for the period of 2036-2065 will increase by 8.8% and will decrease by 5.5% to 18.2%.

Table 3.3.6 Seasonal Rainfall Change (in %) 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
Bulacan	212.4	288.9	1041.4	842.1	4.2	-23.0	12.8	-2.9	-13.2	-36.4	23.6	-3.3
Pampanga	120.8	320.6	1030.4	785.2	16.3	-18.8	4.4	-5.1	-15.4	-26.4	13.9	-7.2
Tarlac	43.4	265.4	1193.5	644.3	26.0	-13.7	-1.6	-9.6	-6.7	-18.2	8.8	-5.5

Source: Climate Change in the Philippines, 2011 PAGASA

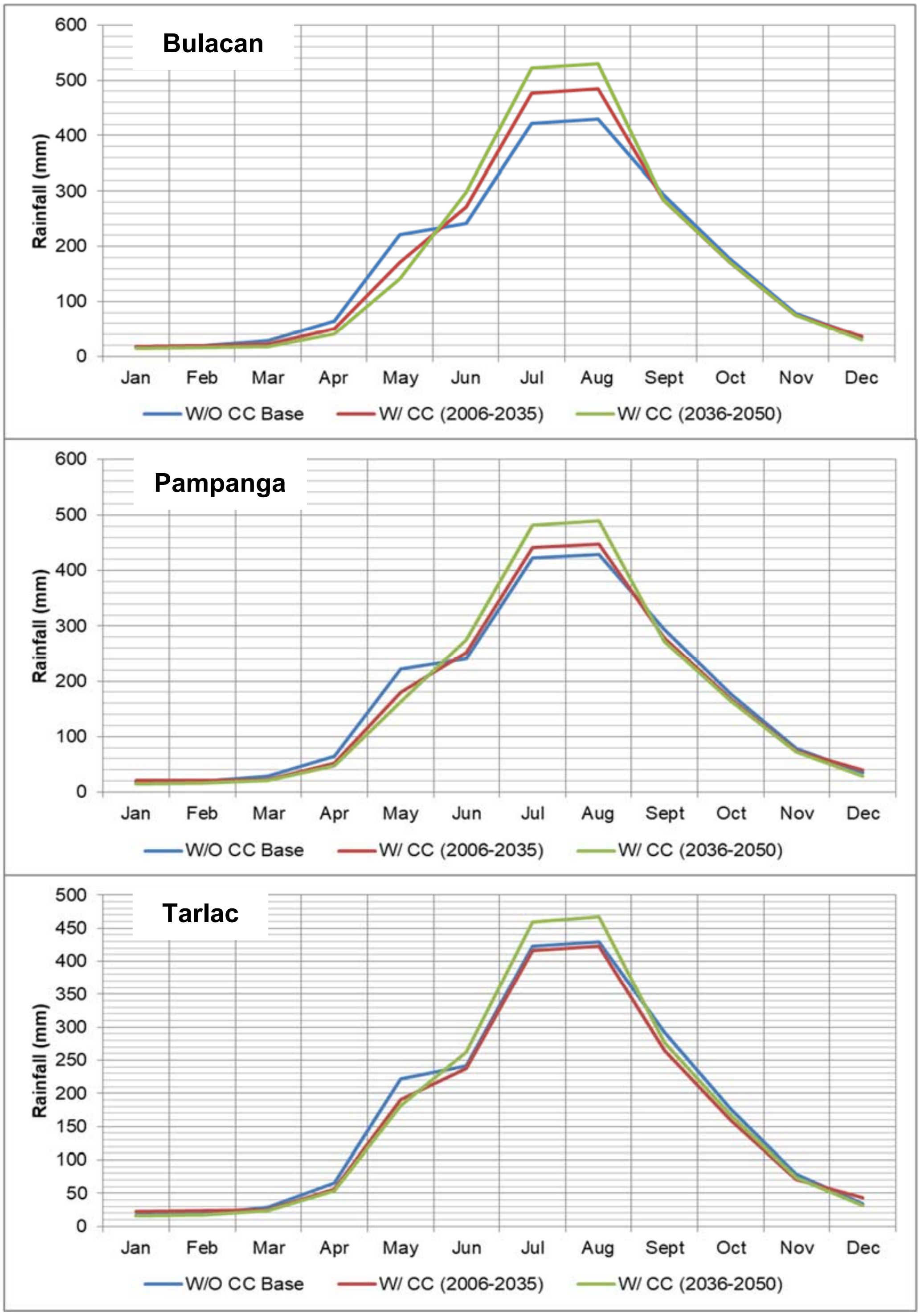
759. **Table 3.3.7** and **Figure 3.3.5** present the projected the monthly average rainfall with climate change scenario for 2006-2035 and the monthly average rainfall with climate change scenario for 2036-2065 in Bulacan, Pampanga and Tarlac.

Table 3.3.7. Projected Monthly Average Rainfall

	Projected Monthly Average Rainfall (mm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Baseline/Without Climate Change Scenario (1981-2010)												
Ave	17.4	18.6	28.4	65	221.8	241.2	422.6	429.4	293.1	177	78	34.2
Bulacan												
With Climate Change Scenario (2006-2035)												
Ave	18.13	19.38	21.69	50.05	170.79	272.07	476.69	484.36	284.6	171.87	75.74	35.64
With Climate Change Scenario (2036-2065)												
Ave	15.10	16.14	18.06	41.34	141.06	298.12	522.33	530.74	283.43	171.16	75.43	29.69
Pampanga												
With Climate Change Scenario (2006-2035)												
Ave	20.24	21.63	23.06	52.78	180.10	251.81	441.19	448.29	278.15	167.97	74.02	39.77
With Climate Change Scenario (2036-2065)												
Ave	14.72	15.74	20.90	47.84	163.24	274.73	481.34	489.09	272.00	164.26	72.38	28.93
Tarlac												
With Climate Change Scenario (2006-2035)												
Ave	21.92	23.35	24.51	56.10	191.41	237.34	415.84	422.53	264.96	160.01	70.51	43.09
With Climate Change Scenario (2036-2065)												
Ave	16.23	17.35	23.23	53.17	181.43	262.43	459.79	467.20	276.98	167.27	73.71	31.91

Note: Calculated based on the PAGASA Climate Change in the Philippines, 2011

Source: PAGASA



Source: Climate Change in the Philippines, 2011 PAGASA

Figure 3.3.5. Projected Seasonal Mean Rainfall in 2020 and 2050 in Bulacan, Pampanga, and Tarlac

2) Temperature

760. The climate change scenario for the Philippines as published by PAGASA in February 2011 indicates that the provinces of Bulacan, Pampanga and Tarlac will have an increased temperature (**Table 3.3.8**). In Bulacan and Pampanga, it is projected that the average monthly temperature will increase by 0.9°C to 1.1°C for the period of 2006-2035, while the temperatures for the period of 2036-2065 will increase by 1.7 °C to 2.1 °C and 1.8 °C to 2.2 °C, respectively. In

Tarlac, it is projected that the average monthly temperature will increase by 1.0 °C to 1.1 °C for the period of 2006-2035, while the temperatures for the period of 2036-2065 will increase by 1.9 °C to 2.2 °C.

761. The annual average temperature covering the period of 2006-2035 will rise to 29.7 °C. However, it will rise to 30.7 °C in Bulacan and 30.8°C in Pampanga and Tarlac for the period of 2036-2065. **Table 3.3.8**, **Figure 3.3.6** and **Figure 3.3.7** present the projected monthly average temperature with climate change (**T_{ave} CC**) and without climate change (**T_{ave} base**).

Table 3.3.8 Seasonal Temperature Increase (in ºC) in 2020 and 2050 under Medium Range Emission Scenario

Province	Observed Baseline (1971-2000)				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Bulacan	25.6	27.9	27.1	26.7	0.9	1.1	0.9	1.0	1.9	2.1	1.7	1.9
Pampanga	26.0	28.3	27.5	27.1	1.0	1.1	0.9	1.0	2.1	2.2	1.8	2.0
Tarlac	26.1	28.3	27.8	27.3	1.1	1.1	1.0	1.1	2.2	2.2	1.9	2.1

Source: Climate Change in the Philippines, 2011 PAGASA

Table 3.3.9 Projected Monthly Average Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Baseline/Without Climate Change Scenario (1997-2010)												
Max	30.1	31	32.6	34	32.7	31.5	30.6	30.1	30.5	31.1	31	30.2
Min	20.5	20.7	21.8	23.2	23.9	23.6	23.5	23.5	23.2	23	22.4	21.3
Ave	25.3	25.9	27.2	28.6	28.3	27.6	27	26.8	26.9	27	26.7	25.8
With Climate Change Scenario (2006-2035)												
Bulacan												
Max	31	31.9	33.7	35.1	33.8	32.4	31.5	31	31.5	32.1	32	31.1
Min	21.4	21.6	22.9	24.3	25	24.5	24.4	24.4	24.2	24	23.4	22.2
Ave	26.2	26.8	28.3	29.7	29.4	28.5	27.9	27.7	27.8	27.9	27.6	26.7
Pampanga												
Max	31.1	32	33.7	35.1	33.8	32.4	31.5	31	31.5	32.1	32	31.2
Min	21.5	21.7	22.9	24.3	25	24.5	24.4	24.4	24.2	24	23.4	22.3
Ave	26.3	26.9	28.3	29.7	29.4	28.5	27.9	27.7	27.8	27.9	27.6	26.8
Tarlac												
Max	31.2	32.1	33.7	35.1	33.8	32.5	31.6	31.1	31.6	32.2	32.1	31.3
Min	21.6	21.8	22.9	24.3	25	24.6	24.5	24.5	24.3	24.1	23.5	22.4
Ave	26.4	27	28.3	29.7	29.4	28.6	28	27.8	28	28.1	27.8	26.9
With Climate Change Scenario (2006-2065)												
Bulacan												
Max	32	32.9	34.7	36.1	34.8	33.2	32.3	31.8	32.4	33	32.9	32.1
Min	22.4	22.6	23.9	25.3	26	25.3	25.2	25.2	25.1	24.9	24.3	23.2
Ave	27.2	27.8	29.3	30.7	30.4	29.3	28.7	28.5	28.8	28.9	28.6	27.7
Pampanga												
Max	32.2	33	34.8	36.2	34.9	33.3	32.4	31.9	32.5	33.1	33	32.3
Min	22.6	22.8	24	25.4	26.1	25.4	25.3	25.3	25.2	25	24.4	23.4
Ave	27.4	28	29.4	30.8	30.5	29.4	28.8	28.6	28.9	29	28.7	27.9
Tarlac												
Max	32.3	33.2	34.8	36.2	34.9	33.4	32.5	32	32.6	33.2	33.1	32.4
Min	22.7	22.9	24	25.4	26.1	25.5	25.4	25.4	25.3	25.1	24.5	23.5
Ave	27.5	28.1	29.4	30.8	30.5	29.5	28.9	28.7	29	29.1	28.8	28

Note: Calculated based on the PAGASA Climate Change in the Philippines, 2011

Source: PAGASA

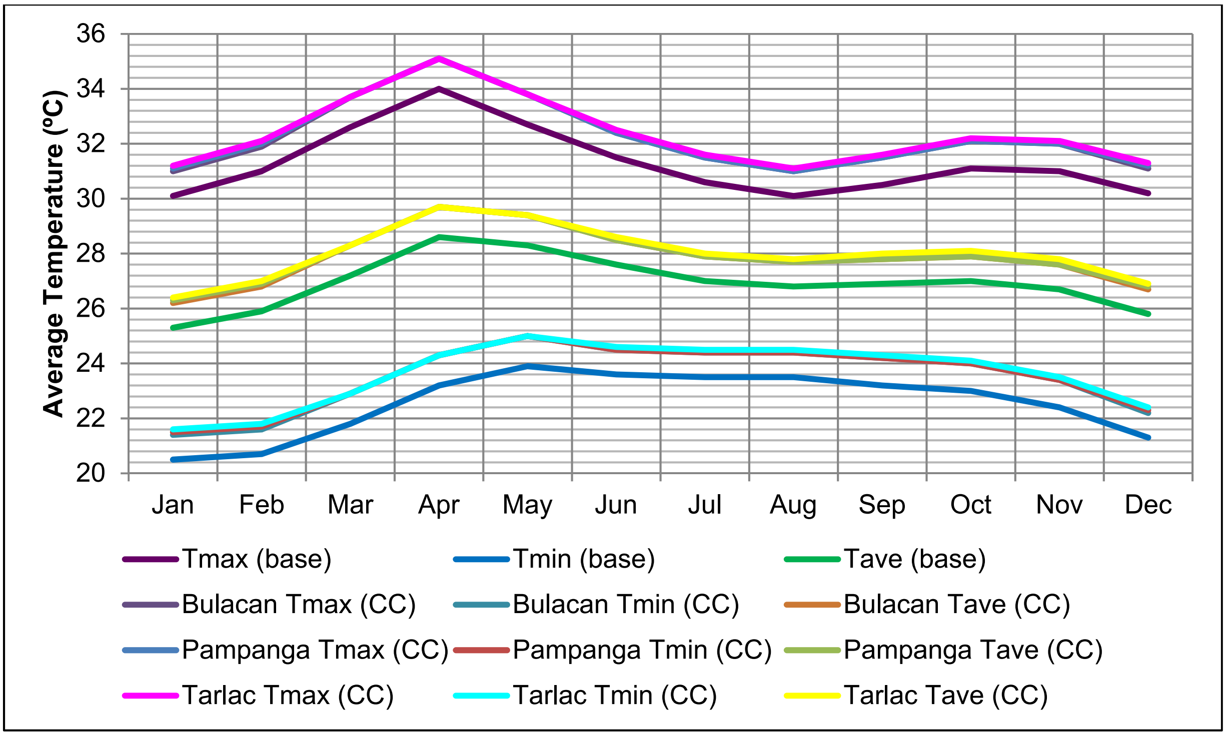


Figure 3.3.6 Change in Monthly Average Temperature for the Period of 2006-2035

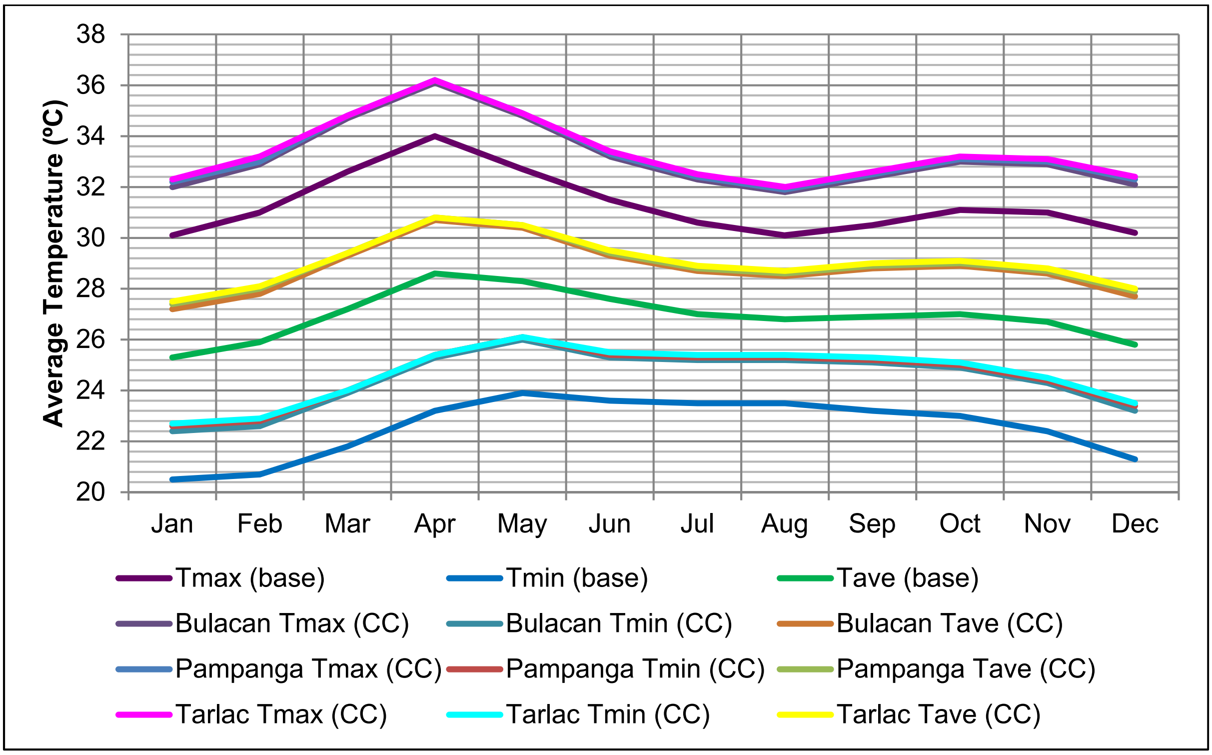


Figure 3.3.7 Change in Monthly Average Temperature for the Period of 2036-2065

3) Frequency of Extreme Events

762. Based from the climate change scenario for the Philippines as published by PAGASA in February 2011, the province of Bulacan will have 1,984 days with maximum temperature of >35 °C during the 2006-2035 period and 3,126 days during the 2036-2050 period; 6,302 dry days

during the 2006-2035 period and 6,220 dry days during the 2036-2050 period; and 13 days with rainfall >200 mm during the 2006-2035 period and 17 days during the 2036-2050 period (**Table 3.3.10**).

763. Moreover, the province of Pampanga and Tarlac will have 1,855 days with maximum temperature of >35°C during the 2006-2035 period and 3,108 days during the 2036-2050 period; 5,701 dry days during the 2006-2035 period and 5,754 dry days during the 2036-2050 period; and 12 days with rainfall >200 mm during the 2006-2035 period and 12 days during the 2036-2050 period.

Table 3.3.10 Frequency of Extreme Events in 2020 and 2050 under Medium Range Emission Scenario

Province	No. of Days w/ T_{max} >35ºC			No. of Dry Days			No. of Days w/ Rainfall >200mm		
	OBS (1971-2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
Bulacan*	1095	1984	3126	7476	6302	6220	9	13	17
Pampanga	355	1855	3108	889	5701	5754	8	12	12
Tarlac**	355	1855	3108	889	5701	5754	8	12	12

Note: * Based from the Frequency of Extreme Events in 2020 and 2050 under Medium Range Emission Scenario in Manila, a nearby province of Bulacan
** Based from the Frequency of Extreme Events in 2020 and 2050 under Medium Range Emission Scenario in Pampanga, a nearby province of Tarlac

Source: Climate Change in the Philippines, 2011 PAGASA

3.3.1.4 Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction

1) Change in Local Climate

764. During construction, variations in microclimate will affect the schedule of construction works, potentially delaying the progress of construction.

765. The changes in the rainfall pattern and significant local temperature changes will be included in the design criteria of the Project. Material selection and technologies to be used in the project will take into consideration the effects of microclimate variations and the effects of extreme temperature changes to operating conditions of Project components. Passenger facilities will incorporate renewable energy, energy efficient technologies and maximise the natural environment as much as possible.

766. Exposure to extreme local microclimate conditions may have negative effects to the worker's health and compromise their safety and productivity. Microclimate variations will have to be integrated to designing work policies, proper work clothing, equipment safety features, etc. to minimize health effects and work hazards for the workers.

2) Contribution in Terms of Greenhouse Gas Emissions

767. As discussed in Section 3.3.1.2 (2), assuming the project construction activities will deploy 50-unit 30-tonner trucks, 20-unit heavy equipment, 30-unit service pick-up, and 20-unit service vans. During pre-construction and construction phase, the estimated total CO2 emission will be 831.60 MT/year.

768. The Philippines SNC on Climate Change has projected 100,402,000 MT of CO2 for 2020. Using the projection of SNC, the construction of the project is expected to contribute an approximately 0.00083% of the total CO_2 emission which represents a small portion of the total CO_2 load of the country.

769. However, in order to minimize unnecessary CO_2 generation from construction activities, the following measures will be implemented:

- Minimize vegetation removal and alteration of topography if possible;
- Implement regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard; and
- Use of electric or fuel-efficient equipment, machineries and vehicles and maximize its operation if possible.

3) Impact of Climate Change to Project

770. The MCRP is generally at high risk to the effects of climate change based on the AWARE climate risk screening report (ADB, 2018) for the project. It determined the level of climate risk of the proposed project to flooding, landslide, typhoons, precipitation increase, temperature increase, and precipitation decrease. Among the climate risk topics analysed, precipitation increase registered at medium level while temperature increase and precipitation decrease registered at low level. The rest, including flooding, landslide and typhoons, are identified to cause high risk to the proposed project.

High Risk

771. The level of climate risk for the project due to flooding, landslides, and typhoons is high. Among the geographical factors considered are proximity to waterbodies, topography, land use characteristics (including land use in upstream catchment areas), design, and maintenance level of drainage infrastructure, and vulnerability of exposed assets. Flooding may cause overflow of drainage systems and restrictions/disruption during construction phase. Relative to flooding, many cities/ municipalities are prone to liquefaction. In terms of increase in frequency and severity of typhoons, the potential impacts are restrictions/ disruption of railway construction.

Medium Risk

772. The level of climate risk for the project due to increase in precipitation is moderate. The design of certain project components may have to be slightly modified to cope with its potential impacts. Intense rainfall would potentially cause damage to embankment and earthwork due to soil erosion, landslides, and flooding. Extended rain periods would potentially cause slower drainage, soil erosion of infrastructure assets as well as disruption in construction. During pre-construction phase, design consideration will be based on the results of the geohazard assessment and geotechnical investigation to prevent or minimize slope failure.

Low Risk

773. The level of climate risk for the project due to increase in temperature, resulting to longer periods of warm temperature/drought as well as warm days and nights, is low. It is further characterized by high temperature and heat waves, sudden temperature changes and intense sunlight. High temperature and heat waves would potentially cause overheating of construction equipment and service vehicles and cause heat stress to workers. In order to mitigate this, construction activities will be adjusted as needed.

774. In consideration to the above climate risk, train system will be designed robust to climate change and related extreme events including drainage, passenger facilities and structures (viaduct, embankment, and tunnels) based on the hydrological and geodetic study. Additional measures include: installation of bridge within the rivers will be minimized; design train facilities above the flood level; and provision of drainage pumping systems to drain runoff water (rainwater, etc.) and divert to the sewer if required. It is also essential to prepare an Emergency Response Plan in cased of potential extreme events.

(2) Operation Phase

1) Change in Local Climate

775. As previously discussed, the changes in the rainfall pattern and local temperature will be included in the design criteria of the Project based on PAGASA projection for 2020 and 2050.

776. Design improvement of the internal drainage system will be considered to accommodate storm water run-off that will be collected in the rail track system based on the PAGASA projection. Thermal threats are due to the susceptibility of tracks to damage during periods of elevated temperatures that exceed the operating conditions. When this temperature is exceeded, the ability of the steel rails to support rail traffic begins to degrade. At extreme heat conditions, the continuously welded rail tracks that make up the modern rail system will buckle due to expanding metal. The variability in daily temperatures together with the longer-term monthly averages defines the design air temperature. The selection of the design temperature reflects an optimization, operational and capital costs based on historical conditions.

777. Regular inspection of railway structures and facilities will be conducted and perform necessary maintenance when needed. Improvement of internal drainage system will also be considered to accommodate water run-off as needed and improvement of railway system considering possible temperature rise as necessary.

2) Contribution in Terms of Greenhouse Gas Emissions

778. Global passenger and freight activity is increasing as economies grow. In the Philippines, majority of existing transport systems are conventional buses, passenger cars, taxies, and jeepneys that heavily rely on petroleum. It supplies 95% of the total energy used by world transport. In 2010, the transport sector accounted for 27% of final energy use and 6.7 Gt CO_2 direct emissions based on IPCC's Fifth Assessment Report (AR5). With the increasing need for transport activities, baseline CO_2 emissions are projected to approximately double by 2050 if not mitigated.

779. Relative to this, the project itself is a climate mitigation measure as it intends to reduce GHG emissions by realizing a "modal shift" from conventional commuter transport systems to passenger railway systems. In addition, "electrification" of passenger railway systems will reduce GHG emissions. In comparison with other transport modes, collective modes of transport, such as the project, use less energy and generate less GHGs. Furthermore, mass transit systems provide more capacity at less marginal cost. The reduced CO_2 emissions represent only one of benefit of the improved mass transit system. Majority of the benefits for the populace and the economy are due to substantially improved accessibility.

780. To maintain and/or further reduce its minimal contribution, necessary measures during operation will be enforced including tree planting, energy/water conservation program implementation as well as the following:

- Provision of incentives and information dissemination activities to encourage commuters to use rail transit and its benefits over other modes of transport (Modal Shift)
- Planting of vegetation as much as possible to open areas at the depot, around the stations and along the railway track
- Energy/water conservation program such as use energy efficient products (i.e. LED lights) and monitor carbon footprint monitoring
- Regular inspection and proper maintenance of railway systems and facilities, and equipment and machinery

3) Impact of Climate Change to Project

781. As described in the pre construction and construction phase, precipitation increase registered at medium level while temperature increase and precipitation decrease registered at low level, and flooding, landslide and typhoons, are identified to cause high risk to the proposed project.

782. Flooding, landslides and typhoons will cause damage to catenary as well as restrictions/ disruption of railway operation. Increase in precipitation would potentially cause damage to embankment due to landslides and flooding. Extended rain periods would potentially cause slower drainage and disruption in operations. Increase in temperature and heat would potentially cause overheating of infrastructure and rolling stock equipment; while, sudden temperature changes and intense sunlight would cause tension/overheating of track buckling and signaling problems. Decrease in precipitation is characterized by droughts, which has potential impact to earthworks desiccation.

783. Mitigation measures and enhancement to address the impact of the project to climate change and vice versa are as follows;

- Regular inspection and preventive maintenance of railway structures and facilities to ensure optimum working condition;
- When necessary, install improvement of railway system to make it more resilient to temperature and rainfall increase;
- Planting of vegetation as much as possible in open areas at the depot, around the stations and along the railway track;
- Establish and implement an Emergency Response Plan.

3.3.2 Air Quality

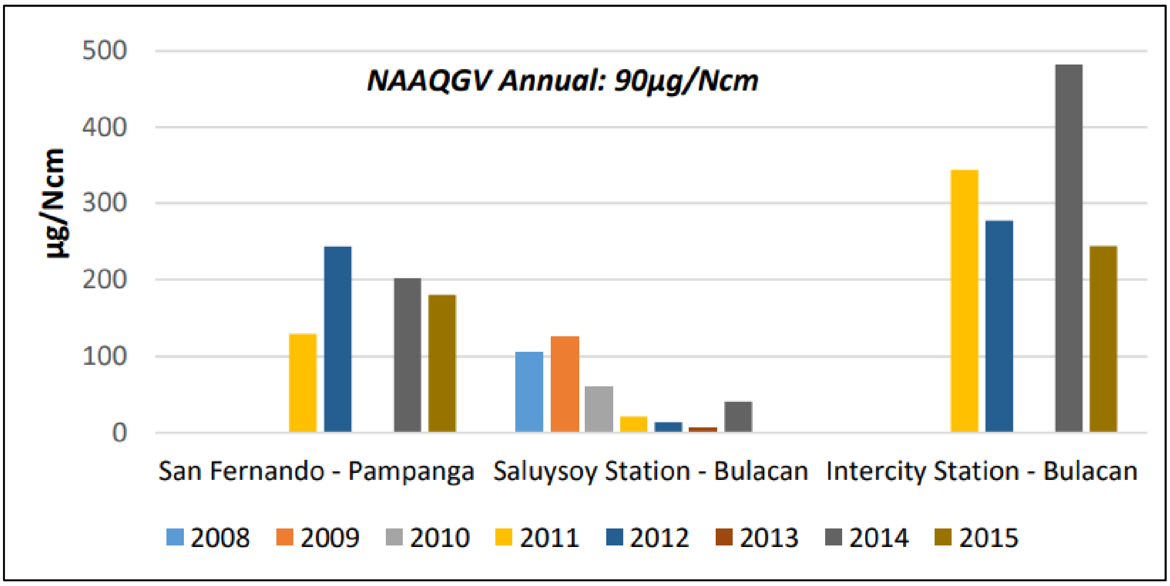
3.3.2.1 Ambient Air Quality

784. Ambient Air Quality is defined by RA 8749 as the general amount of pollution present in a broad area and refers to the atmosphere's average purity as distinguished from discharge measurements taken at the source of pollution. In order to monitor the ambient air quality of the country, EMB regional monitoring stations routinely take measurements of criteria air pollutants, namely: Total Suspended Particulates (TSP), Particulate Matter less than 10 microns (PM_{10}), ($PM_{2.5}$), Lead (Pb), Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Ozone (O_3) and Carbon Monoxide (CO).

785. The National Air Quality Status Report for 2008-2015 of EMB mentioned that TSP have been the subject of monitoring for the longest period among criteria pollutants. **Figure 3.3.8** presents the annual TSP trends at Region 3 for the period 2008-2015. It must also be noted that a number of sites in some regions did not have data or had incomplete data during certain years. This is because there are no data from monitoring stations that are undergoing repair and those that did not meet the 75% percent minimum data capture requirement.

786. Figure 3.3.8 shows that the TSP levels in Region 3 were monitored in 3 stations: 1) San Fernando in Pampanga, 2) Saluysoy in Bulacan and 3) Intercity in Bulacan. In San Fernando and Intercity, TSP levels since 2011 to 2015 were way above the long-term NAAQGV while lower values were observed in Saluysoy for the same period. In San Fernando, the high TSP levels can be attributed to road dust and motor vehicle emissions alongside the growing development of the area. Although the Saluysoy station is exposed to open burning of solid waste, vehicular emissions and surrounded by several legal and illegal smelting plants, TSP levels were lower due to the close coordination of the LGU and EMB regional office to monitor all existing gold smelting plants in

the area. As for Intercity, it is located in an industrial area composed of around 90 units/sets of multi-pass rice milling machines owned by about 60 operators.



Source: https://emb.gov.ph/wp-content/uploads/2015/09/1-Air-Quality-1.8-National-Air-Quality-Status-Report-2008-2015.pdf (Date retrieved April 10, 2018)

Figure 3.3.8 TSP Annual Mean Values in Region 3, 2008-2015

(1) Field Survey

787. The ambient air quality sampling for the proposed MCRP was conducted on January 27 to February 7, 2018 to measure the concentrations of TSP, PM10, $PM_{2.5}$, SO_2, NO_2, CO, O_3 and Pb at nine (9) sampling stations established along the proposed alignment, as presented in **Table 3.3.11** and **Figure 3.3.9**. The monitoring was conducted in accordance to the standard methods of the DENR as prescribed in its DAO No. 2000-81, the Implementing Rules and Regulations (IRR) of the Philippine Clean Act of 1999 and the Presidential Decree No. 984 (National Pollution Control Decree of 1976), as amended by NPCC MC No. 1980-002.

788. The collected samples were brought to Mach Union Laboratory, Inc., a DENR recognized laboratory in Las Piñas City and to EMB Central Office Laboratory for analysis.

789. Temperature, wind direction and other relevant parameters, which describe the weather condition in the area, were also recorded at each station during sampling.

Table 3.3.11. Date and Time of Air Quality Sampling Per Station

Sampling Station		Description	Coordinates	Sampling Date/Time	
				24-Hour	1-Hour
AAQ1	Malolos Station	Residential area approx. 90m northeast of La Consolacion University – Catmon Campus, approx. 35 m south of old PNR Malolos Station	14°51'13.15" N; 120°48'50.91" E	Jan 27-28, 2018 1445H-1445H	Jan 29, 2018 0945H-1045H
AAQ2	Calumpit Station	Within Bonifacio Park, approx. 50m west of St. John the Baptist Church, approx. 90m west of St. John the Baptist Catholic School	14°54'57.72" N; 120°46'05.10" E	Jan 28-29, 2018 2107H-2107H	Jan 29, 2018 1212H-1312H
AAQ3	Apalit Station	Residential area abut 25 m northeast of Brgy. San Vicente Brgy. Hall, approx. 100m east of Sampaga Integrated School	14°56'46.86"N, 120°44'52.44"E	Jan 30-31, 2018 1052H-1052H	Jan 31, 2018 0950H-1050H
AAQ4	San Fernando Station	Brgy. Santo Niño residential area approx. 8 m southwest of PNR San Fernando Station, approx. 45 m northeast of governor's residence	15°01'36.00"N, 120°41'12.00"E	Jan 31-Feb 1, 2018 1217H-1217H	Jan 31, 2018 1220H-1320H
AAQ5	Angeles Station	Brgy. Pulungbulu residential area, approx. 100m south of La Pieta chapel and	15° 8'9.00"N, 120°35'51.00"E	Feb 1-Feb 2, 2018 1604H-1604H	Feb. 2, 2018 0930H-1030H

Sampling Station		Description	Coordinates	Sampling Date/Time	
				24-Hour	1-Hour
		crematorium			
AAQ6	Mabalacat/ Clark Station	Brgy Lakandula residential area	15°10'26.00"N, 120°34'57.00"E	Feb. 3- 4, 2018 0013-0013H H	Feb. 2, 2018 1133H-1233H
AAQ7	Depot Site	Approx. 250m northwest of Catudtud Elementary School, 10m south of Brgy. Dolores Barangay Hall and 30m southwest of covered gym	15°14'18.12"N, 120°34'5.95"E	Feb.4-5, 2018 0714H-0714H	Feb. 5, 2018 1104H-1204H
AAQ8	Brgy. San Roque, Bamban	Basketball court at Dapdap resettlement site, approx. 10m south of Barangay Hall and Barangay Day Care center	15°16'32.13"N, 120°31'3.48"E	Feb. 5-6, 2018 0904H-0904H	Feb. 5, 2018 0936H-1036H
AAQ9	NCC Station	Rural residential area approx. 200 m from the planned PNR NCC Station at Brgy. Aranguren, Tarlac	15°20'56.42" N; 120°31'39.42" E	Feb. 6-7, 2018 1248H-1248H	Feb. 7, 2018 1132H-1232H

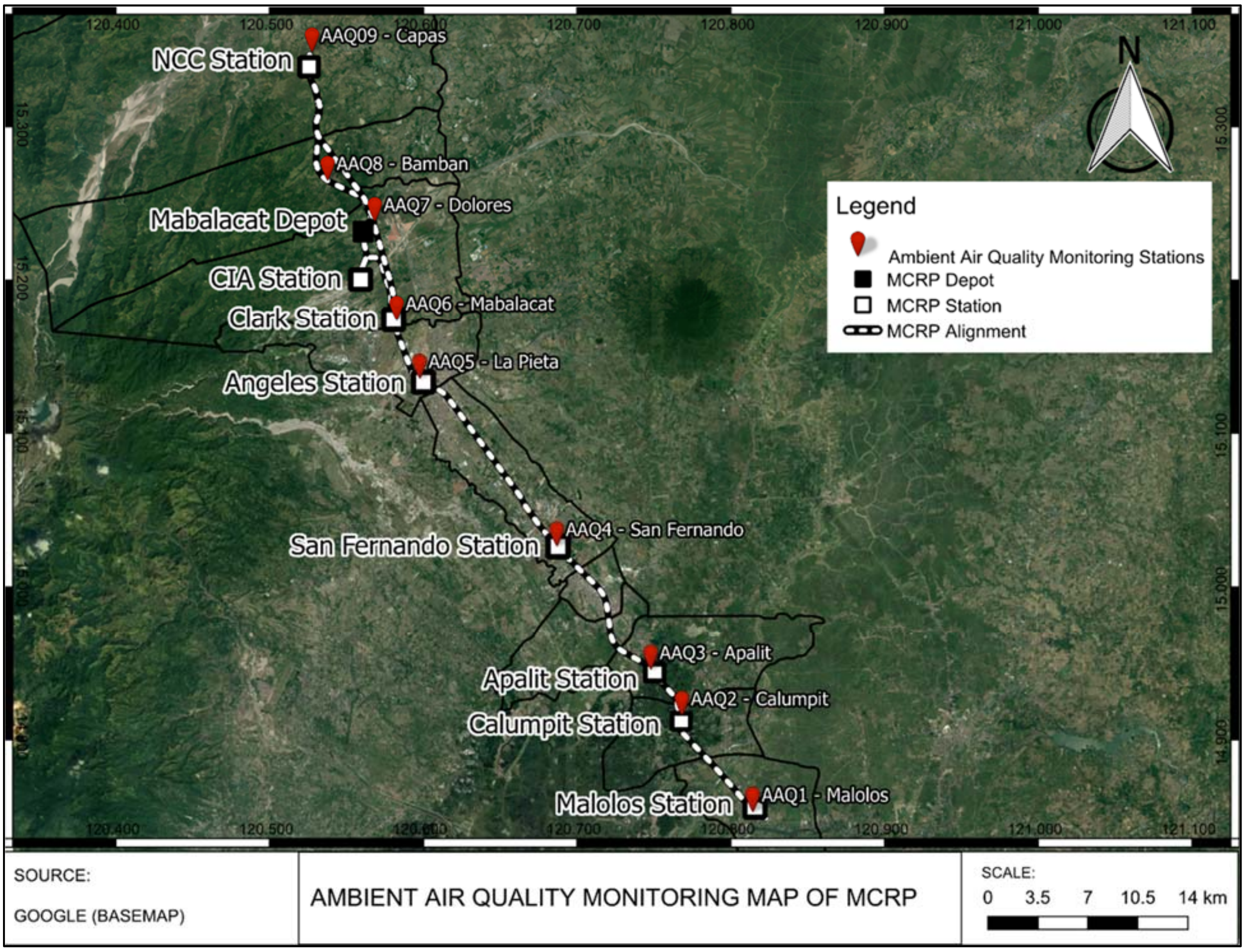


Figure 3.3.9. Map of the Ambient Air Quality Sampling Stations

(2) Criteria for Assessment of Ambient Air Quality

790. The results of ambient air quality monitoring for MCRP were compared to the standard levels of the DENR set forth in the Philippine Clean Air Act of 1999, DENR Administrative Order No. 2013-13 and the International Finance Corporation (IFC) Standards (PM2.5 Guideline Value) which adopted the relevant standards and guidelines of the World Bank (WB) and the World Health Organization (WHO) as presented in **Table 3.3.12.** It must be noted that for lead, the DENR and WHO have no relevant standard for 24-hour averaging time. Likewise, for Nitrogen dioxide and ozone, the IFC standards are for 1-hour and 8-hour means, respectively. WHO has

replaced TSP in favour of PM10 and PM2.5 for determining the exposure-response relationship of particulate matter and health effects.

Table 3.3.12. Relevant Guideline Values for Ambient Air Quality

Parameter	Averaging Time	DENR Standards (µg/Ncm) (1)	WHO Ambient Air Quality Guidelines (2)
TSP	24 Hours	230	-
PM10	24 Hours	150	50 µg/ m3
PM2.5	24 Hours	50 (3)	25 µg/ m3
Lead (Pb)	24 Hours	1.5 µg/NCM (3 mos.) 1.0 µg/NCM (annual)	0.5 µg/m3 (annual)(4)
Sulphur dioxide (SO2)	24 Hours	180	20 µg/ m3
Nitrogen dioxide (NO2)	24 Hours	150	200 µg/m3 (1-hour mean)
Ozone (O3)	1 Hour	140	100 µg/ m3 (8-hour mean)
Carbon monoxide (CO)	1 Hour	35,000	30 mg/m3 (4)

Sources: (1) National Ambient Air Quality Guideline for Criteria Pollutants of the Philippine Clean Air Act of 1999
(2) IFC General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality, Table 1.1.1: WHO Ambient Air Quality Guidelines, April 30, 2007
(3) DENR Administrative Order No. 2013-13
(4) WHO air quality guidelines for Europe (2000)

(3) Results and Analysis

791. The results of ambient air quality monitoring showed that the concentrations of TSP, PM10, PM2.5, SO2, NO2, CO, and Pb in all sampling stations are way below the DENR Standards. Concentrations of PM10 in Stations AAQ4, AAQ5 and AAQ7 exceeded the WHO AAQ Guideline Value of 50 µg/NCM. Likewise, concentration of PM2.5 in Station AAQ4 exceeded the WHO AAQ Guideline Value of 25 µg/NCM, while concentrations of SO2 in Stations AAQ2 and AAQ3 exceeded the WHO AAQ Guideline Value of 20 µg/NCM. The results of monitoring are briefly described below, and summarized in **Table 3.3.13**.

1) Results by Sampling Stations

Station AAQ1 (Malolos)

792. During testing, the prevailing winds were coming from the northeast direction, with average wind speed at 2.90 m/s. The average temperature was 24.8 °C, while the barometric pressure was 29.85 inHg and relative humidity at 83%.

793. As shown, the concentration levels of TSP, PM10, PM2.5, SO2, NO2 and CO at station AAQ1 (Malolos Station) were below the DENR Standards and WHO AAQ Guideline Values. Pb and O3 were not detected at this station.

Station AAQ2 (Calumpit)

794. During testing, the prevailing winds were coming from the north direction, with average wind speed at 2.41 m/s. The average temperature was 27.3 °C, while the barometric pressure was 29.85 inHg and relative humidity at 70%.

795. The concentration levels of TSP, PM10, PM2.5, SO2, NO2 and CO in station AAQ2 (Calumpit Station) were below the DENR Standards. SO2 exceeded the WHO AAQ Guideline Value while Pb and O3 were not detected at this station.

Station AAQ3 (Apalit)

796. During testing, the prevailing winds were coming from the north-northwest and east-northeast directions, with average wind speed at 2.52 m/s. The average temperature was 27 °C, while the barometric pressure was 29.86 inHg and relative humidity at 70%.

797. The concentration levels of TSP, PM_{10}, $PM_{2.5}$, SO_2, and NO_2 in station AAQ3 (Apalit Station) were below the DENR Standards. SO_2 exceeded the WHO AAQ Guideline Value while Pb, CO and O_3 were not detected at this station.

Station AAQ4 (San Fernando)

798. During testing, the prevailing winds were coming from the north direction, with average wind speed at 2.20 m/s. The average temperature was 27 °C, while the barometric pressure was 29.89 inHg and relative humidity at 76%.

799. The concentration levels of TSP, PM_{10}, $PM_{2.5}$ and NO_2 in station AAQ4 (San Fernando Station) were below the DENR Standards. PM_{10} and $PM_{2.5}$ exceeded the WHO AAQ Guideline Values while SO_2, Pb, CO and O_3 were not detected at this station.

Station AAQ5 (Angeles)

800. During testing, the prevailing winds were coming from the north direction, with average wind speed at 2.66 m/s. The average temperature was 26.7 °C, while the barometric pressure was 29.91 inHg and relative humidity at 71%.

801. The concentration levels of TSP, PM_{10}, $PM_{2.5}$, NO_2 and Pb in station AAQ5 (Angeles Station) were below the DENR Standards. PM_{10} exceeded the WHO AAQ Guideline Values while SO_2, CO and O_3 were not detected at this station.

Station AAQ6 (Mabalacat)

802. During testing, the prevailing winds were coming from the northwest direction, with average wind speed at 1.81 m/s. The average temperature was 26 °C, while the barometric pressure was 29.94 inHg and relative humidity at 66%.

803. The concentration levels of TSP, PM_{10}, $PM_{2.5}$, NO_2 and Pb in station AAQ6 (Mabalacat Station) were below the DENR Standards and WHO AAQ Guideline Values while SO_2, CO and O_3 were not detected at this station.

Station AAQ7 (Depot Site)

804. During testing, the prevailing winds were coming from the north direction, with average wind speed at 2.57 m/s. The average temperature was 25.5 °C, while the barometric pressure was 29.92 inHg and relative humidity at 72%.

805. The concentration levels of TSP, PM_{10}, $PM_{2.5}$, NO_2, Pb and CO in station AAQ7 (Dolores Station) were below the DENR Standards. PM_{10} exceeded the WHO AAQ Guideline Values while SO_2 and O_3 were not detected at this station.

Station AAQ8 (Bamban)

806. During testing, the prevailing winds were coming from the north-northwest direction, with average wind speed at 4.97 m/s. The average temperature was 24.3 °C, while the barometric pressure was 29.93 inHg and relative humidity at 72%.

807. The concentration levels of TSP, PM_{10}, $PM_{2.5}$ and NO_2 in station AAQ8 (Bamban Station) were below the DENR Standards and WHO Guideline Values. SO_2, Pb, CO and O_3 were not detected at this station.

Station AAQ9 (NCC)

808. During testing, the prevailing winds were coming from the east-northeast and northwest directions, with average wind speed at 0.77 m/s. The average temperature was 25.2 °C, while the barometric pressure was 29.89 inHg and relative humidity at 65%.

809. The concentration levels of TSP, PM_{10}, $PM_{2.5}$ and NO_2 in AAQ9 (NCC Station) were below the DENR Standards and WHO Guideline Values. SO_2, Pb, CO and O_3 were not detected at this station.

Table 3.3.13. Ambient Air Sampling Results

Para-meter	Unit	Sampling Stations									Standards	
		AAQ1-Malolos Station	AAQ2-Calumpit Station	AAQ3-Apalit Station	AAQ4-San Fernando Station	AAQ5-Angeles Station	AAQ6-Mabalacat Station	AAQ7-Dolores Station	AAQ8-Bamban Station	AAQ9 - NCC Station	DENR Standard	WHO AAQ Guide-lines[1]
Date	-	Jan. 27 (1445H) -Jan. 28 (1445H)	Jan. 28 (2107H) - Jan. 29 (2107H)	Jan. 30 (1052H) - Jan. 31 (1052H)	Jan. 31 (1217H) - Feb. 01 (1217H)	Feb. 01 (1604H) - Feb. 02 (1604H)	Feb. 03 (0013H) - Feb. 04 (0013H)	Feb. 04 (0714H) - Feb. 05 (0714H)	Feb. 05 (0904H) - Feb. 06 (0904H)	Feb. 06 (1248H) - Feb. 07 (1248H)		
Prevailing Wind Direction	-	NE	N	NNE/ENE	N	N	NW	N	NNW	ENE/WNW		
Highest Wind Speed	m/s	4.02	3.58	3.58	3.13	4.02	3.13	3.58	6.26	1.79		
Ave. Wind Speed	m/s	2.90	2.41	2.52	2.20	2.66	1.81	2.57	4.97	0.77		
Calm Winds	m/s	0	0	0	0							
Ave. Temp	C	24.8	27.3	27.0	27.0	26.7	26.0	25.5	24.3	25.2		
Ave. Barometric Pressure		29.85	29.85	29.86	29.89	29.91	29.94	29.92	29.93	29.89		
Ave. Relative Humidity	%	83	70	70	76	71	66	72	72	65		
TSP	ug/m3	55.58	54.69	77.15	119.65	181.63	95.93	111.36	18.52	81.85	230	-
PM10	ug/m3	42.21	26.86	48.87	70.51	88.34	45.79	91.49	16.07	44.35	150	50
PM2.5	ug/m3	18.31	15.65	22.05	30.45	22.83	17.81	21.3	11.94	10.62	50	25
SO2,	ug/m3	4.42	130.19	134.93	ND	ND	ND	ND	ND	ND	180	20
NO2	ug/m3	7.55	16.18	14.19	5.08	1.6	3.66	4.25	3.79	5.67	150	-
Pb	ug/m3	ND	ND	ND	ND	0.0004	0.0043	0.0002	ND	ND	-	-
CO	ug/m3	1.14	1.14	ND	ND	ND	ND	10.29	ND	ND	35,000	30,0002
O3	ug/m3	ND	ND	ND	ND	ND	ND	ND	ND	ND	140	-

Note: ND means less than method detection limit (MDL)
Values in red indicates exceedance to WHO Guideline Values

Source: Ambient Air Monitoring, GEOSPHERE Technologies 2018;
1As stated in Guideline Values of IFC General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality, Table 1.1.1: WHO Ambient Air Quality Guidelines, April 30, 2007
2WHO Air Quality Guidelines for Europe (2000)

2) Results by Parameters

810. Results of analysis for each parameter were graphed showing its relative concentration levels at the eight (8) sampling stations. Brief discussions were made comparing the results across the sampling stations and against relevant DENR standards and WHO guideline values.

Total Suspended Particulates (TSP)

811. **Figure 3.3.10** shows the graphical presentation of the concentration levels of TSP in eight (8) sampling stations. As shown, concentration levels of TSP in all stations are within the DENR Standard of 230 ug/m^3. The highest TSP concentration was observed in Station AAQ5 (Angeles Station) at 181.63 ug/m^3. The lowest concentration was recorded in station AAQ8 (Bamban Station) at 18.52 ug/m^3. WHO has no 24-hour standard for TSP.

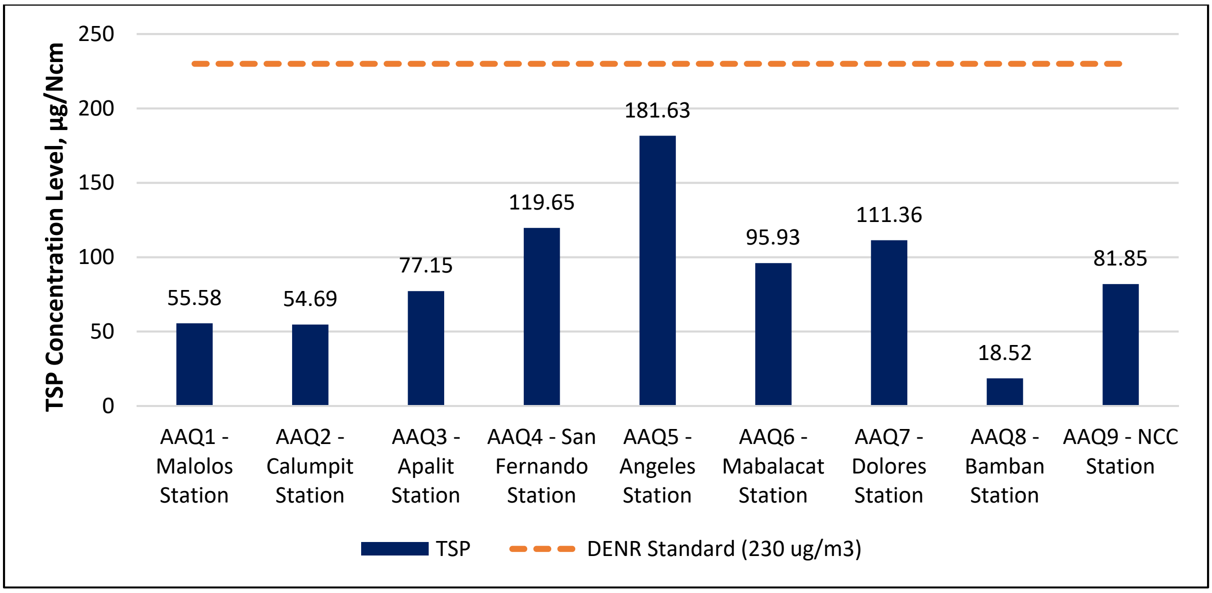


Figure 3.3.10. Concentration Levels of TSP (µg/m^3) at Eight (8) Sampling Stations

Particulate Matter up to 10 microns (PM_{10})

812. **Figure 3.3.11** shows the graphical presentation of the concentration levels of PM_{10} in eight (8) sampling stations. As shown, concentration levels of PM_{10} in all stations are within the DENR Standard of 150 ug/m^3. The highest PM_{10} concentration was observed in Station AAQ7 (Dolores Station) at 91.49 ug/m^3. The lowest concentration was recorded in station AAQ8 (Bamban Station) at 16.07 ug/m^3. PM_{10} concentrations at stations AAQ4 (San Fernando Station), AAQ5 (Angeles Station) and AAQ7 (Dolores Station) exceeded the WHO guideline value of 50 ug/m^3.

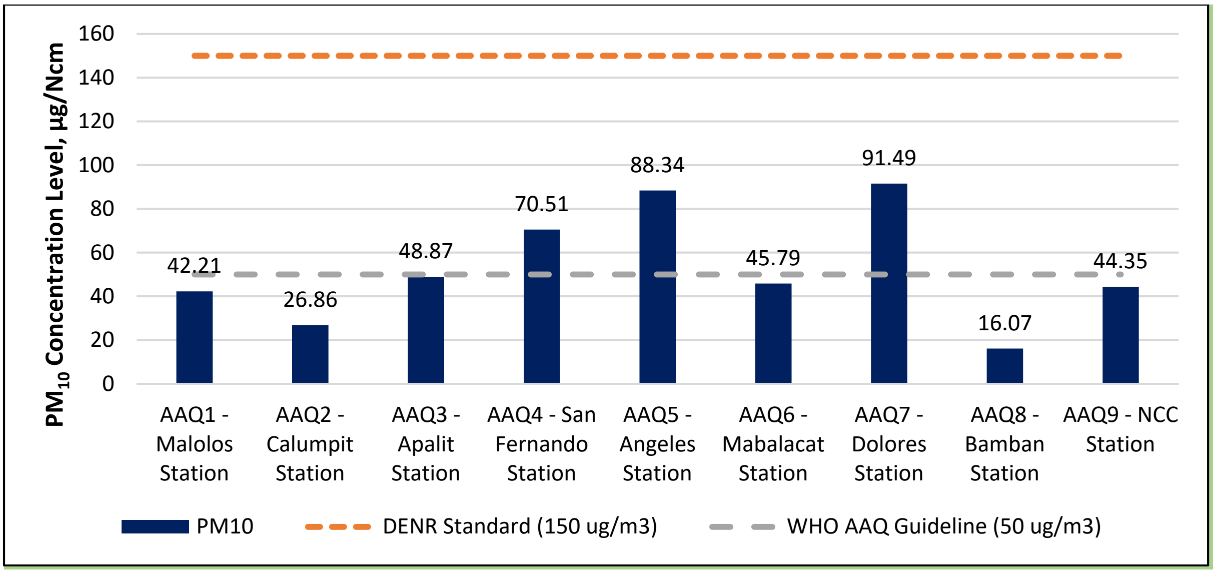


Figure 3.3.11. Concentration Levels of PM_{10} (µg/m^3) at Eight (8) Sampling Stations

Particulate Matter up to 2.5 microns ($PM_{2.5}$)

813. **Figure 3.3.12** shows the graphical presentation of the concentration levels of $PM_{2.5}$ in eight (8) sampling stations. As shown, concentration levels of $PM_{2.5}$ in all stations are within the DENR Standard of 50 ug/m^3. The highest $PM_{2.5}$ concentration was observed in Station AAQ4 (San Fernando Station) at 30.45 ug/m^3. The lowest concentration was recorded in station AAQ9 (NCC Station) at 10.62 ug/m^3. $PM_{2.5}$ concentrations at station AAQ4 (San Fernando Station) exceeded the WHO guideline value of 25 ug/m^3.

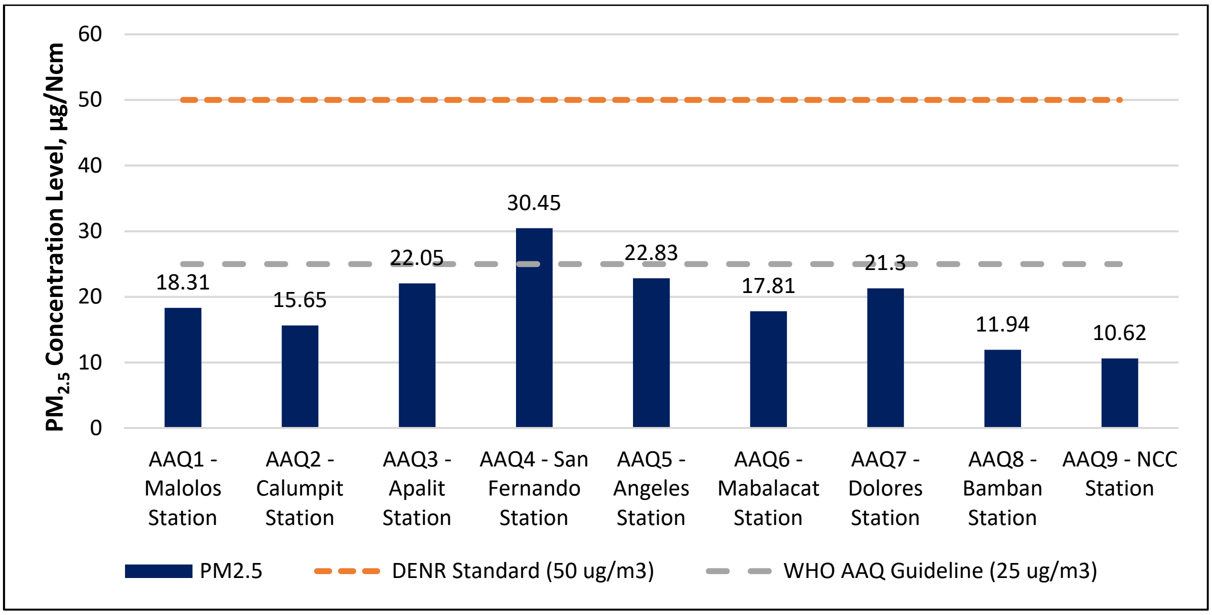


Figure 3.3.12. Concentration Levels of $PM_{2.5}$ (µg/m^3) at Eight (8) Sampling Stations

Sulfur Dioxide (SO_2)

814. **Figure 3.3.13** shows the graphical presentation of the concentration levels of SO_2 in eight (8) sampling stations. As shown, concentration levels of SO_2 in all stations are within the DENR Standard of 180 ug/m^3. The highest SO_2 concentration was observed in Station AAQ3 (Apalit Station) at 134.93 ug/m^3. SO_2 was only detected at three (3) stations. SO_2 concentrations at stations AAQ2 (Calumpit Station) and AAQ3 (Apalit Station) exceeded the WHO guideline value of 20 ug/m^3.

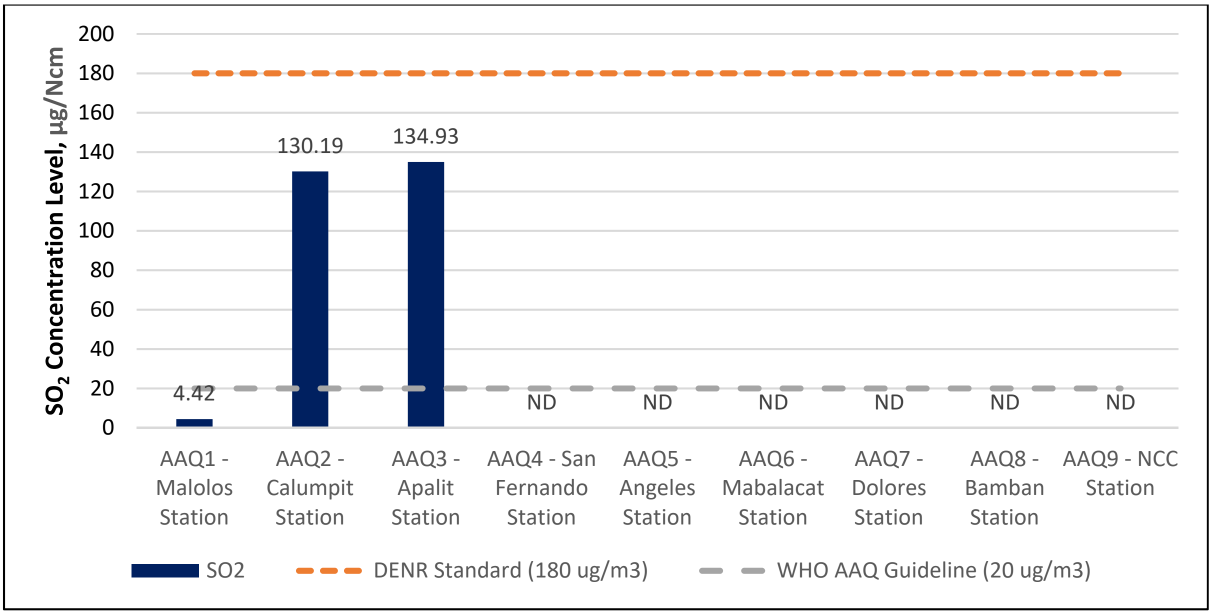


Figure 3.3.13. Concentration Levels of SO_2 (µg/m^3) at Eight (8) Sampling Stations

Nitrogen Dioxide (NO_2)

815. **Figure 3.3.14** shows the graphical presentation of the concentration levels of NO_2 in eight (8) sampling stations. As shown, concentration levels of NO_2 in all stations are within the DENR Standard of 150 ug/m^3. The highest SO_2 concentration was observed in Station AAQ2 (Calumpit Station) at 16.18 ug/m^3, while the lowest SO_2 concentration was observed in AAQ5 (Angeles Station). There is no 24-hour WHO guideline value for NO_2.

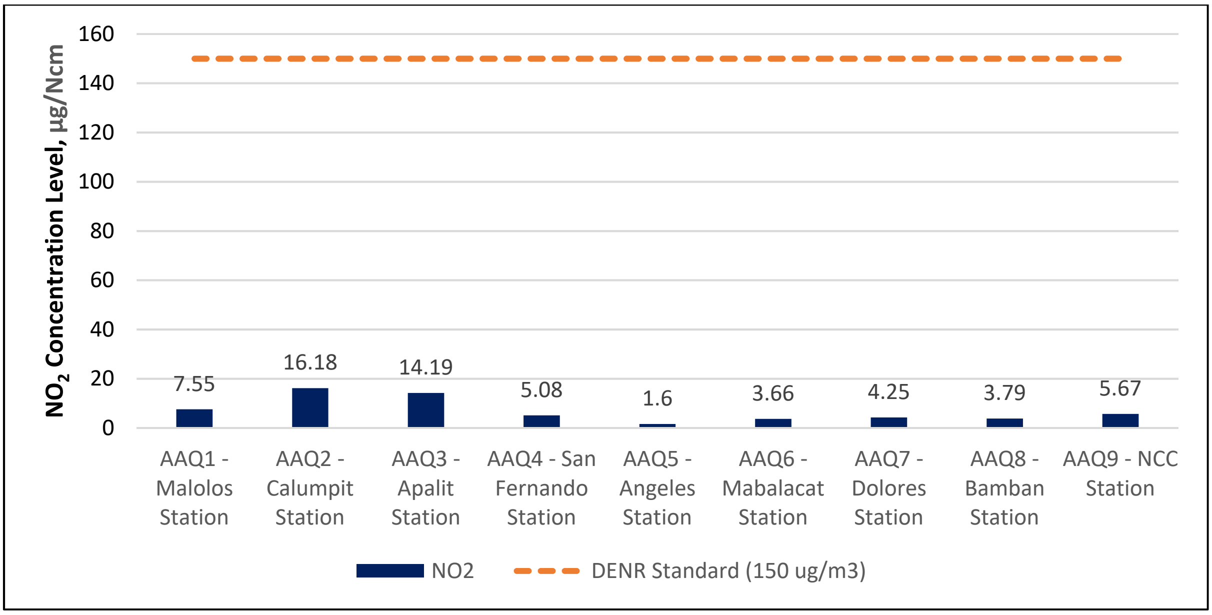


Figure 3.3.14. Concentration Levels of NO_2 (µg/m^3) at Eight (8) Sampling Stations

Lead (Pb)

816. **Figure 3.3.15** shows the graphical presentation of the concentration levels of Pb in eight (8) sampling stations. The highest Pb concentration was observed in Station AAQ6 (Mabalacat Station) at 0.0043 ug/m^3. Lead was only detected at station AAQ5 (Angeles Station), AAQ6

(Mabalacat Station) and AAQ7 (Dolores Station). Both the DENR and WHO have no 24-hour standard for Pb.

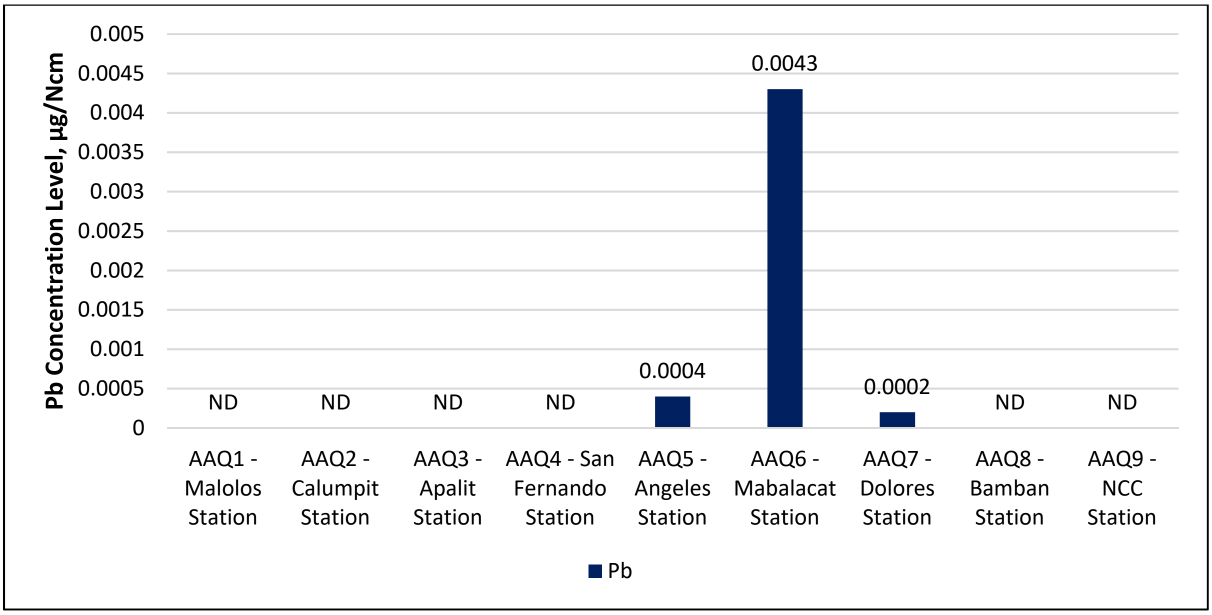


Figure 3.3.15. Concentration Levels of Lead at each Sampling Station

Carbon Monoxide (CO)

817. **Figure 3.3.16** shows the graphical presentation of the concentration levels of CO in eight (8) sampling stations. CO was only detected at stations AAQ1 (Malolos Station), AAQ2 (Calumpit Station) and AAQ7 (Dolores Station), which has the highest CO concentration at 10.29 ug/m^3.

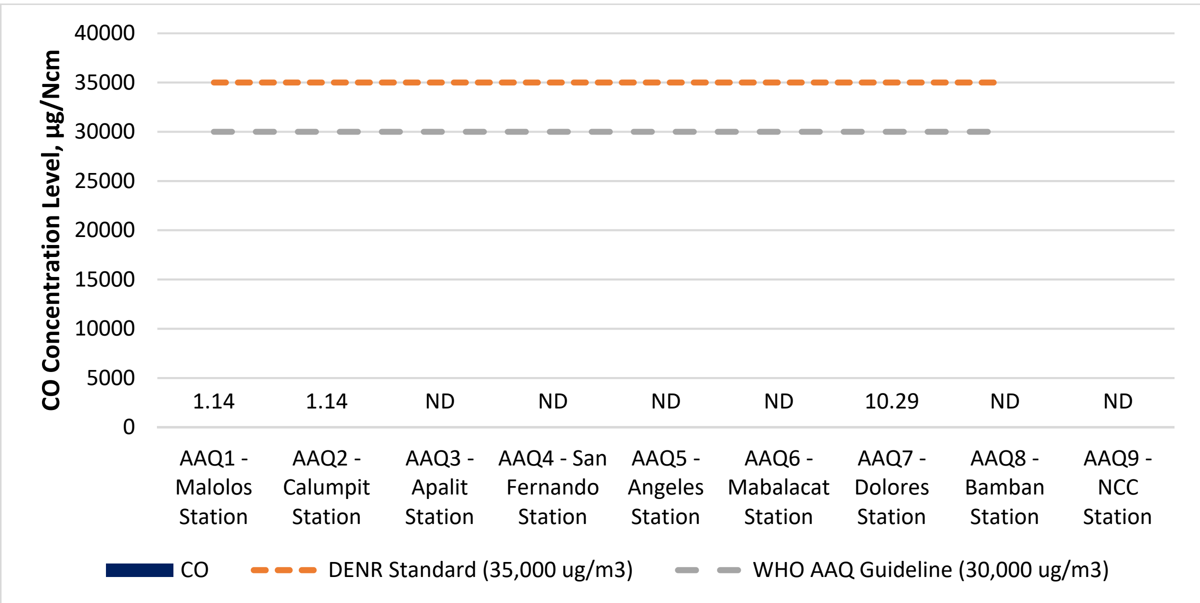


Figure 3.3.16. Concentration Levels of CO at each Sampling Station

Ozone (O_3)

818. **Figure 3.3.17** shows the graphical presentation of the concentration levels of O_3 in eight (8) sampling stations. No O_3 was detected in all sampling stations.

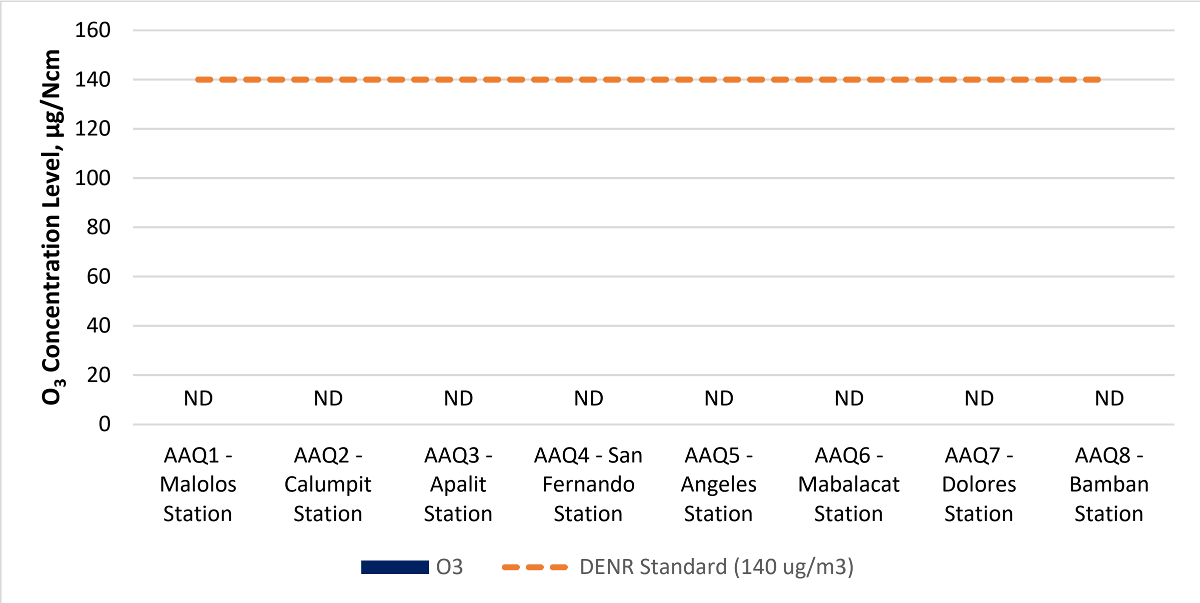


Figure 3.3.17. Concentration Levels of O_3 at each Sampling Station

3.3.2.2 Impact Identification, Prediction and Assessment, and Mitigation

(1) Pre-construction and Construction Phase

819. The major sources of impacts on air quality by the project in the construction phases are as follows:

- Exhaust emission from movement of equipment by vehicles, excavated soil carried by vehicle and other heavy loaders;
- Earthworks including excavation activities;
- Site clearance including removal of topsoil at the depot site;
- Construction site generate dust from construction materials, waste, loose earth, and moving excavated material and transporting wastes on vehicles;
- Diesel based construction machineries may cause huge air quality impact; and
- Loading and unloading construction materials.

820. The emissions, however, will not be constant and will fluctuate based on operating periods and the combination equipment to be used at any one time. The location of emission sources will also change as the construction activity progresses along the alignment. Intensive construction activities will not be generally carried out at night time. Potential receptors such as residents will not be continually exposed during construction for extended period and limited daily exposure.

Dust Generation

821. Maximum construction activities have the potential to generate dust. The expansion of impacts from dust will depend on the location of construction activities and types of vehicles. Weather also plays an important factor for dust generation. Stronger winds and dry condition will increase the transfer of dust, whereas damp or wet conditions will reduce the impact.

822. Transportation of excavation materials and establishment of the material will involve use of heavy machinery like compactors, rollers, water tankers, and dumpers. This activity is machinery intensive resulting in dust generation. However, this activity will only be short term and the air pollution during construction is localized and only around the station site, viaduct site and depot construction site only.

823. The magnitude of the impact associated with the emission of dust during construction activities on the basis of above factors is predicted to be medium.

824. The proposed mitigating measures to minimize dust suspension are as follows:

- Minimise alteration of topography and removal of vegetation to minimise earthworks;
- Regular cleaning and clearing of construction access /sites and the surfaces of spoils and debris from construction equipment and vehicles and wetting of ground soil in the construction site when necessary;
- Store excavated materials at designated disposal area. Construction materials and trucks loaded with spoils will be covered;
- Undertake daily cleaning of paved routes around the pier construction sites;
- Control vehicle movement maintaining the speed limit within the construction site to <10kph;
- Store excavated materials outside road reserve, but where there is no area, spoils will be loaded and transported immediately; and
- Plant vegetation on bare ground as early as possible and create vegetated buffer zone where possible.

<u>Exhaust Generation</u>

825. Transportation of construction materials and excavated soil by trucks that use diesel for fuel will cause impacts on ambient air quality. Operation of construction machine will cause exhaust gas emissions. However, the air quality impacts associated with the vehicular and operational equipment emissions during construction activities will be less significant as the construction period will be short term.

826. The proposed mitigating measures to minimize exhaust emissions are as follows:

- Regular preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standards. Wherever possible, use electrically-powered equipment;
- Minimise vehicle transport by maximising the use of site-generated materials.

827. Air quality will be monitored at identified baseline sampling points including nearby sensitive receptors (residential, school and hospital areas) and ecologically significant area/s (if any) likely to be affected by the operation of construction machines and evaluate effectiveness of the air pollution reduction measures provided. Monitor actions on complaints, if any, based on Grievance Redress Mechanism.

(2) Operation Phase

828. During the operation phase, vehicle exhaust emissions and entrained dust could increase in the vicinity of stations due to increased traffic of people. Activities within the depot area might also aggrevate the quality of air within its vicinity. Mitigation and enhancement measures to address these possible impacts are as follows:

- Select appropriate operation and maintenance equipment that are fuel efficient to reduce emission;

- Regular inspection and proper preventive maintenance of service vehicles, generator sets and other equipment/facilities to ensure compliance with DENR source emission standards;
- Comply with environmental permitting requirements for the storage, transport, handling treatment and disposal of hazardous material/ wastes and contaminated soil in accordance with RA 6969 at the depot area, and provide appropriate PPE for the concerned personnel;
- Regular cleaning and clearing of road from spoils and debris, and wetting of soil in the periphery of the depot when necessary;
- Control service vehicle movement maintaining the speed limit to <10kph. Minimise vehicle transport by maximising the use of site-generated materials; and
- Monitor air quality at vicinity of the proposed stations and evaluate effectiveness of the air pollution reduction measures provide. Monitor actions on complaints, if any, based on Grievance Redress Mechanism.

3.3.3 Noise

3.3.3.1 Ambient Noise Level

829. Increase in population density and increase in road netwoks are two conditions that go along with development and urbanization. Noise levels will also reflect the general conditions of urban areas. Generally, higher noise levels are expected in urban areas as compared to rural areas.

830. As of 2010 data of Philippine Statistics Authority, Angeles, Pampanga is 93.7% urban, while the rest of Pampanga is 56.5% urban. Bulacan, on the other hand, is 70.9% urban, while Tarlac is 34.7% of urban.

831. During the noise monitoring for the proposed Central Luzon Link Expressway (CLLEx) conducted in 2009 by Department of Public Works and Highways (DPWH), noise levels ranging from 69 dBA to 79 dBA were reported for Tarlac stations.

832. During the noise monitoring for the North South Commuter Rail (NSCR) conducted in 2015 by Department of Transportation and Communications (DOTC), noise levels ranging from 50.8 dBA to 65.1 dBA were reported for the Malolos, Bulacan station, situated in the city proper, near La Consolacion University.

(1) Field Survey

833. Noise levels for the proposed MCRP were measured at fifteen (15) monitoring stations during morning (5:00 AM to 9:00 AM), daytime (9:00 AM to 6:00 PM), evening (6:00 to 10:00 PM) and nighttime (10:00 PM to 5:00AM) using an Extech® Model No. SDL600 and Extech® Model No. SL355. Noise levels were recorded manually and the median of the seven highest noise level readings was determined and compared with the NPCC standards for noise.

834. On the other hand, for noise levels recorded at 1-second interval for a period of one-hour, the equivalent energy level (LAeq) was computed using the formula below.

$$LA_{eq} = 10 \times log_{10} \{(10^{L_{AE1}/10} + 10^{L_{AE2}/10} + \cdots + 10^{L_{AEi}/10})/n\}$$

$$where: L_{AEi} = sound\ level\ at\ i^{th}\ interval$$
$$n = number\ of\ samples$$

835. The computed LAeq was then compared with the guidelines for community noise of the WHO.

836. **Table 3.3.14** describes the location of the noise sampling stations and their categories according to applied standards.

Table 3.3.14 Description of Noise Sampling Stations

Station ID	Station	Description	NPCC Area Class	WHO Category[1]
N01	Malolos Station 14°51'13.15" N; 120°48'50.91" E	Residential area approx. 90m northeast of La Consolacion University – Catmon Campus, approx. 35m south of old PNR Malolos Station	AA*	RIE
N02	Calumpit Station 14°54'57.72" N; 120°46'05.10" E	Within Bonifacio Park, approx. 50m west of St. John the Baptist Church, approx. 90m west of St. John the Baptist Catholic School	AA	RIE
N03	Apalit Station 14°56'46.86"N, 120°44'52.44"E	Residential area about 25m northeast of Brgy. San Vicente Brgy. Hall, approx. 100m east of Sampaga Integrated School	AA	RIE
N04	Old PNR Santo Tomas Station 15°00'14.88" N; 120°42'31.47" E	Residential area approx. 200m southeast of the old PNR Santo Tomas Station	A	RIE
N05	San Fernando Station 15°01'36.00"N, 120°41'12.00"E	Brgy. Santo Niño residential area approx. 8m southwest of PNR San Fernando Station, approx. 45m northeast of governor's residence	A	RIE
N06	Brgy.Quebiawan Station 15°03'20.95" N; 120°39'54.58" E	Residential area approx. 90m northeast of St. Scholastica's Academy of Pampanga, Inc.; approx. 70m southeast of St.Vincent of Quebiawan Integrated School	AA	RIE
N07	New Barrio Rd. - Sindalan Memorial Park 15° 05'18.16"N, 120°38'28.60"E	Brgy. Sindalan residential area, approx. 30m south of the cemetery entrance	A	RIE
N08	Angeles Station (Near La Pieta Memorial Cemetery) 15° 8'9.00"N, 120°35'51.00"E	Brgy. Pulungbulu residential area approx. 100m south of La Pieta chapel and crematorium	AA**	RIE
N09	Angeles old PNR Station 15°08'41.51" N; 120°35'28.12" E	Brgy. Claro M. Recto residential area, approx. 50m south of Agapito del Rosario basketball court	A	RIE
N10	Brgy. Santa Teresita 15°08'58.31" N; 120°35'20.47" E	Residential area approx. 30m north of Iglesia ni Kristo church, 10m south of UCCP-Angeles church	AA	RIE
N11	Mabalacat Station 15°10'26.00"N, 120°34'57.00"E	Brgy Lakandula residential area	A	RIE
N12	Mabalacat Municipal Cemetery 15°12'50.88" N; 120°34'25.78" E	Brgy. San Francisco residential area, approx. 80m east of Subic-Clark-Tarlac Expressway (SCTEx)	A	RIE
N13	Depot Site (Brgy. Dolores) 15°14'18.12"N, 120°34'5.95"E	Approx. 250m northwest of Catudtud Elementary School, 10m south of Brgy. Dolores Barangay Hall and 30m southwest of covered gym	A**	RIE
N14	Brgy. San Roque, Bamban 15°16'32.13"N, 120°31'3.48"E	Basketball court at Dapdap resettlement site, approx. 10m south of Barangay Hall and Barangay Day Care center	AA	RIE
N15	NCC Entrance 15°20'56.42" N; 120°31'39.42" E	Rural residential area approx. 200m from the planned PNR NCC Station	A	RIE

Notes:
*Area directly fronting or facing wider than four-lane road wherein NPCC MC 1980-002 Standards for Noise in General Areas plus +10 dBA correction factor will be applied.
**Areas directly fronting or facing a four-lane road wherein NPCC MC 1980-002 Standards for Noise in General Areas plus +5 dBA correction factor will be applied.
[1]RIE – Residential; Institutional; Educational

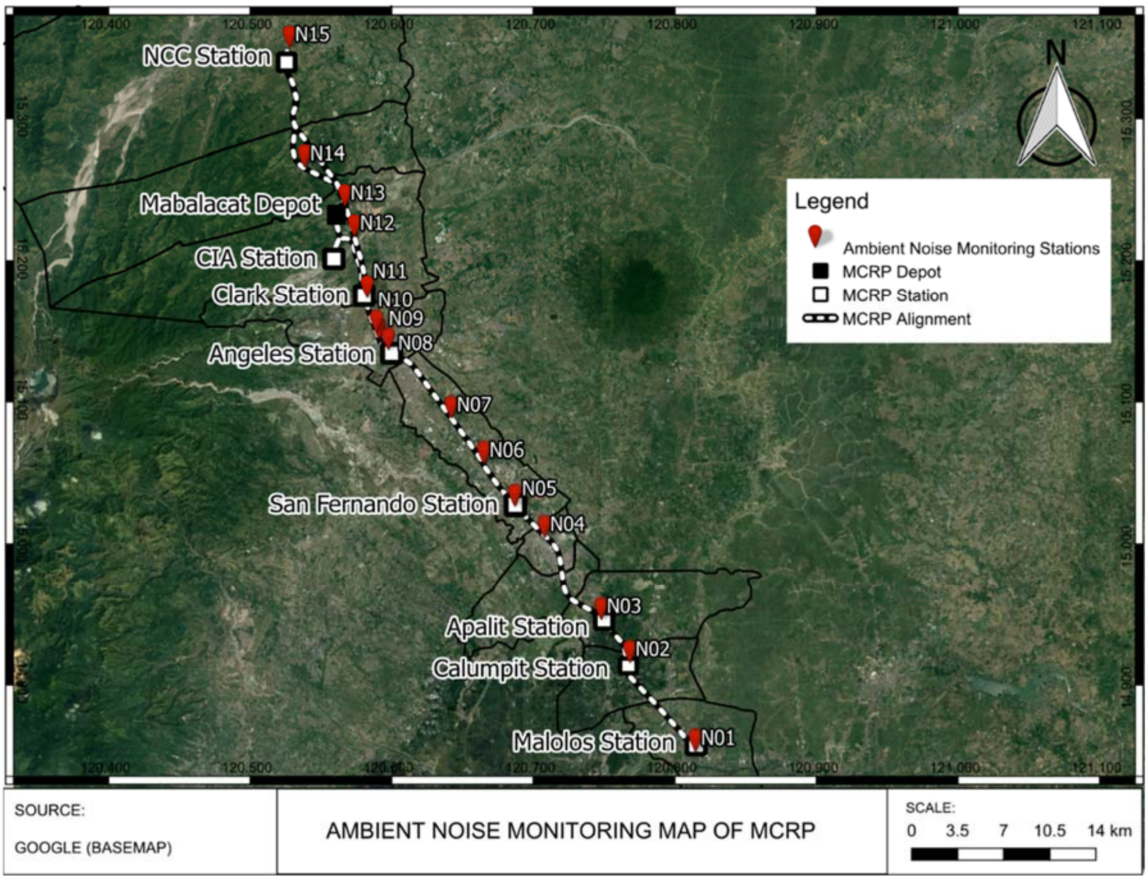


Figure 3.3.18. Ambient Noise Levels Monitoring Stations along Proposed MCRP Alignment

(2) Applied standard

837. The measured noise levels were compared to the Environmental Quality Standards for Noise in General Areas (Ambient [Noise] Quality and Emission Standards for Noise of NPCC Memorandum Circular No. 1980-002) and the Guidelines for Community Noise of WHO, 1999. The details of the criteria used in this study are presented in Section 2.6.4.

(3) Results and Analysis

838. The results of noise level monitoring which was conducted in accordance to the requirements of NPCC MC No. 1980-002 were above the standard values of the Environmental Quality Standards for Noise in General Areas of NPCC. The lowest noise level measured at 54.6 dBA was obtained in Station N15 (NCC Station) during nighttime, while the highest noise level measured at 81.0 dBA was obtained in Station N06 (Brgy Quebiawan) during daytime. The summary of results of the noise level monitoring conducted at MCRP alignment is shown in **Table 3.3.15**.

839. Moreover, the results of noise level monitoring, which was conducted in accordance to the Guidelines for Community Noise of WHO, showed that the ambient noise levels measured in all stations were above the WHO guideline values. The lowest 1-Hour LAeq measured at 48.2 dBA was obtained in Station N15 (NCC Entrance) during nighttime, while the highest 1-Hour LAeq measured at 72.9 dBA was obtained in Station N10 (Sta. Teresita) during evening. The noise levels measured during morning period range from 55.3 dBA (N05-San Fernando) to 68.3 dBA (N06 – Brgy.Quebiawan), while for daytime, noise levels range from 55.1 dBA (N15 – NCC Entrance) to

70.3 dBA (N05 – San Fernando). During evening, noise levels range from 56.6 dBA (N08 – Angeles Station) to 72.9 dBA (Brgy. Sta. Teresita), while during nighttime, noise levels range from 48.2 dBA (N15 – NCC Entrance) to 65.8 dBA (N02 – Calumpit Station). The most frequently observed sources of noise were vehicles passing near the monitoring station, followed by voices of people talking nearby. Most of the ambient noise monitoring stations were located at urban areas, with the exception of N15 - NCC Entrance, which is located at a residential area with few houses near ricefields. The summary of results of noise level monitoring conducted in accordance to the WHO Guideline for Community Noise is shown in **Table 3.3.16**.

840. A brief discussion of the results of noise level monitoring in each station during morning, daytime, evening and nighttime for NPCC standards and during daytime and nighttime for WHO guideline values is presented below.

1) Results by sampling Stations

N01 – Malolos

841. Station N01 was located approximately 90 meters northeast of La Consolacion University – Catmon Campus and was therefore categorized as Class AA area according to NPCC classification. Moreover, it is adjacent to McArthur Highway, thereby increasing its acceptable maximum noise levels by 10 dBA. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 60 dBA for daytime, 55dBA for morning and evening, and 50 dBA for nighttime.

842. Station N01 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N02 – Calumpit

843. Station N02 was located within Bonifacio Park, approximately 50 meters west of St. John the Baptist Church and approximately 90 meters west of St. John the Baptist Catholic School and was therefore categorized as an AA Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 50 dBA for daytime, 45 dBA for morning and evening, and 40 dBA for nighttime.

844. Station N02 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N03 – Apalit

845. Station N03 was located in a residential area close to Brgy. San Vicente Brgy. Hall. Furthermore, it is located approximately 100 meters east of Sampaguita Integrated School and was thus categorized as an AA Class area according to NPCC classification Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 50 dBA for daytime, 45 dBA for morning and evening, and 40 dBA for nighttime.

846. Station N03 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N04 – Old PNR Santo Tomas

847. Station N04 was located in a residential area and was therefore categorized as an A Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

848. Station N04 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N05 – San Fernando

849. Station N05 was located in a residential area at Brgy. Santo Niño, and thus was categorized as an A Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

850. Station N05 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N06 – Brgy Quebiawan

851. Station N06 was located within 90 meters of St. Scholastica's Academy of Pampanga, Inc, and thus was categorized as an AA Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 50 dBA for daytime, 45 dBA for morning and evening, and 40 dBA for nighttime.

852. Station N06 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N07 – Sindalan Memorial Park

853. Station N07 was located in a residential area at Brgy. Sindalan, and was therefore categorized as an A Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

854. Station N07 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N08 – Angeles Station (near La Pieta Memorial Cemetery)

855. Station N08 was located in a residential area at Brgy Pulungbulu adjacent to La Pieta chapel and crematorium, and thus was categorized as an AA Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

856. Station N08 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher

than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N09 – Angeles Old PNR

857. Station N09 was located in a residential area at Brgy. Claro M. Recto, and thus was categorized as an A Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

858. Station N09 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N10 – Brgy. Santa Teresita

859. Station N10 was located in a residential area, and thus was categorized as an AA Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 50 dBA for daytime, 45 dBA for morning and evening, and 40 dBA for nighttime.

860. Station N10 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N11 - Mabalacat

861. Station N11 was located in a residential area at Brgy.Lakandula and was therefore categorized as an A Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

862. Station N11 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N12 – Mabalacat Municipal Cemetery

863. Station N12 was located in a residential area at Brgy. San Francisco, and thus was categorized as an A Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

864. Station N12 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N13 – Depot Site (Brgy. Dolores)

865. Station N13 was located in a residential area in Barangay Dolores and was therefore categorized as an A Class area according to NPCC classification. Moreover, it is adjacent to SCTEx, thereby increasing its acceptable maximum noise levels by 5 dBA Noise levels measured

in all monitoring periods were higher than maximum noise levels set for its classification, which are 60 dBA for daytime, 55 dBA for morning and evening, and 50 dBA for nighttime.

866. Station N13 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N14 – Brgy. San Roque, Bamban

867. Station N14 was located in the basketball court of Dapdap resettlement site and adjacent to Brgy. Dapdap Day Care Center, and thus was categorized as an AA Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 50 dBA for daytime, 45 dBA for morning and evening, and 40 dBA for nighttime.

868. Station N014 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N15 – NCC Entrance

869. Station N15 was located in a rural residential area and thus was categorized as an A Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

870. Station N15 was categorized under Residential, Institutional and Educational areas based on WHO guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

Table 3.3.15. Summary of Results of Noise Level Monitoring for MCRP as Compared with NPCC Standards

Station Number	Date	Time	Noise Levels, dBA	DENR Standard			Sources of Noise
				Area Class	Monitoring Period	Noise Level(dBA)	
N01	Jan 28, 2018	0710H	64.5	AA*	Morning	55 dBA	People talking nearby; chirping of birds
	Jan 28, 2018	1321H	74.7		Daytime	60 dBA	Dogs barking; people talking nearby; light vehicles passing near station
	Jan 27, 2018	1900H	68.6		Evening	55 dBA	Dogs barking; light vehicles and tricycles passing near station
	Jan 27-28, 2018	2300H	64.3		Nighttime	50 dBA	Dogs barking; light vehicles passing near station
N02	Jan 29, 2018	0704H	77.7	AA	Morning	45 dBA	Light vehicles passing
	Jan 29, 2018	1305H	73.1		Daytime	50 dBA	Light vehicles passing; people talking nearby
	Jan 29, 2018	1905H	76.8		Evening	45 dBA	Light vehicles passing; people talking nearby
	Jan 28-29, 2018	2304H	74.2		Nighttime	40 dBA	Light vehicles passing; chirping of nocturnal insects
N03	Jan 31, 2018	0658H	70.1	AA	Morning	45 dBA	Light vehicles passing
	Jan 30, 2018	1259H	72.7		Daytime	50 dBA	Light vehicles passing; children playing and shouting nearby
	Jan 30, 2018	1858H	68.4		Evening	45 dBA	Light vehicles and tricycles passing nearby
	Jan 30-31, 2018	2259H	57.2		Nighttime	40 dBA	Tricycles passing nearby
N04	Mar 2, 2018	0729H	66.8	A	Morning	50 dBA	Motorized vehicles passing nearby; chirping birds; barking dogs nearby
	Mar 3, 2018	1645H	68.9		Daytime	55 dBA	Motorized vehicles; trucks and cars passing nearby
	Mar 3, 2018	1801H	69.5		Evening	50 dBA	Chirping of birds; barking of dogs; motorized vehicles, jeepneys and private vehicles passing nearby
	Mar 6, 2018	2222H	64.4		Nighttime	45 dBA	Light vehicles and motorcycles passing nearby
N05	Feb 1, 2018	0654H	56.8	A	Morning	50 dBA	Chirping of birds
	Jan 31, 2018	1255H	64.1		Daytime	55 dBA	Light vehicles passing nearby
	Jan 31, 2018	1854H	57.7		Evening	50 dBA	Chirping of nocturnal insects
	Jan 31-Feb 1, 2018	2304H	57.5		Nighttime	45 dBA	Chirping of nocturnal insects
N06	Mar 3, 2018	0456H	68.9	AA	Morning	45 dBA	People talking; cars and light vehicles passing nearby
	Mar 2, 2018	0956H	81.0		Daytime	50 dBA	Children playing nearby
	Mar 6, 2018	2003H	69.0		Evening	45 dBA	People talking nearby
	Mar 6-7, 2018	2344H	55.7		Nighttime	40 dBA	Light vehicles and motorcycles passing nearby
N07	Mar 3, 2018	0630H	69.4	A	Morning	50 dBA	Chirping birds nearby; crowing of rooster
	Mar 2, 2018	1139H	64.7		Daytime	55 dBA	Goat bleating nearby; motor vehicles passing nearby; trucks passing nearby; fighting dogs
	Mar 2, 2018	2040H	70.7		Evening	50 dBA	Motor vehicles, trucks and jeepneys passing nearby
	Mar 2, 2018	2234H	77.6		Nighttime	45 dBA	Motor vehicles, trucks and jeepneys, cars passing nearby
N08	Feb 2, 2018	0656H	64.8	AA**	Morning	50 dBA	Trucks and light vehicles passing nearby
	Feb 2, 20188	0957H	67.2		Daytime	55 dBA	Trucks and light vehicles passing nearby
	Feb 1, 2018	1857H	66.6		Evening	50 dBA	Light vehicles passing nearby
	Feb 1, 2018	2156H	64.8		Nighttime	45 dBA	Light vehicles passing nearby
N09	Mar 3, 2018	0747H	67.20	A	Morning	50 dBA	People walking and talking nearby; light vehicles passing nearby 2-lane road

Station Number	Date	Time	Noise Levels, dBA	DENR Standard			Sources of Noise
				Area Class	Monitoring Period	Noise Level(dBA)	
	Mar 2, 2018	1335H	62.70		Daytime	55 dBA	Police patrol, jeepneys, cars and light vehicles passing nearby 2-lane road
	Mar 2, 2018	1755H	79.40		Evening	50 dBA	People playing in the basketball court 5 meters from the station
	Mar 6-7, 2018	2324H	72.40		Nighttime	45 dBA	People walking and talking nearby
N10	Mar 7, 2018	0740H	64.90	AA	Morning	45 dBA	Motorcycles and light vehicles passing nearby road; food vendor shouting; sound system blaring nearby
	Mar 2, 2018	1554H	73.60		Daytime	50 dBA	Motorcycles and light vehicles passing nearby road; pedestrians talking nearby
	Mar 2, 2018	1929H	79.40		Evening	45 dBA	Motorcycles and light vehicles passing nearby road, nearby church service ongoing; balot vendor; children playing nearby
	Mar 6, 2018	2210H	64.10		Nighttime	40 dBA	People talking nearby
N11	Feb 3, 2018	0655H	60.90	A	Morning	50 dBA	Chirping of birds; people talking nearby
	Feb 3, 2018	1224H	69.40		Daytime	55 dBA	People talking nearby; children playing
	Feb 3, 2018	1844H	75.70		Evening	50 dBA	Children playing
	Feb 3, 2018	0105H	65.70		Nighttime	45 dBA	Chirping of nocturnal insects
N12	Mar 7, 2018	0559H	68.20	A	Morning	50 dBA	Children walking and playing nearby; tricycles and motorcycles passing nearby; dogs barking
	Mar 3, 2018	1103H	74.40		Daytime	55 dBA	People walking and talking nearby
	Mar 6, 2018	1754H	71.50		Evening	50 dBA	Motorcycles passing nearby; barking dogs
	Mar 7, 2018	0350H	62.90		Nighttime	45 dBA	People walking and talking nearby; barking of dogs
N13	Feb 5, 2018	0604H	71.0	A**	Morning	55 dBA	Vehicles passing nearby
	Feb 4, 2018	1304H	79.0		Daytime	60 dBA	Vehicles blowing their horns
	Feb 4, 2018	1855H	67.8		Evening	55 dBA	Vehicles blowing their horns; motorcycles with loud mufflers; people talking nearby
	Feb 4-5, 2018	2254H	63.1		Nighttime	50 dBA	Vehicles blowing their horns; motorcycles with loud mufflers
N14	Feb 6, 2018	0701H	67.8	AA	Morning	45 dBA	People talking nearby
	Feb 5, 2018	1300H	67.7		Daytime	50 dBA	People talking nearby; children practicing dance
	Feb 5, 2018	1900H	62.3		Evening	45 dBA	People talking nearby; chirping of nocturnal insects
	Feb 5, 2018	2300H	60.3		Nighttime	40 dBA	Chirping of nocturnal insects
N15	Feb 7, 2018	0700H	62.4	A	Morning	50 dBA	People talking nearby; Trucks and other vehicles passing nearby road
	Feb 6, 2018	1402H	59.9		Daytime	55 dBA	Trucks, motorcycles and other vehicles passing nearby road
	Feb 6, 2018	1913H	64.0		Evening	50 dBA	People talking nearby
	Feb 6-7, 2018	2302H	54.6		Nighttime	45 dBA	Chirping of nocturnal insects

Notes: *Area directly fronting or facing wider than four-lane road wherein NPCC MC 1980-002 Standards for Noise in General Areas plus +10 dBA correction factor were applied
**Areas directly fronting or facing a four-lane road wherein NPCC MC 1980-002 Standards for Noise in General Areas plus +5 dBA correction factor were applied.

Table 3.3.16. Summary of Results of Noise Level Monitoring in Compliance with the WHO Guidelines

Station Number	Date	Time	Noise Levels, dBA	WHO Guidelines			Sources of Noise
				Area Class	Monitoring Period	Noise Level (dBA)	
N01	Jan 28, 2018	1326H-1426H	63.4	RIE	Daytime	55	Dogs barking; people talking nearby; light vehicles passing near station
	Jan 27-28, 2018	2306H-0006H	59.4		Nighttime	45	Dogs barking; light vehicles passing near station
N02	Jan 29, 2018	1310H-1410H	61.1	RIE	Daytime	55	Light vehicles passing; people talking nearby
	Jan 28-29, 2018	2310H-0010H	65.8		Nighttime	45	Light vehicles passing; chirping of nocturnal insects
N03	Jan 30, 2018	1304H-1404H	67.3	RIE	Daytime	55	Light vehicles passing; children playing and shouting nearby
	Jan 30-31, 2018	2304H-0004H	63		Nighttime	45	Tricycles passing nearby
N04	Mar 3, 2018	1650H-1750H	66.2	RIE	Daytime	55	Motorized vehicles; trucks and cars passing nearby
	Mar 6, 2018	2228H-2328H	60.1		Nighttime	45	Light vehicles and motorcycles passing nearby
N05	Jan 31, 2018	1300H-1400H	60.2	RIE	Daytime	55	Light vehicles passing nearby
	Jan 31-Feb 1, 2018	2310H-0010H	60.9		Nighttime	45	Chirping of nocturnal insects
N06	Mar 2, 2018	1001H-1101H	70.3	RIE	Daytime	55	Children playing nearby
	Mar 6-7, 2018	2349H-0049H	51.9		Nighttime	45	Light vehicles and motorcycles passing nearby
N07	Mar 2, 2018	1145H-1245H	61.8	RIE	Daytime	55	Goat bleating nearby; motor vehicles passing nearby; trucks passing nearby; fighting dogs
	Mar 2, 2018	2240H-2340H	65.3		Nighttime	45	Motor vehicles, trucks and jeepneys, cars passing nearby
N08	Feb 2, 20188	1002H-1102H	65.7	RIE	Daytime	55	Trucks and light vehicles passing nearby
	Feb 1, 2018	2202H-2302H	62.5		Nighttime	45	Light vehicles passing nearby
N09	Mar 2, 2018	1340H-1440H	59.9	RIE	Daytime	55	Police patrol, jeepneys, cars and light vehicles passing nearby 2-lane road
	Mar 6-7, 2018	2330H-0030H	64.4		Nighttime	45	People walking and talking nearby
N10	Mar 2, 2018	1600H-1700H	66.9	RIE	Daytime	55	Motorcycles and light vehicles passing nearby road; pedestrians talking nearby
	Mar 6, 2018	2215H-2315H	65.5		Nighttime	45	People talking nearby
N11	Feb 3, 2018	1230H-1330H	62.9	RIE	Daytime	55	People talking nearby; children playing
	Feb 3, 2018	0110H-0210H	51.4		Nighttime	45	Chirping of nocturnal insects
N12	Mar 3, 2018	1108H-1208H	61.5	RIE	Daytime	55	People walking and talking nearby
	Mar 7, 2018	0355H-0455H	61.2		Nighttime	45	People walking and talking nearby; barking of dogs
N13	Feb 4, 2018	1310H-1410H	64.2	RIE	Daytime	55	Vehicles blowing their horns
	Feb 4-5, 2018	2300H-0000H	63.6		Nighttime	45	Vehicles blowing their horns; motorcycles with loud mufflers
N14	Feb 5, 2018	1306H-1406H	64	RIE	Daytime	55	People talking nearby; children practicing dance
	Feb 5, 2018	2306H-0006H	62.3		Nighttime	45	Chirping of nocturnal insects
N15	Feb 6, 2018	1408H-1508H	55.1	RIE	Daytime	55	Trucks, motorcycles and other vehicles passing nearby road
	Feb 6-7, 2018	2308H-0008H	48.2		Nighttime	45	Chirping of nocturnal insects

Notes: RIE – Residential; Institutional; Educational

2) Results by Monitoring Period

a) For NPCC MC 1980-002 Compliance

Noise Levels During Morning

871. As shown in **Figure 3.3.19**, noise levels in all stations exceeded the NPCC standards during the morning period. The highest noise level of 77.7 dBA was measured at station N02 – Calumpit Station while the lowest noise level of 56.8 dBA was measured at station N05 – San Fernando Station. The morning period covers the time between 5:00 AM to 9:00 AM.

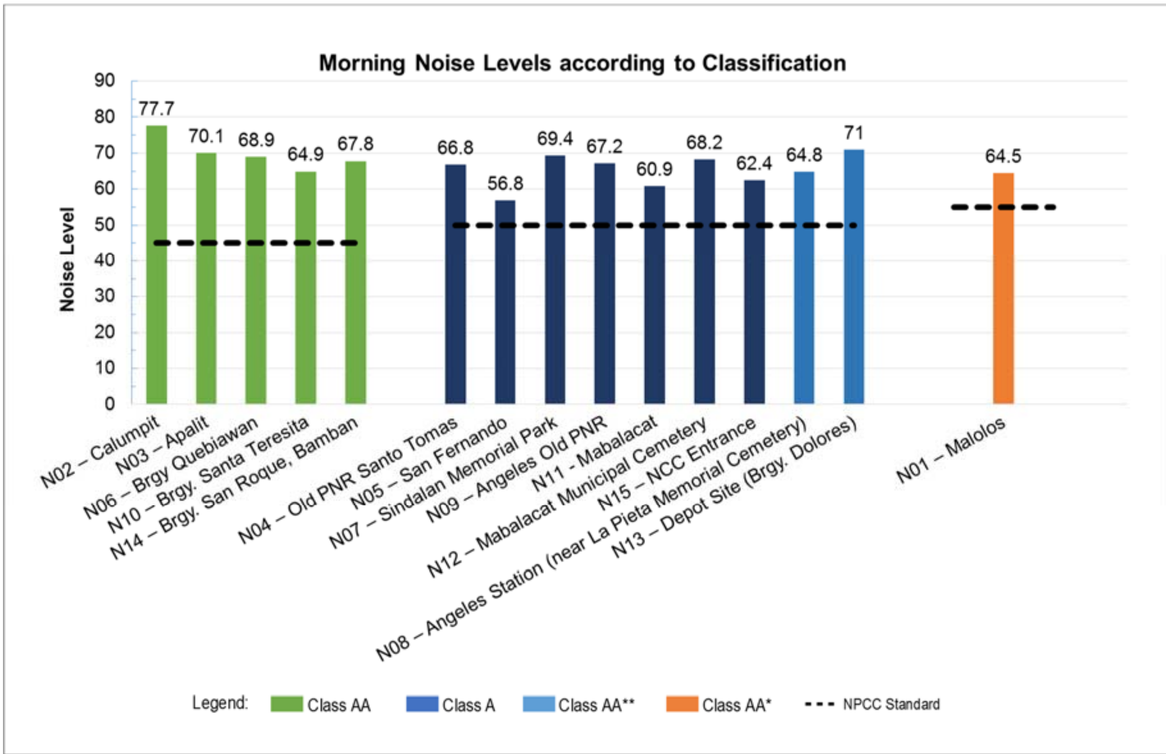


Figure 3.3.19. Morning Ambient Noise Levels According to NPCC Classification

Noise Levels During Daytime

872. As shown in **Figure 3.3.20**, noise levels in all stations exceeded the NPCC standards during the daytime period. The highest noise level of 81 dBA was measured at station N06 – Brgy. Quebiawan Station while the lowest noise level of 59.9 dBA was measured at station N15 – NCC Entrance Station. The morning period covers the time between 9:00 AM to 6:00 PM.

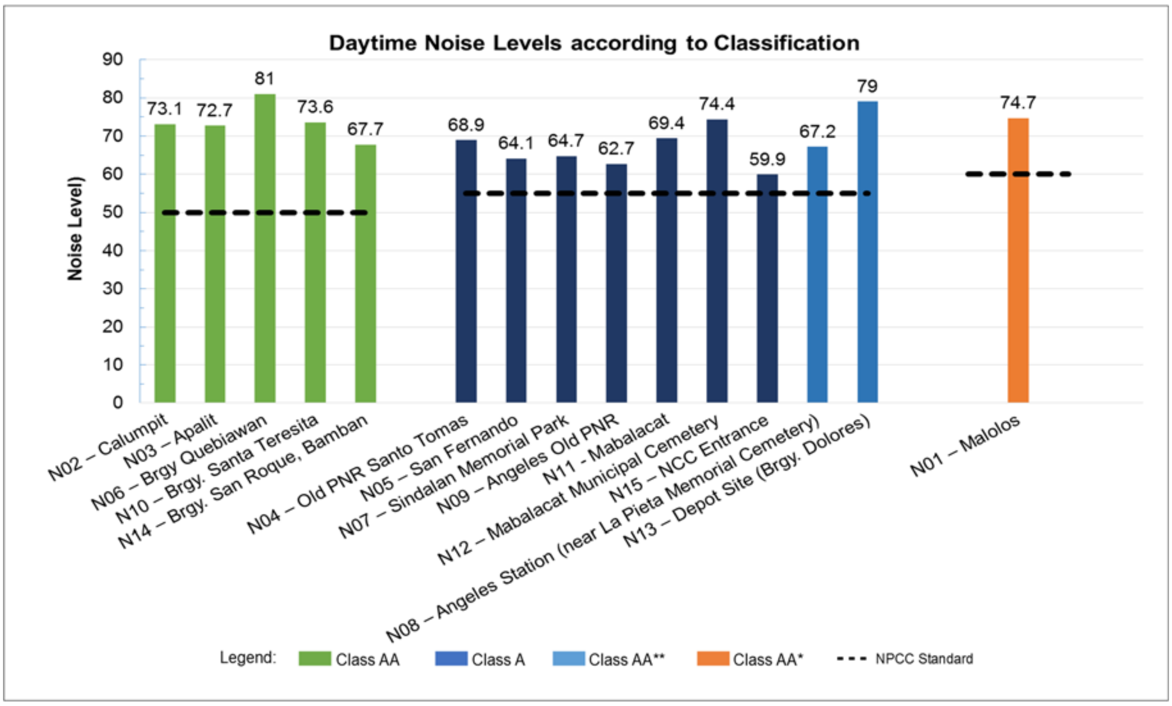


Figure 3.3.20. Daytime Ambient Noise Levels According to NPCC Classification

Noise Levels During Evening

873. As shown in **Figure 3.3.21**, noise levels in all stations exceeded the NPCC standards during the evening period. The highest noise level of 79.4 dBA was measured at stations N09 – Angeles Old PNR Station and N10 – Brgy. Sta. Teresita Station while the lowest noise level of 57.7 dBA was measured at station N05 – San Fernando Station. The evening period covers the time between 6:00 PM to 10:00 PM.

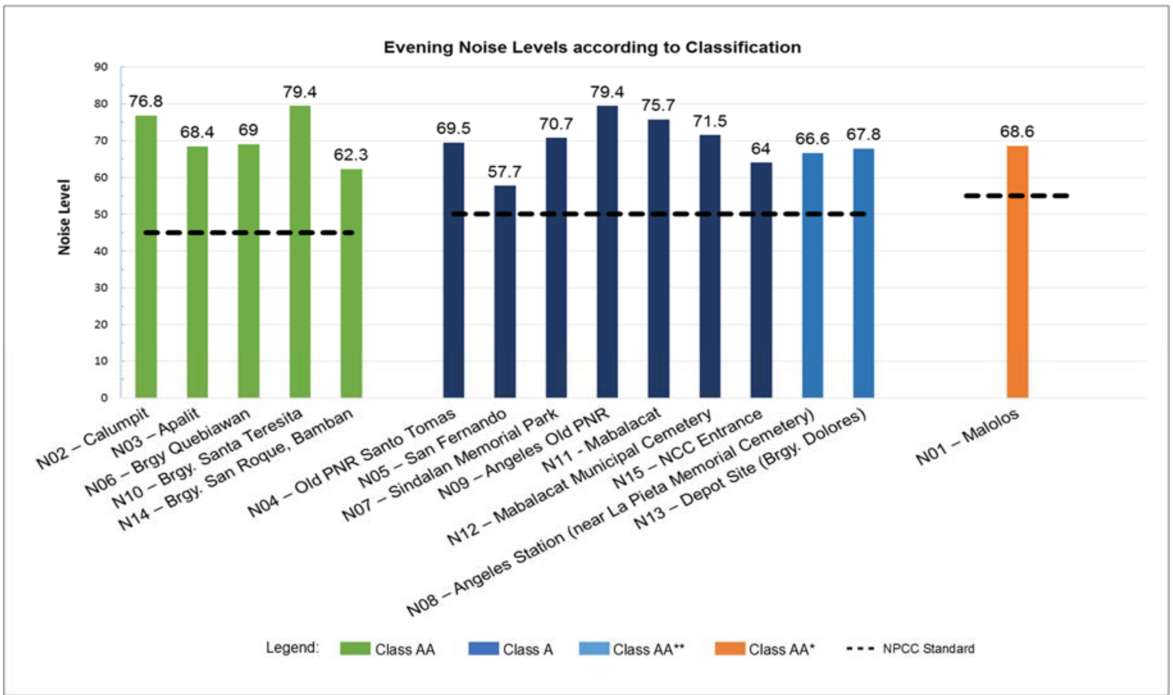


Figure 3.3.21. Evening Ambient Noise Levels According to NPCC Classification

Noise Levels During Nighttime

874. As shown in **Figure 3.3.22**, noise levels in all stations exceeded the NPCC standards during the nighttime period. The highest noise level of 77.6 dBA was measured at station N07 – Sindalan Memorial Park Station while the lowest noise level of 54.6 dBA was measured at station N15– NCC Entrance Station. The nighttime period covers the time between 10:00 PM to 5:00 AM.

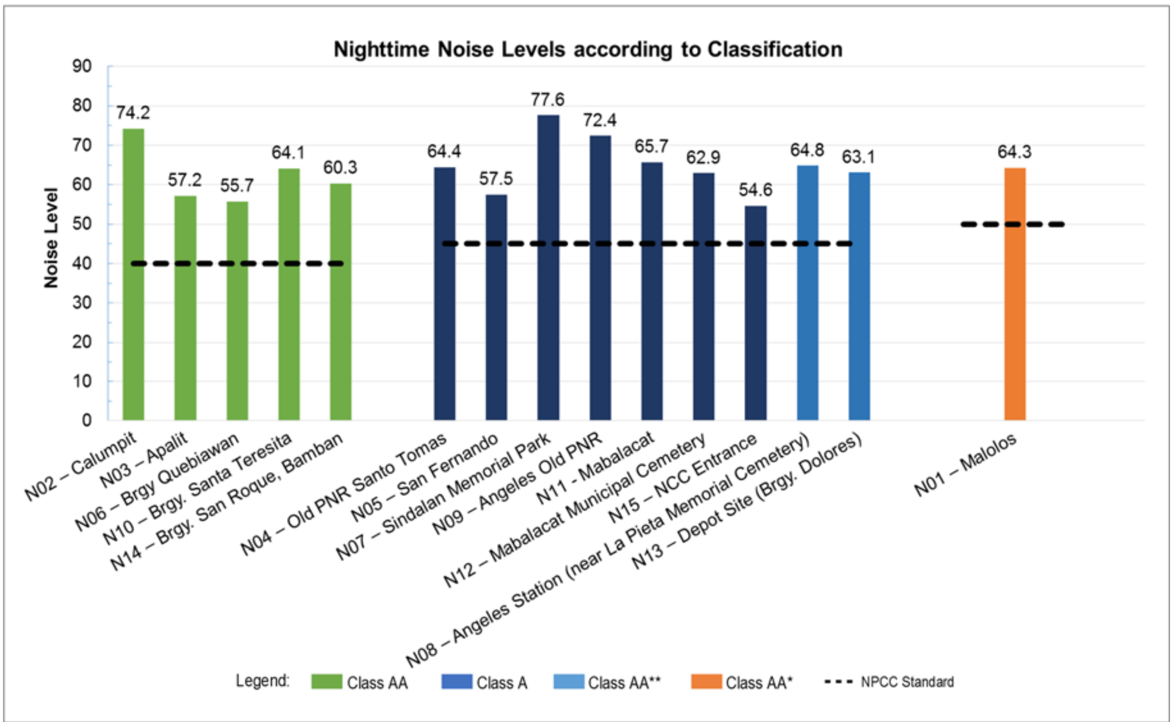


Figure 3.3.22. Nighttime Ambient Noise Levels According to NPCC Classification

b) For WHO Guildines Compliance

Noise Levels During Daytime

875. As shown in **Figure 3.3.23**, the daytime noise levels in all stations exceeded the WHO guideline values of 55 dBA for the Residential, Institutional and Educational Category. The highest noise level of 70.3 dBA was measured at station N06 – Brgy. Quebiawan Station while the lowest noise level of 55.1 dBA was measured at station N15 – NCC Entrance Station. The daytime period as set by WHO covers the time between 7:00 AM to 10:00 PM.

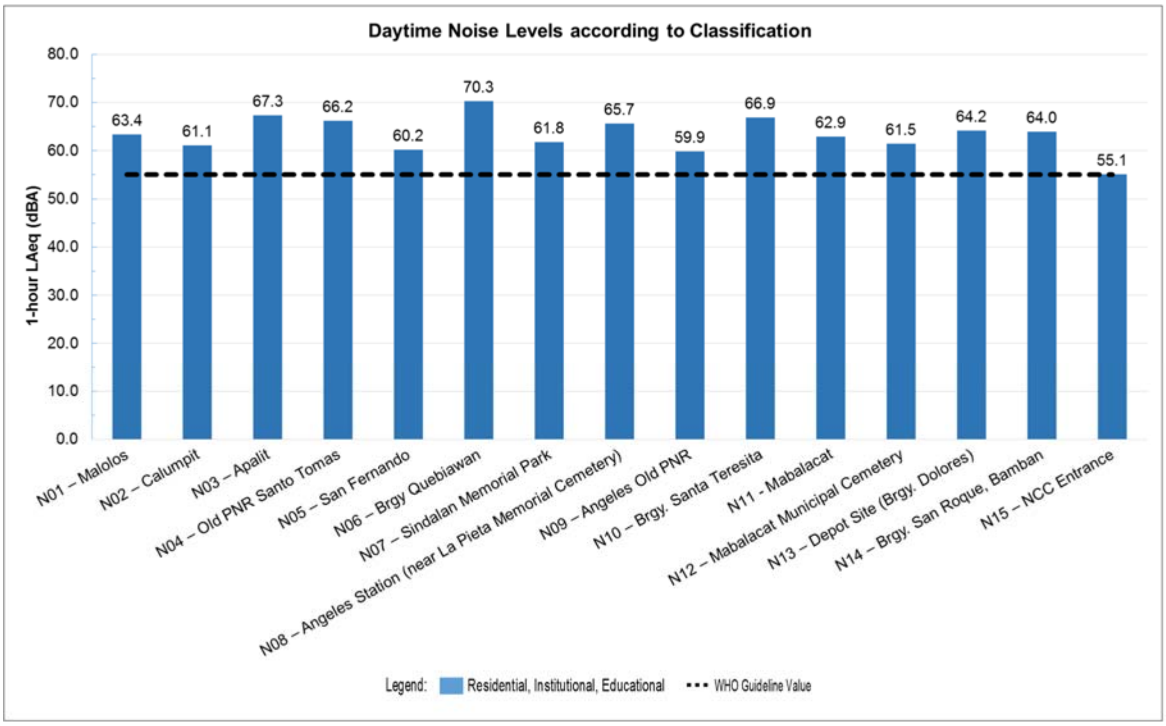


Figure 3.3.23. Daytime Ambient Noise Levels According to NPCC Classification

Noise Levels During Nighttime

876. As shown in **Figure 3.3.24**, the nighttime noise levels in all stations exceeded the WHO guideline value of 45 dBA for the Residential, Institutional and Educational Category. The highest noise level of 65.8 dBA was measured at station N02 – Calumpit Station while the lowest noise level of 48.2 dBA was measured at station N15 – NCC Entrance Station. The nighttime period as set by WHO covers the time between 10:00 PM to 7:00 AM.

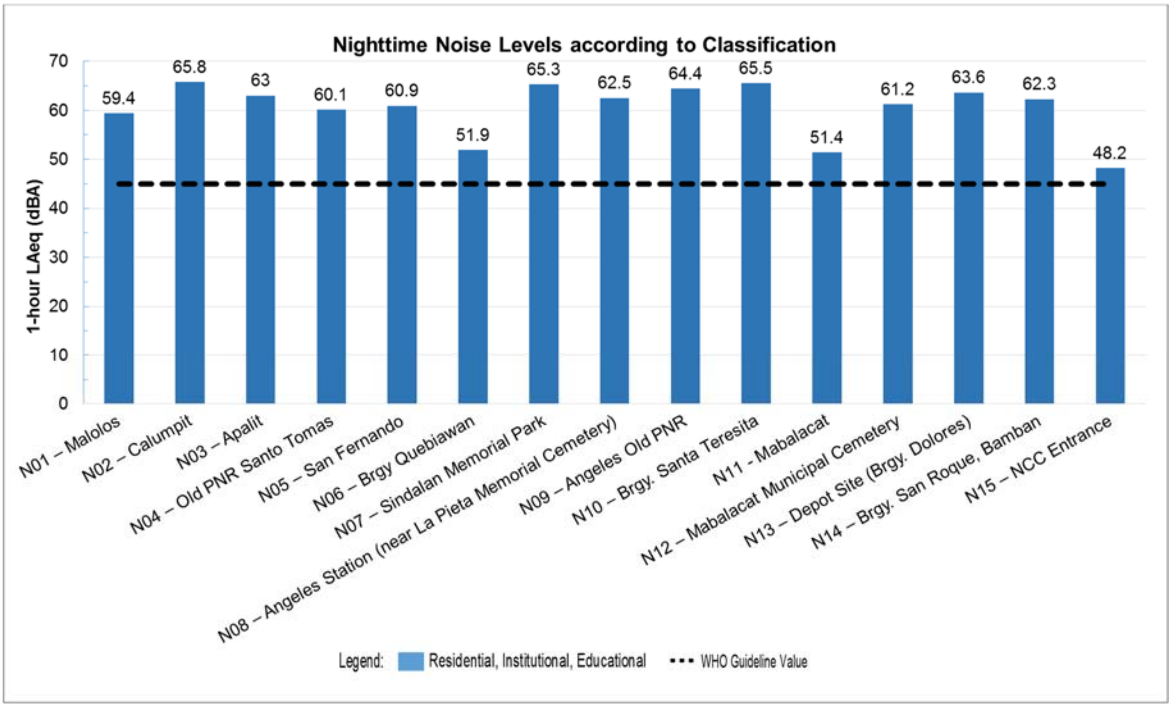


Figure 3.3.24. Nighttime Ambient Noise Levels According to NPCC Classification

3.3.3.2 Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction Phase

877. Noise level will definitely increase because of the project construction activities. Sources of noise will include heavy equipment and machineries, generator sets, construction activities, tunnelling, and vehicles coming in and out of the Project site.

878. Based on noise survey conducted in the area, measured noise levels at various stations are already above the NPCC and WHO standards. It is important, therefore, that the MCRP construction activities do not worsen the acoustic situation of existing condition.

879. Sensitive receptors near the MCRP alignment that may be affected by the construction activities will be identified for provision of appropriate mitigating measures during the Detailed Design Phase of the Project.

1) Prediction method

880. The prediction model developed in the Technical Handbook for Environmental Impact Assessment of Roads (2007) is applied.

a. Prediction model

881. The noise level at receiving points is calculated by the following formula of sound propagation.

$$L_p = L_w + 10log\left\{\frac{Q}{4\pi r^2}\right\} = L_w - 20logr - 8$$

Where, L_p: Noise level at Receiving Point (dB)
L_w: Power Level of noise source (dB)
r: Distance between noise source and receiving point (m)
Q: Constant on sound radiation (in case of hemisphere radiation: =2)

b. Power level of construction machinery

882. The power levels of main construction machinery are shown in Table 3.3.17.

Table 3.3.17. Weighted Power Level of Construction Type

Construction Type	A weighted power level (dB)
Pile drivers (hydraulic pile hammer)	135
Rock drilling (soft rock)	119
Slope surface splay	108
Asphalt pavement	108

Source: Technical Handbook for Environmental Impact Assessment of Roads (2007)

c. Location of noise source and receiving point

883. The construction machinery, i.e., noise emission source is assumed to be set on the center of the track (see **Figure 3.3.25**). During the construction, temporary walls (3.0 m) will be set at the edge of the ROW (construction limit). The height of the receiving point is 1.2 m.

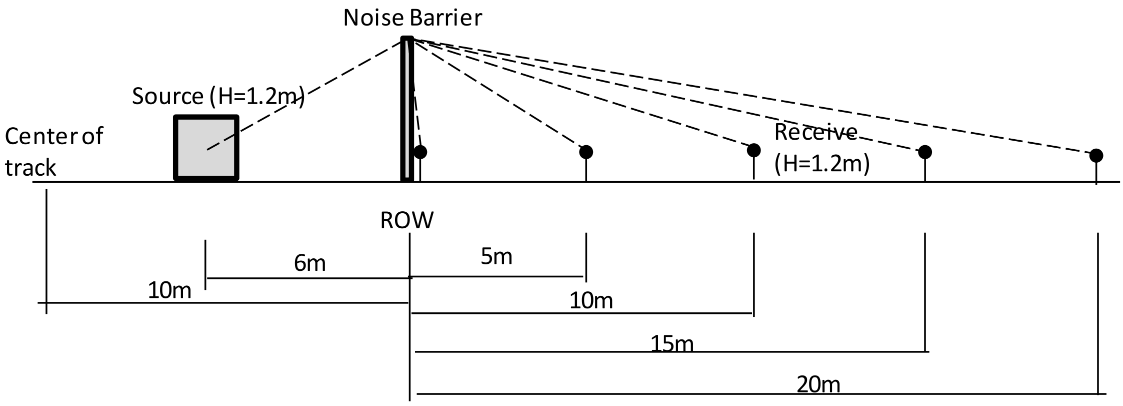


Figure 3.3.25 Location of Source and Receiving Points

d. Example of Computation of Construction Noise

Rock drilling (soft rock)
Power level (A weighted): 119dB
In case that distance from the edge of the ROW to receiving point is 5m,

Case of "without noise barrier;

$$L_p = L_w + 10log\left\{\frac{Q}{4\pi r^2}\right\} = L_w - 20logr - 8$$

Where,L_p: Noise level at Receiving Point (dB)
L_w: Power Level of noise source (dB) =119dB
r: Distance between noise source and receiving point (m)
= 6 (Source – ROW) +5 (ROW-Receiving Point) =11m
Q: Constant on sound radiation (in case of hemisphere radiation: =2)

<u>Lp (without noise barrier) = 90.2dB (without noise barrier)</u>

Case of "with noise barrier (3m)

Differential of diffraction (m): δ = 0.58m
Attenuation due to differential of diffraction: Δ Ld (dB)
Δ Ld is referred on below figure. (MLIT, J) = <u>-17 dB</u>

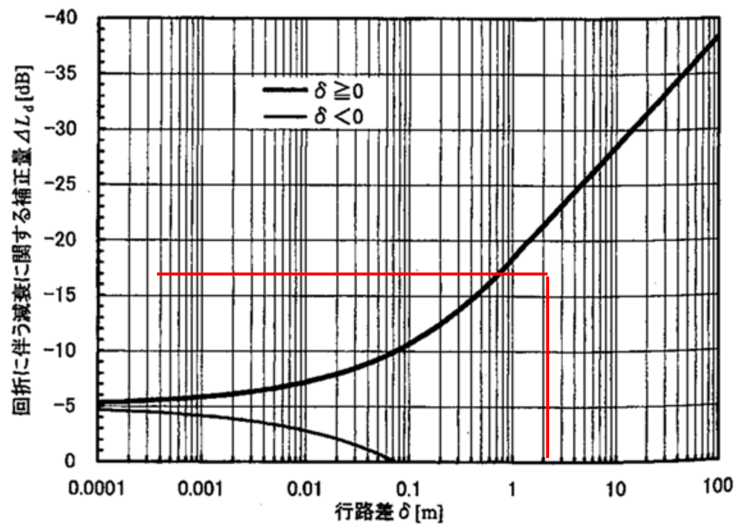


Figure 3.3.26 Attenuation of noise barrier (for construction machinery, MLIT, J)

<u>Lp (with noise barrier) = 90.2 – 17 = 73.2 dB (without noise barrier)</u>

2) Results of the prediction and evaluation

884. The results of the prediction of the construction noise are shown in **Table 3.3.18**. Without the temporary wall, the noise levels of pile driver will exceed the maximum allowable level 90 dB. The predicted noise levels of rock drilling will exceed maximum allowable level 85 dB up to 10 m from the edge of the ROW. In case of the slope surface spray and asphalt pavement, the predicted noise level will not exceed the maximum allowable noise. With the 3 m high temporary wall, the predicted noise levels of all types of construction work will be below the maximum allowable noise levels during the construction.

Table 3.3.18. Results of Prediction of Construction Noise

Construction Work		Distance from the Edge of the ROW to Receiving Point (m)					Maximum Allowable Noise Level2 (dBA)	
Type1	Power Level (dB)	0	5	10	15	20		
Without temporary wall								
Pile drivers	135	111.4	106.2	102.9	100.6	98.7	90	Class 1
Rock drilling (soft rock)	119	95.4	90.2	86.9	84.6	82.7	85	Class 2
Slope surface splay	108	84.4	79.2	75.9	73.6	71.7	75	Class 3
Asphalt pavement	108	84.4	79.2	75.9	73.6	71.7	75	Class 4
With temporary wall (3.0m)								
Pile drivers	135	90.4	89.2	88.9	86.6	84.7	90	Class 1
Rock drilling (soft rock)	119	74.4	73.2	72.9	70.6	68.7	85	Class 2
Slope surface spray	108	63.4	62.2	61.9	59.6	57.7	75	Class 3
Asphalt pavement	108	63.4	62.2	61.9	59.6	57.7	75	Class 4

Note: 1) Technical Handbook for Environmental Impact Assessment of Roads, 2007
2) NPCC Memorandum Circular No. 002, May 12, 1980
Class 1 Work which requires pile drivers (excluding manual type), file extractors, riveting hammers or combination thereof. This classification does not include work in which pile drivers are used in combination with earth augers.
Class 2 Work which requires rock drills or similar equipment like jack hammers or pavement breakers
Class 3 Work which requires air compressor (limited to those compressors which use power other than electric motors with a rated output of 15 KW or more in excludes air compressors powering rock drills, jack hammers and pavement breakers)
Class 4 Operation involving batching plant (limited to those with a mixer capacity of 0.5 or more cubic meters) and/or asphalt plants (limited to those with mixer capacity of 200 KG or more). Batching plants for the making or mortar are excluded.

Source: JICA Study Team

3) Mitigation Measures

885. Construction sites are very common sources of noise pollution. The main sources of noise pollution are heavy machineries and transportation of equipment, materials handling equipment, stationary equipment, tunneling procedures, and other types of equipment etc.

886. The identified impacts will have moderate to high adverse effect, with the effect more pronounced along the alignment where schools, hospitals, and residential areas are closely nearby. However, mitigating measures described below are anticipated to address almost all identified impacts.

887. To reduce noise disturbance that will have direct effects to workers and nearby community, the following measures will be implemented.

888. For pre-construction phase;

- Select sites in consideration of sensitive receptors including ecologically significant areas (if any) that are likely to be affected;
- Minimise alteration of topography and removal of vegetation;

- Plan construction activities in consideration of time and scale of construction to optimize the use of construction equipment, machineries, and vehicles to minimize nuisance noise;
- Schedule high noise generating activities during daytime to reduce disturbance to nearby communities;
- Plan and design effective height of noise barriers on area with sensitive facilities such as school, hospital, residential area. For the tunnel section, install noise absorbing mechanism.

889. For construction phase;

- Provision of noise control devices such as mufflers and noise suppressors for all construction equipment and machineries to help minimize the generation of noise. Use of electric instead of diesel powered equipment and hydraulic tools instead of pneumatic tools;
- Regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard;
- Provision of temporary noise barriers such as acoustic curtains, particularly in noise-sensitive areas such as churches, schools, and hospitals in the immediate vicinity of the construction area;
- Minimize vehicle transport by maximizing the use and recycling of materials generated on-site;
- Provision of training on noise mitigation and provide appropriate personal protective equipment (PPE), e.g. earmuffs to construction workers; and
- Monitor noise levels at identified sampling point including nearby sensitive receptors (residential, school and hospital areas) including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provide. Monitor actions on complaints, if any, based on Grievance Redress Mechanism.

(2) Operation Phase

890. The noise by train operation was examined with reference to "Proposal of a Prediction Model for Noise of Conventional Railway, Noise Control Engineering 20(3), 1996, Institute of Noise Control Engineering, Japan" and "EIA report for Osaka Outer Ring for East-Osaka Urban Rapid Transit, 1999, Osaka Prefecture".

1) Prediction method

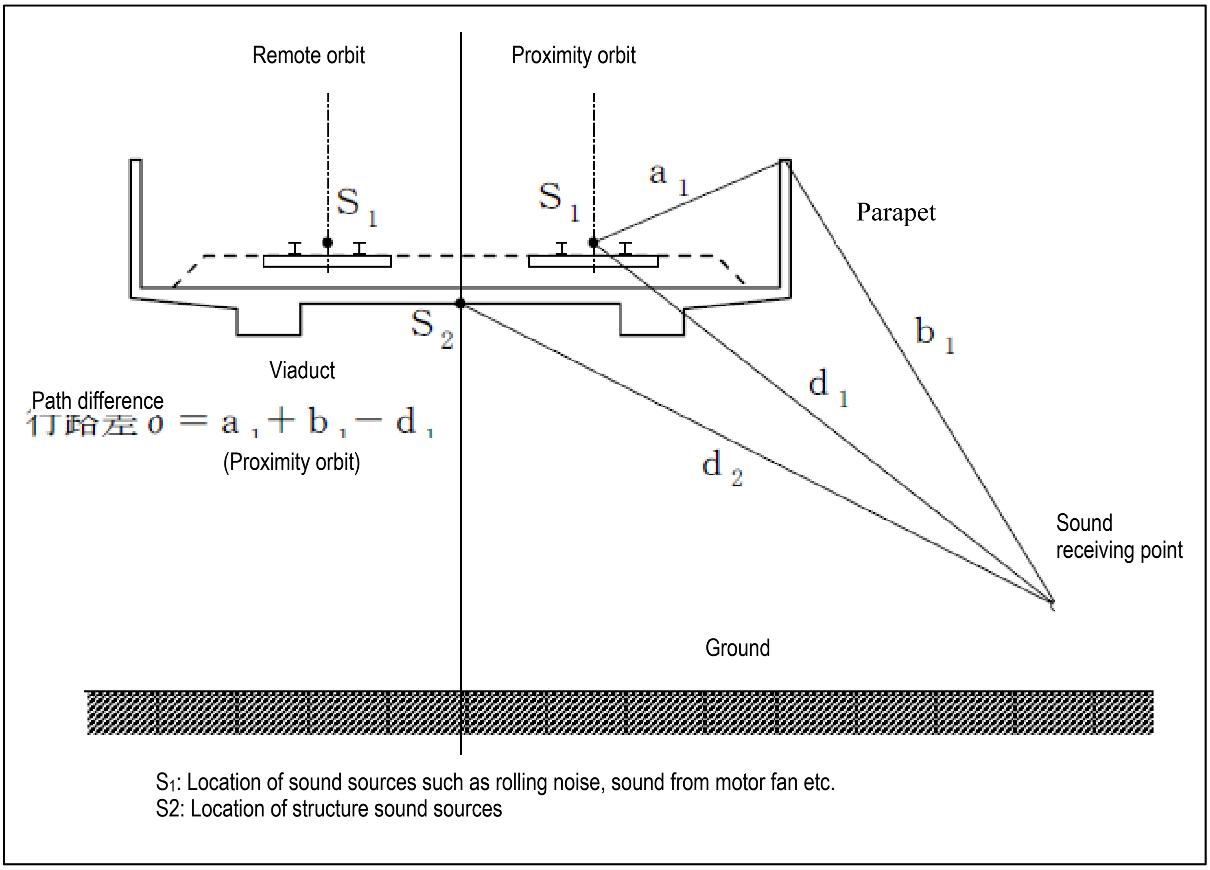
891. Based on section structure and train velocity, the maximum noise level at the time of the run of 1 train (L_{Amax}) is initially estimated. Moreover, single event sound exposure level (L_{AE}) is estimated from train transit time. Finally, equivalent continuous sound pressure level (L_{Aeq}) by train number every train type of time zone is calculated.

2) Prediction model

892. The prediction model by Japanese formula is applied. The noise generated by the train operation compounds 3 main sound sources such as rolling noise of running train, structure sound from vibration of slab on concrete viaduct, and railway vehicle sound. The formula is calculated by combining these sound sources.

a. Estimation of maximum value of noise level (L_{Amax})

893. The prediction formula for train length I m and train velocity V km/h indicates Formula 1 - 4 by definition of each variable shown in **Figure 3.3.27**.



Source: Proposal of a Prediction Model for Noise of Conventional Railway, Noise Control Engineering 20(3), 1996, Institute of Noise Control Engineering, Japan

Figure 3.3.27 Arrangement of Sound Source, Sound Receiving Point and Explanation of Path Difference

(a.1) Rolling noise

$$L_{Amax}(R) = PWL_R - 5 - 10log_{10}d_1 + 10log_{10}\left(\frac{\left(\frac{l}{2d_1}\right)}{1+\left(\frac{l}{2d_1}\right)^2} + \tan^{-1}\left(\frac{l}{2d_1}\right)\right) + \alpha_1 \quad --\text{Fomula 1}$$

Where, $L_{Amax}(R)$: maximum value of noise level (decibel)

PWL_R : Sound source power level (decibel)

$PWL_R = 30.0 \log_{10}(V) + 42.6$

D_1 : Distance between center of run orbit and sound receiving point (m)

L : Train length (m)

V : Train velocity (km/h)α_1 : damping effect by balustrade (decibel)

(a.2) Structure sound

$$L_{Amax}(C) = PWL_C - 5 - 10log_{10}d_2 + 10log_{10}\left(\frac{\left(\frac{l}{2d_2}\right)}{1+\left(\frac{l}{2d_2}\right)^2} + \tan^{-1}\left(\frac{l}{2d_2}\right)\right) + \varDelta L_C \quad --\text{Formula 2}$$

Where, $L_{Amax}(C)$: Maximum value of noise level (decibel)

PWL_C : Sound power level of structure sound (decibel)

$PWL_C = 72$

d_2 : Distance between center of structure underside and sound receiving point (m)

$\varDelta L_C$: Correction value

$r < 4h$: $\varDelta L_C = 0$

$r > 4h$: $\varDelta L_C = - 10 \log_{10}(r/4h)$

r: Horizontal distance between center of viaduct and sound receiving point (m)
h: Height of viaduct underside from ground (m)

(a.3) Maximum value of noise level (L_{Amax})

The maximum value of noise level for one (1) train formation is calculated by combining noise levels calculated by Formula 1 - 2.

$$L_{Amax} = 10log_{10}\left(10^{\frac{L_{Amax}(R)}{10}} + 10^{\frac{L_{Amax}(C)}{10}}\right) - -\text{Formula 3}$$

Relation between estimation of maximum value of noise level (L_{Amax}) and single event sound exposure level (L_{AE}).

The relation between estimation of maximum value of noise level (L_{Amax}) and single event sound exposure level (L_{AE}) is calculated by using Formula 4.

$$L_{AE} = L_{Amax} + 10log_{10}(l/(1000V/3600)) - -\text{Formula 4}$$

Calculation of equivalent continuous sound pressure level (LAeq)

$$L_{Aeq} = 10log_{10}\left(\frac{T_i}{T}\sum_{i=1}^{n} 10^{L_{AEi}/10}\right) - -\text{Formula 5}$$

Where, L_{AEi} : Single event sound exposure level by direction and train type (decibel)
N : Number of trains
T : Time for L_{Aeq} (second)

3) Predictive condition

a. Prediction points

894. The prediction points are 1.2 m height at 0, 10, 20, 30, 40, 50 m from the edge of railway.

b. Structural condition

895. The structural conditions are as follows:

- Railway structure: Viaduct
- Track structure: Slab track
- Installation of Ballast for noise reduction
- Rail type: Long rail
- Train length: 160 m (20 m x 8 cars)

c. Operation condition

896. The number of operated trains is shown in **Table 3.3.19** based on the train operation condition. The train velocity is maximum 120 km/h.

Table 3.3.19. Total Number of Operated Trains (one-way)

Day Time (7:00 ~ 22:00)	Night Time (22:00 ~ 24:00 & 6:00 ~ 7:00)	Total
150	55	205

Source: JICA Study Team

4) Prediction results

897. The results of prediction on railway noise of the equivalent continuous sound pressure level (LAeq) (dBA) are shown on the following tables.

898. The guideline values are set at the distance of 12.5 m from the center of the nearest track. The predicted noise levels caused by the train operation cannot be can be compared to the DENR environmental standards for noise and WHO as referece. **Table 3.3.19** shows the predicted noise level at different height of noise barrier.

Table 3.3.20. Prediction of Noise Level during Train Operation

Mitigation measures	Day/ Night	Distance from ROW						Guideline values[1] (LAeq)	WHO Guidelines[2]	
		0 m	10 m	20 m	30 m	40m	50m		RIE	IC
Barrier H=1.1m	Day	58.1	58.6	58.3	59.0	59.5	59.0	60	55	70
	Night	56.0	56.5	56.2	56.9	57.3	56.8	55	45	70
Barrier H=1.5m	Day	57.8	58.1	58.1	58.1	57.8	57.7	60	55	70
	Night	55.7	55.9	56.0	55.9	55.7	55.5	55	45	70
Barrier H=2.0 m	Day	57.6	57.1	57.1	56.6	55.7	55.5	60	55	70
	Night	55.4	55.0	55.0	54.4	53.6	53.4	55	45	70

Note
[1] Noise guideline values for the new project and large-scale modification of the conventional railway in Japan (Environmental Agency, 1995)
[2] REI – Residential, Institutional, Educational; IC – Industrial, Commercial

Source: JICA Study Team

899. The following findings are drawn from the resulting data:

- Results shows that the predicted noise level with noise barrier of 1.1 m and 1.5 m height will exceed the guideline values for night..
- With a 2 m height noise barrier installed, the predicted noise level is below 55 dBA during night time.

900. The predicted noise levels satisfy the noise guideline values for the areas directly facing the railway. However, according to the guidelines, noise level should be further reduced in the noise sensitive areas. The adequate measurements are recommended for noise sensitive receptors of Class AA within 50 m of the alignment.

901. The impact to the noise sensitive receptors within 50m distance from the aligment is also examined as shown in the **Table 3.3.21**. The noise level shows that with 2 m height noise barrier will meet Japanses standard howeve does not coform the NCPP and WHO standards. It is highly recommended that the appropriate height of noise barrier, additional mitigation measure will be provided.

Table 3.3.21. Prediction of Noise Level at Sensitive receptors during Train Operation

No.	Sensitive Receptors	Approximate Distance from Alignment centerline (meters)	Noise from train with 2.0m barrier dBA	Japanese Standard[1]	NCPP standard Night time (10 pm- 5 am) dBA	WHO Standard
Malolos, Bulacan						
1	Malolos Height United Methodist Church	50	53.4	55	40 (AA)	45
2	Reign with Christ Ministry Chapel	20	55.0	55	40 (AA)	45
3	John 3:16 Ministries Chapel	15	55.0	55	40 (AA)	45
4	Royal Estate Subdivision Houses	15	55.0	55	45 (A)	45
5	Church of the Lord National Christian Ministries Inc. Chapel	15	55.0	55	40 (AA)	45

No.	Sensitive Receptors	Approximate Distance from Alignment centerline (meters)	Noise from train with 2.0m barrier dBA	Japanese Standard[1]	NCPP standard Night time (10 pm- 5 am) dBA	WHO Standard
Calumpit, Bulacan						
4	Green Plains Subdivision Houses	10	55.0	55	45 (A)	45
5	Glorious Lord Ministries Chapel	15	55.0	55	40 (AA)	45
6	Bisita ng Sto. Nino Chapel	15	55.0	55	40 (AA)	45
7	Iglesia ni Cristo, Calumpang	50	53.4	55	40 (AA)	45
8	Calumpit National High School	30	54.4	55	40 (AA)	45
9	Calumpit College	30	54.4	55	40 (AA)	45
10	St. Anthony Academy of Bulacan	50	53.4	55	40 (AA)	45
11	The Grove, Row-houses	5	55.2	55	45 (A)	45
Apalit, Pampanga						
12	Ceneca Birthing Home Clinic	20	55.0	55	40 (AA)	45
Sto. Tomas, Pampanga						
13	Bondoc Ville Resettlement Site	10	55.0	55	45 (A)	45
San Fernando, Pampanga						
14	Ang Dating Daan Church	5	55.2	55	40 (AA)	45
15	New Sta. Lucia Parish	10	55.0	55	40 (AA)	45
16	DAR Field Unit (RFU II) - Integrated Laboratories	0	55.4	55	45 (40+5) AA)	45
17	Let's Play Provincial Day Care Center	5	55.2	55	40 (AA)	45
18	Provincial Governor's Residence	35	54.0	55	45 (A)	45
19	San Fernando Station Church	0	55.4	55	45 (40+5) AA)	45
20	ACO Arcade Appartelle	10	55.0	55	45 (A)	45
21	St. Scholastica Grade School	25	54.0	55	40 (AA)	45
22	Quebiawan Elementary School	10	55.0	55	40 (AA)	45
23	Central Luzon Regional Government Complex Blgds.	20	55.0	55	40 (AA)	45
24	Maimpis Elementary School	50	53.4	55	40 (AA)	45
25	Anchored Bible Baptist Church of Sindalan	50	53.4	55	40 (AA)	45
26	Christian Church Fellowship	50	53.4	55	40 (AA)	45
27	Eternal Peace / Sindalan Memorial Park	20	55.0	55	40 (AA)	45
28	Fortuneville Phase 1 and 2	10	55.0	55	45 (A)	45
Angeles						
29	La Pieta Memorial Park	10	55.0	55	40 (AA)	45
30	House of Many Mansions Memorial Chapel	35	54.0	55	40 (AA)	45
31	Angeles Public School Teachers Credit	40	53.6	55	40 (AA)	45
32	Angeles Elementary School	15	55.0	55	40 (AA)	45
33	LSE Day Care Center	20	55.0	55	40 (AA)	45
34	Lourdes Sur Day Care Center	0	55.4	55	45 (40+5) AA)	45
35	Proposed Chapel Development	10	55.0	55	40 (AA)	45
36	PNP Station	5	55.2	55	40 (AA)	45
37	Iglesia ni Cristo Church, Sta. Teresita	40	53.6	55	40 (AA)	45
38	United Church of Christ (with Kindergarten)	30	54.4	55	40 (AA)	45
Mabalacat, Pampanga						
39	CIA Structure	5	55.2	55	40 (AA)	45
40	Mabalacat City Hall	50	53.4	55	40 (AA)	45
41	Grotto of our Lady of Lourdes	10	55.0	55	40 (AA)	45

Note: [1]Noise guideline values for the new project and large-scale modification of the conventional railway in Japan (Environmental Agency, 1995)

5) Mitigation Measures

902. The generated noise of the train operations has a moderate adverse effect to the receiving environment, especially in areas where the alignment would be near schools, churches, and hospitals.

903. With the operation of the MCRP, it is expected that traffic volume will be reduced. A 50% reduction of the traffic volume may result in a 3 dB reduction in noise levels, regardless of the absolute number of vehicles. 10% reduction in traffic volume will decrease noise by 0.5dB.

904. Based on the results of the predicted noise levels, mitigation and enhancement measures are as follows:

- Use of long rails and ballast-less track with elastic and absorbent sleeper supports to minimize noise generation from train operation;
- Optimize the number of train operation at night time to reduce generated noise;
- Provision of effective height of noise barriers ideally site specific, especially at areas with sensitive receptors such as school, hospital, residential area;
- Provision of noise control device such as muffler to all stationary sources (i.e. generator set);
- Regular inspection and proper maintenance of trains and tracks to ensure its optimal operation and functionality;
- Monitor noise levels at identified sampling point including nearby sensitive receptors (residential, school and hospital areas) including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provide. Monitor actions on complaints, if any, based on Grievance Redress Mechanism.

3.3.4 Vibration

905. Vibration introduced by a rail transport system, is composed of the vibration energy transmitted through the supporting structure under the tracks and into the ground. Once the vibration gets into the ground, it propagates through the various soil and rock strata, creating a path into the nearby buildings and facilities. The level of vibration is reduced by distance from the source, according to the local geological conditions. Relevant receptors can be the vibration-sensitive buildings (e.g., residences, hospitals, or schools). Vibrations at high levels may cause perceptible shaking of the structures and create disturbing sound inside the rooms. Vibration sensitive instruments (microscopes, medical test instruments, radio transmission facilities, etc.) can be adversely affected if these are located within a short distance (e.g., a few tens of meters) away from the rail tracks.

906. The tolerance of humans to vibration is widely ranged, since people have become accustomed to large movements while riding vehicles in motion. Many people have even learned to take a rest and sleep even while inside moving and vibrating cars, trains, and airplanes. As such, people have therefore adjusted to various levels of vibration and their tolerance level have also become variable, being sensitive during nighttime and while at home or in buildings, and very insensitive while inside moving vehicles and when awake or during daytime. Thus, not all receivers have the same vibration-sensitivity. People outdoors are usually very tolerant to vibration, while those inside are annoyed when vibration is perceptible and sustained, or when these suddenly occur while at rest.

907. The Philippines does not have any environmental criteria for vibration. This report uses as reference the vibration standards for environmental assessment in Britain which describe vibration criteria for various types of receivers. Ground borne vibration can be described in terms of displacement, velocity, or acceleration. In evaluating impacts from this transit project we consider the adverse levels of vibration according to certain levels that can cause damage to buildings and thus, as compared to seismic/earthquake shaking. The levels of vibration that disrupt sensitive receptors (equipment, structures) and can cause annoyance to humans inside buildings are also used as criteria in this report.

3.3.4.1 Ambient Vibration Level

(1) Field Survey

908. Vibration study for the proposed MCRP was conducted on February 12-20, 2018. Vibration levels were measured at 15 sampling stations established along the proposed MCRP. The sites were predominantly rural. The sites varied from residential areas to vacant areas near the

roads in urbanized areas. The descriptions of the sampling stations and the schedule of sampling are presented in **Table 3.3.22** and **Figure 3.3.28**.

909. Vibration study was conducted in accordance to the provisions of the British Standard 7385 (1993) since Philippines has no standards or procedures of investigation for the vibration study.

910. At each site, 24-hour sampling was undertaken where vibration was recorded using Vibron Seismometer which is a seismic data recorder connected to geophones. Three (3) sets of vertical sensors and three (3) additional sets of triaxial sensors created the four (4) sets of sensors that are spread one (1) meter apart around each observation area. The uniaxial sensors have a natural frequency of 4.5 Hz and a sampling frequency of 147 samples per second. Each seismic sensor was deployed in pre-identified sites, on grade of concrete or asphalt pavement or on barren surface road side or grounds of the facility.

Table 3.3.22. Description of Vibration Sampling Stations

Station ID	Description	Latitude	Longitude	Date of Sampling
V01	Malolos Station	14°51'12.87"N	120°48'51.89"E	Feb. 12-13, 2018
V02	Calumpit Station	14°54'57.69"N	120°46'5.09"E	Feb. 12-13, 2018
V03	Apalit Station	14°56'47.04"N	120°44'52.35"E	Feb. 13-14, 2018
V04	Santo Tomas old PNR Station	15° 0'16.70"N	120°42'28.21"E	Feb. 13-14, 2018
V05	San Fernando Station	15° 1'36.12"N	120°41'12.75"E	Feb. 14-15, 2018
V06	Quebiawan Elementary School	15° 3'24.23"N	120°39'54.07"E	Feb. 14-15, 2018
V07	New Barrio Rd. - Sindalan Memorial Park	15° 5'18.93"N	120°38'31.10"E	Feb. 15-16, 2018
V08	Angeles Station (Near La Pieta Memorial Cemetery)	15° 8'40.12"N	120°35'27.18"E	Feb. 15-16, 2018
V09	Angeles old PNR Station	15° 8'12.72"N	120°35'50.97"E	Feb. 16-17, 2018
V10	Iglesia ni Cristo, Brgy. Santa Teresita	15° 8'57.78"N	120°35'20.91"E	Feb. 16-17, 2018
V11	Mabalacat Station (Brgy. Lakandula)	15°10'26.03"N	120°34'57.22"E	Feb. 17-18, 2018
V12	Mabalacat Cemetery, Brgy. San Francisco	15°13'1.69"N	120°34'24.90"E	Feb. 17-18, 2018
V13	Depot Site (Brgy. Dolores)	15°14'18.37"N	120°34'1.00"E	Feb. 18-19, 2018
V14	Dapdap Resettlement Site, Brgy. San Roque, Bamban	15°17'6.41"N	120°31'45.60"E	Feb. 18-19, 2018
V15	NCC Station	15°21'0.35"N	120°31'39.79"E	Feb. 19-20, 2018

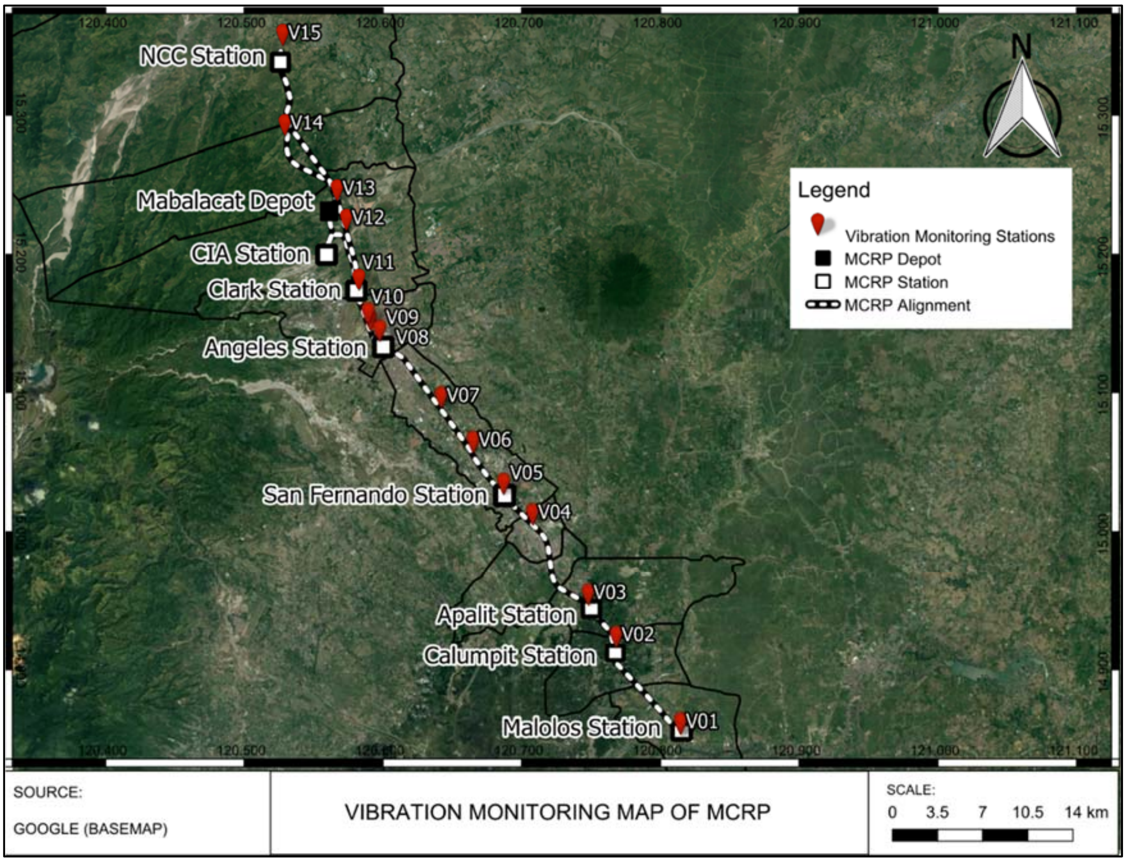


Figure 3.3.28. Location of the Vibration Sampling Station

(2) Applied Standard

911. **Table 3.3.23** presents the effects of vibration levels in terms of human perception and disturbance. Vibration levels were compared to the threshold of tolerance set at 10 mm/s.

Table 3.3.23. Guidance on Effects of Vibration Levels

Vibration Level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Source: BS 5228-2:2009 (BSI British Standards: Code of practice for noise and vibration control on construction and open sites)

(3) Results and Analysis

912. Observations of vibration at the areas along the proposed MCRP indicate that sites vary in levels of vibration from a low of 1.1 mm/s to a high of 32 mm/s. The areas with the highest levels of vibration are in the Depot Site (Brgy. Dolores), La Pieta Memorial Cemetery, Sindalan Memorial Park, Quebiawan Elementary School, Sto. Tomas/Brgy. Sto. Niño, and Mabalacat Cemetery. Road traffic appears to dominate the cause of high levels of vibration. At these areas, the range of vibration levels may reach beyond 10 mm/s which may be considered unpleasant by people if subjected to continuous motion. The sites with the lowest level of vibration are the Apalit Station and Lakandula, where vibration levels range only between 2.5 mm/s to 5.0 mm/s.

913. Significant spikes in vibration levels reaching beyond 20 mm/s are notably observed in Capas, Depot Site (Brgy. Dolores), and Mabalacat Cemetery. In Capas, vibration level spiked to 31.0 mm/s corresponding to the passing of a huge truck carrying a backhoe equipment. Similarly, in Depot Site (Brgy. Dolores), vibration level spiked to 29 mm/s corresponding to the passing of huge truck carrying sand and gravel. In Mabalacat Cemetery, vibration level spiked several times reaching up to 25 mm/s as large aircrafts ascending from the nearby Clark runway cause disturbance on the ground. In all other sites, the dominant source of impulsive and short duration vibration is commonly the passing of vehicular traffic.

914. The La Pieta Memorial Cemetery, Sindalan Memorial Park, Angeles, and Calumpit sites have the most pronounced changing pattern of vibration over the 24-hour period, and these are likely caused by the commercial activity and road traffic affecting these sites.

915. The summary of observed peak values for velocities (mm/s) is shown in **Table 3.3.24** while **Table 3.3.24** shows the average vibration velocity (mm/s).

Table 3.3.24. Summary Peak Velocity (mm/s) for Each Station

Sampling Stations	Recorded Peak Velocity (mm/s)	Peak Time (Velocity & Vibration)	Tolerable Effect Threshold (10mm/s)
Depot Site, Brgy. Dolores	29	8:51 PM	Above
Bamban	10.1	7:00 AM	Above
Mabalacat Cemetery	26	1:51 PM	Above
Lakandula	7.6	10:52 PM	Below
INC/Brgy. Sta. Teresita	11.8	4:27 PM	Above
Angeles Station	13.6	12:00 PM	Above
La Pieta Memorial Cemetery	13	6:25 AM	Above
Sindalan Memorial Park	12	10:59 AM	Above
Quebiawan Elementary School	15.8	9:39 AM	Above
San Fernando Station	9.4	7:09 AM	Below
Sto. Tomas/Brgy. Sto. Niño	13	5:55 PM	Above
Apalit Station	6.5	4:23 AM	Below
Calumpit	10	1:20 PM	Threshold
Malolos	9.2	1:26 PM	Below
Capas	32	4:08 AM	Above

Table 3.3.25. Summary of Average Vibration (in mm/s) for Each Station

Sampling Stations		Vibration Level (mm/s)			
		Morning (5am – 9am)	Day (9am – 6 pm)	Evening (6pm – 10 pm)	Night (10 pm – 5am)
Depot Site, Brgy. Dolores	1	7.87735	9.17196	9.95773	6.95615
	2	8.48811	9.0053	9.05045	7.01569
	3	8.91991	8.9437	9.9508	7.39966
Bamban	1	5.91803	5.17791	4.80164	5.13468
	2	6.53883	6.13931	6.12888	5.93606
	3	7.32152	6.69258	6.31838	6.49052
Mabalacat Cemetery	1	9.76048	10.9555	17.15917	10.23125
	2	8.67168	9.94621	15.17268	9.59615
	3	9.02573	9.71456	15.69867	9.13919
Lakandula	1	5.82093	6.30257	6.34295	5.71426
	2	3.74839	4.13648	4.23236	3.77939
	3	3.30793	3.75879	3.85278	3.28708
INC/Brgy. Sta. Teresita	1	5.70298	7.08218	6.77936	5.75071
	2	6.04906	6.95778	6.62504	5.45534
	3	7.82933	8.71727	8.32436	6.88854
Angeles Station	1	8.21655	8.05897	6.00236	7.41689
	2	7.08479	6.21927	4.7675	5.77263
	3	5.58902	5.96171	4.06028	5.18094
La Pieta Memorial Cemetery	1	10.08698	10.9043	9.73584	8.29985
	2	9.33757	9.95866	8.69615	7.55301

Sampling Stations		Vibration Level (mm/s)			
		Morning	Day	Evening	Night
		(5am – 9am)	(9am – 6 pm)	(6pm – 10 pm)	(10 pm – 5am)
	3	9.25606	10.14978	9.44869	8.0549
Sindalan Memorial Park	1	8.22066	9.029	7.70542	7.17551
	2	7.12942	7.51216	6.53327	7.00525
	3	8.36373	8.87986	8.26864	7.94387
Quebiawan Elementary School	1	10.61093	11.5244	10.80395	10.74102
	2	9.8812	11.31707	10.67649	10.24383
	3	12.56935	13.57628	13.3145	12.21174
San Fernando Station	1	7.1033	6.78161	5.42175	6.21761
	2	6.54811	6.68436	5.5923	6.00949
	3	5.30876	5.52461	5.19356	4.81884
Sto. Tomas/Brgy. Sto. Niño	1	9.80058	10.4536	8.45934	9.62035
	2	8.73593	9.27358	7.18827	8.25563
	3	9.63897	9.82015	7.84647	9.55053
Apalit Station	1	4.43312	5.15312	4.07527	3.5759
	2	3.69336	3.40258	2.60602	2.72647
	3	3.51373	4.87197	4.30169	3.83949
Calumpit	1	5.15935	6.82134	6.12556	4.44539
	2	4.14313	5.08501	4.72209	3.72946
	3	5.72584	7.48115	7.18716	4.98179
Malolos	1	7.48236	7.31739	7.32151	6.61595
	2	8.0491	8.1098	7.72538	7.44936
	3	8.05465	8.04957	7.59031	7.57901
Capas	1	6.87711	5.4819	5.44875	11.19401
	2	7.65601	4.71937	4.32209	11.75241
	3	8.28705	6.12291	5.84689	12.79351

V01 Malolos Station

916. The Malolos site is located within the Malolos Old PNR station. Some impulsive events were observed, and may be coming from the traffic of heavy trucks in the nearby highway. This site has background vibration with minimum level at 6.5 mm/s and maximum level at 9.0 mm/s (**Figure 3.3.29**). This level of vibrations can be considered as unpleasant for people subjected to continuous vibrations. The recorded peak velocity for this station is 9.2 mm/s. Based on the British Standard Guidance, this level of vibration in residential environments will likely cause complaint but can be tolerated if prior warning and explanation has been given to residents.

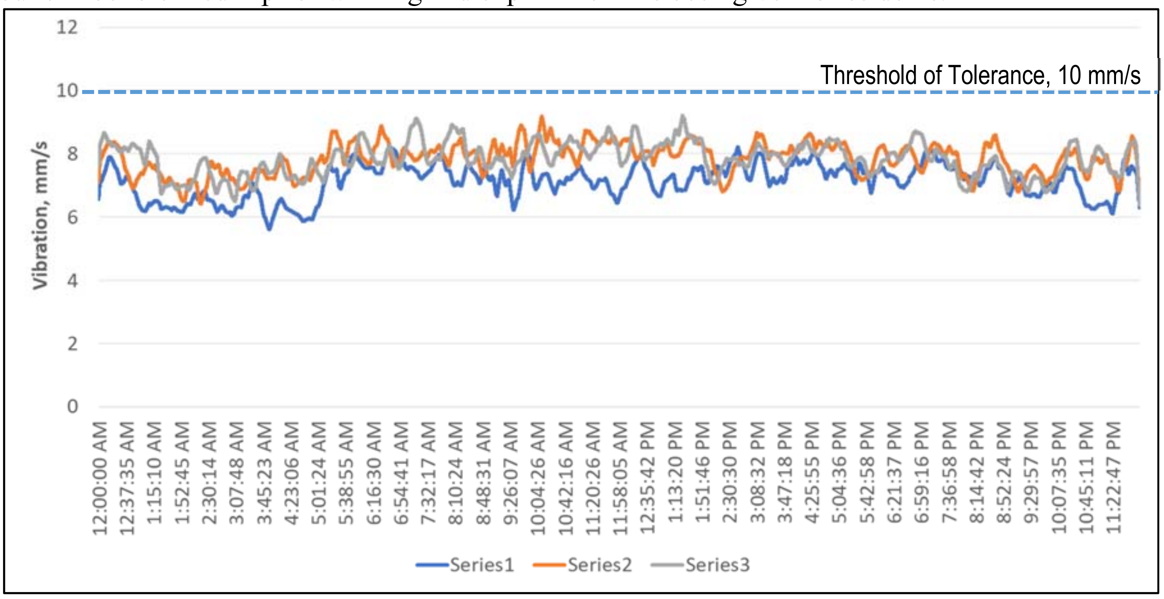


Figure 3.3.29. Malolos Site Peak Vibration Level in mm/s at 4.5Hz

V02 Calumpit Station

917. The Calumpit observation site is located in the Barangay Hall of Poblacion, Calumpit, Bulacan and is also near residential area.Vibrations are caused by passing students and light vehicles. This activity continues throughout the day and vibration level drop at around 8:00 in the evening. This site has background vibration with minimum level at 3.5 mm/s and maximum level at 9.0 mm/s (**Figure 3.3.30**). The recorded peak velocity for this station is 10 mm/s. Based on the British Standard Guidance, vibration is likely to be intolerable for any more than a very brief exposure to this level.

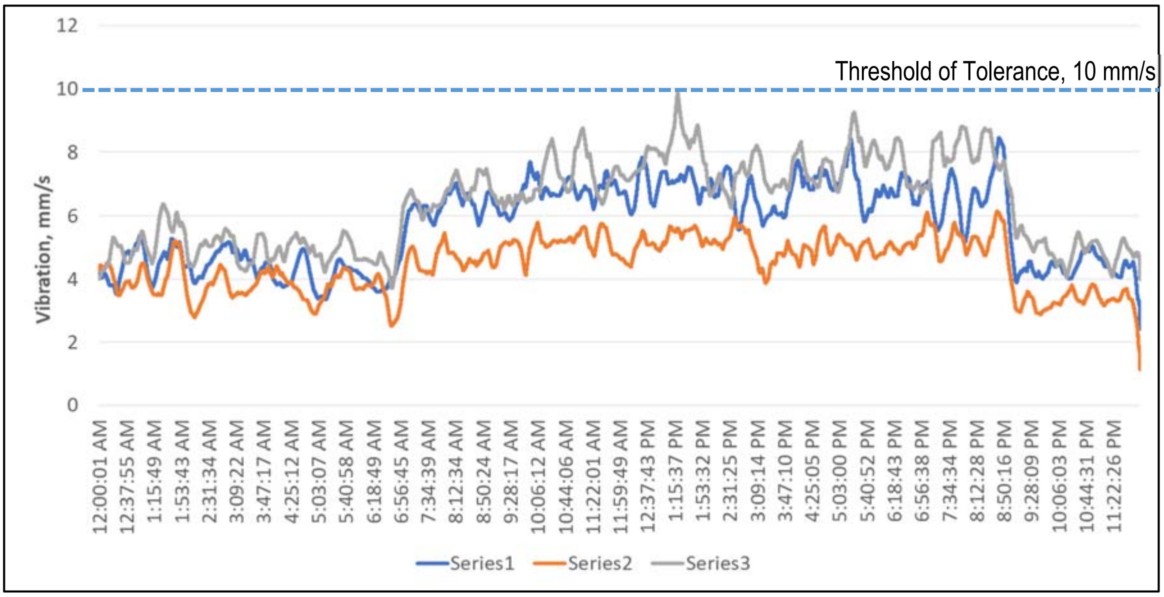


Figure 3.3.30. Calumpit Site Peak Vibration Level in mm/s at 4.5Hz

V03 Apalit Station

918. The Apalit observation site is located in a residential area near a major highway and most of the vibrations come from vehicles and people passing by. This site has background vibration with minimum level at 2.5 mm/s and maximum level at 5.0 mm/s (**Figure 3.3.31**). This level of vibrations is considered to be unpleasant for people subjected to continuous vibrations. The recorded peak velocity for this station is 6.5 mm/s. Based on the British Standard Guidance, this level of vibration in residential environments is perceptible and can be annoying to people at rest but can be tolerated if prior warning and explanation has been given to residents.

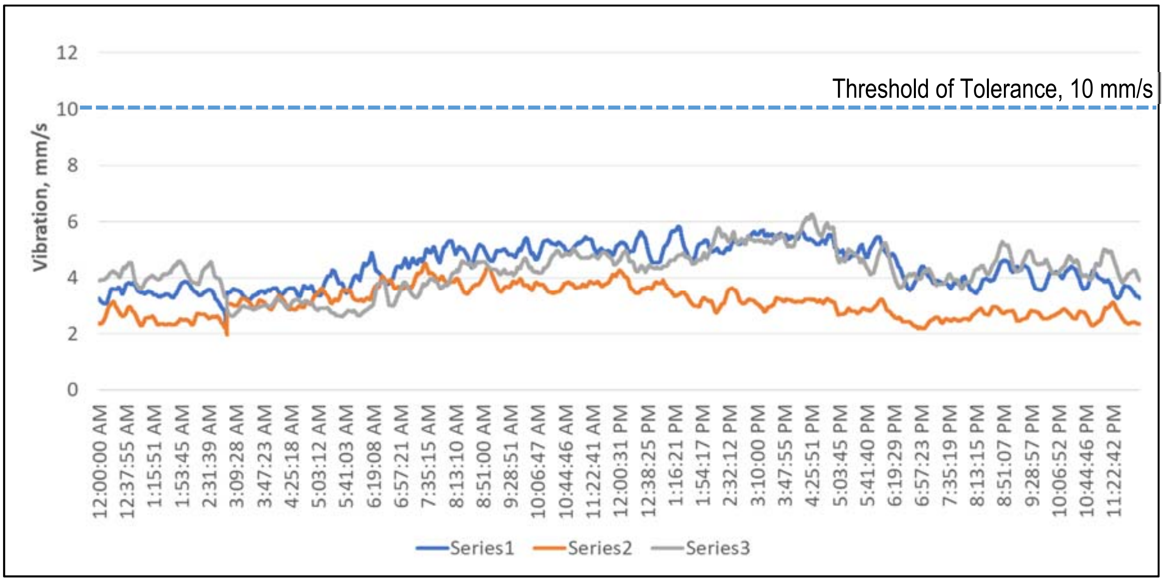


Figure 3.3.31. Apalit Vibration Peak Level in mm/s at 4.5Hz

V04 Sto. Tomas Old PNR Station

919. The Sto. Tomas observation site is an open area near the old Sto. Tomas PNR Station. Only few vehicular traffic use the road and people rarely pass by the site. This site has background vibration with minimum level at 7.0 mm/s and maximum level at 11.0 mm/s (**Figure 3.3.32**). This level of vibrations is considered to be unpleasant for people subjected to continuous vibrations. The recorded peak velocity for this station is 13 mm/s which is above the threshold level set at 10 mm/s by the British Standard Guidance. This level of vibration in residential environments will likely be intolerable for any more than a very brief exposure to this level.

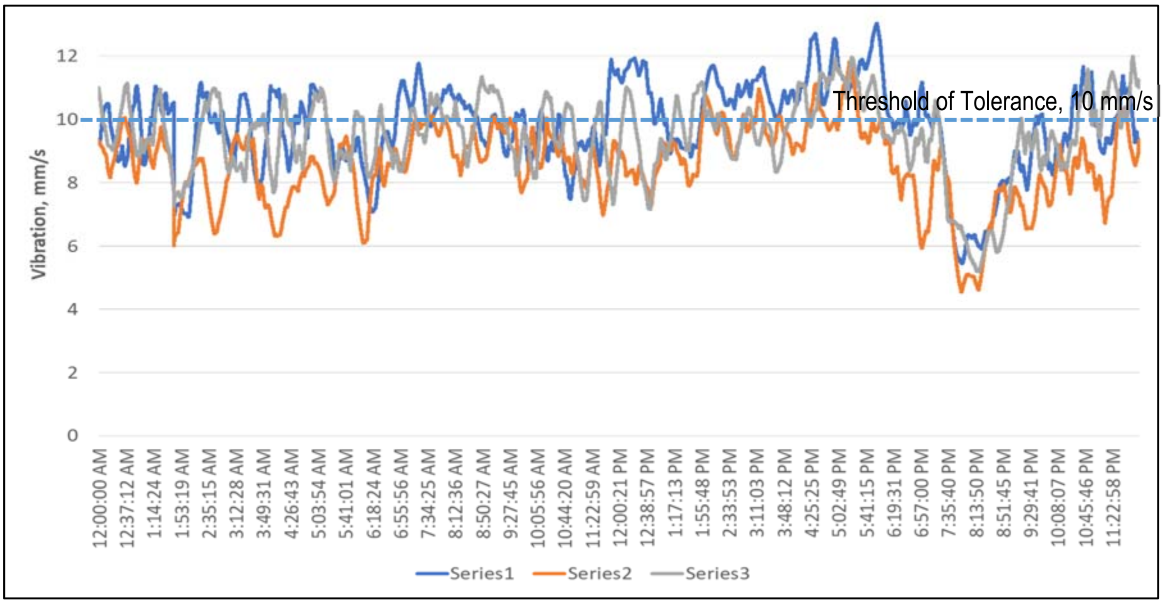


Figure 3.3.32. Sto. Tomas Peak Vibration Level mm/s at 4.5 Hz

V05 San Fernando Station

920. The San Fernando site is located in a residential area at the old PNR San Fernando Station. Most vibrations are caused by vehicles and students walking by. The old PNR station presently serves as a museum and heritage site which is visited by many students. This site has background

vibration with minimum level at 4.5 mm/s and maximum level at 8.0 mm/s (**Figure 3.3.33**). This level of vibrations is considered to be unpleasant for people subjected to continuous vibrations. The recorded peak velocity for this station is 9.4 mm/s. Based on the British Standard Guidance, this level of vibration in residential environments will likely cause complaint but can be tolerated if prior warning and explanation has been given to residents. This is close to the threshold of intolerable vibration, set at 10 mm/s by British Standard Guidance.

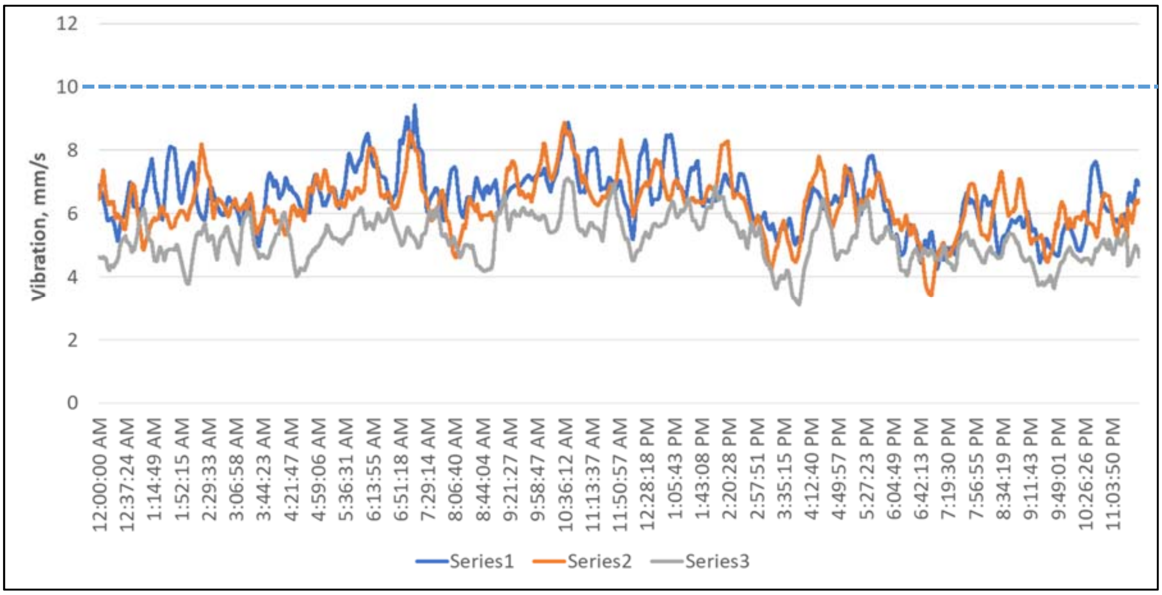


Figure 3.3.33. San Fernando Vibration Peak Level in mm/s at 4.5Hz

V0-6 Quebiawan Elementary School

921. The Quebiawan observation site is a residential area. Most vibrations are caused by students passing by the seismograph instrument. The instruments were located along the road in front of the community's elementary school. This site has background vibration with minimum level at 9.0 mm/s and maximum level at 13 mm/s (**Figure 3.3.34**).The recorded peak velocity for this station is 15.8 mm/s which is above the threshold level set at 10 mm/s by the British Standard Guidance. This level of vibration in residential environments will likely be intolerable for any more than a very brief exposure to this level.

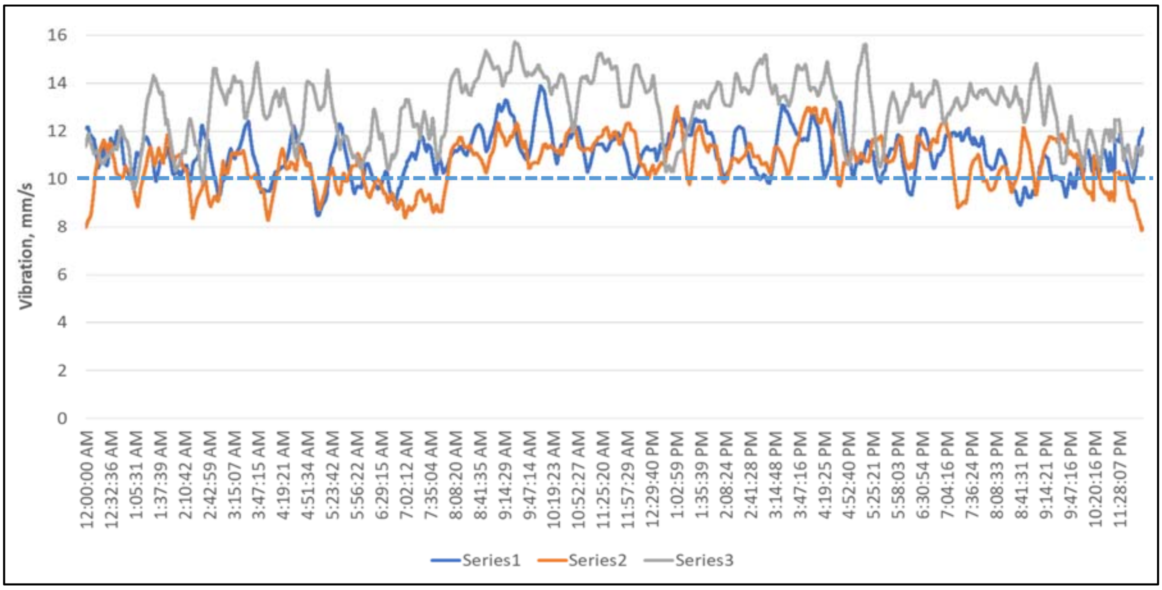


Figure 3.3.34. Quebiawan Peak Vibration Level in mm/s at 4.5Hz

V07 New Barrio Rd. - Sindalan Memorial Park

922. The Sindalan observation site is an open area near a cemetery along the old PNR railway. Most vibrations are due to passing big freight trucks carrying sand and gravel. This site has background vibration with minimum level at 5.0 mm/s and maximum level at 11.0 mm/s (**Figure 3.3.35**). The recorded peak velocity for this station is 12 mm/s which is above the threshold level set at 10 mm/s by the British Standard Guidance. This level of vibration in residential environments will likely be intolerable for any more than a very brief exposure to this level.

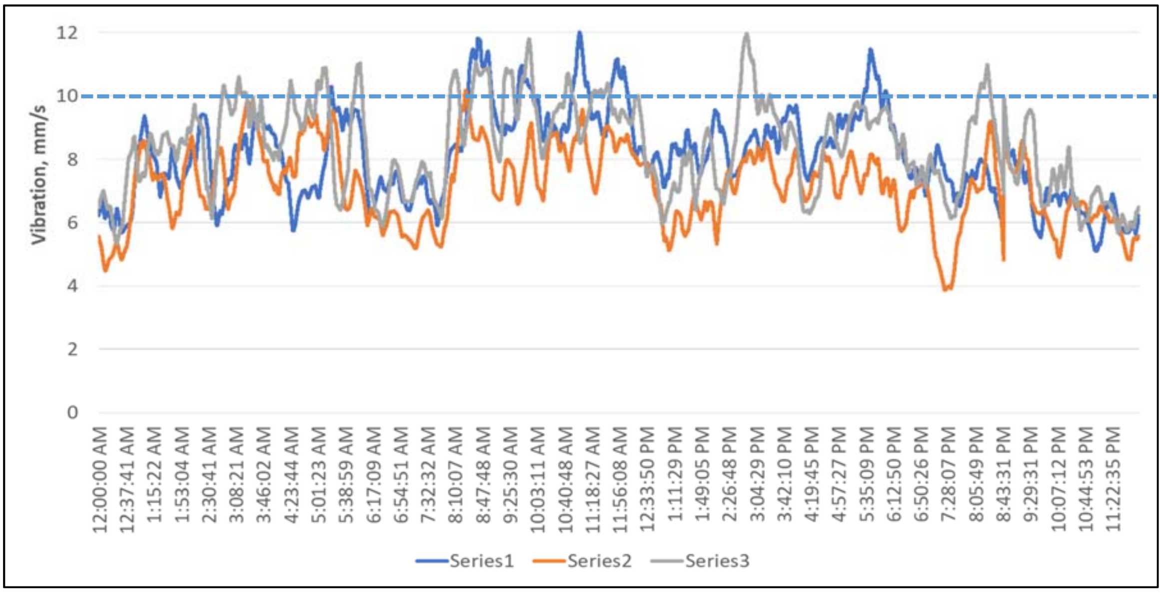


Figure 3.3.35. Sindalan Vibration Peak Level in mm/s at 4.5Hz

V08 Angeles Station (Near La Pieta Memorial Cemetery)

923. The La Pieta observation site is located near a major highway. Most of the vibrations are caused by speeding cars, especially during night time where drag racing by cars was observed in the highway. This site has background vibration with minimum level at 9.0 mm/s and maximum level at 12.5 mm/s (**Figure 3.3.36**). The recorded peak velocity for this station is 13 mm/s which is

above the threshold level set at 10 mm/s by the British Standard Guidance. This level of vibration in residential environments will likely be intolerable for any more than a very brief exposure to this level.

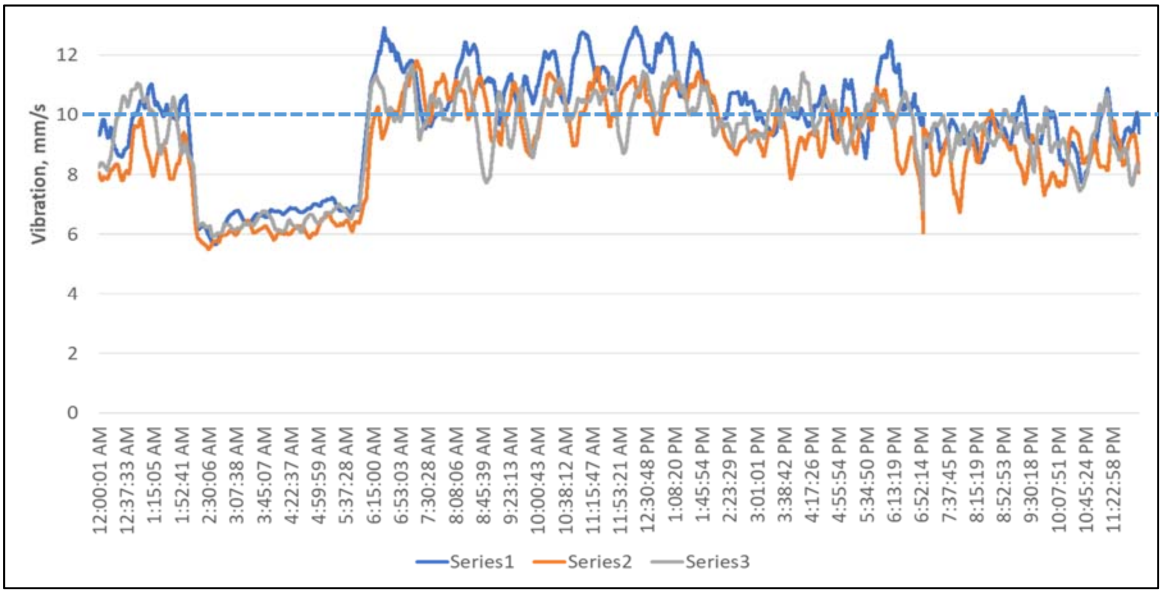


Figure 3.3.36. La Pieta Peak Vibration Level in mm/s at 4.5Hz

V09 Angeles Old PNR Station

924. The Angeles observation site is near a commercial area and a parking lot. Most of the vibrations are caused by parking vehicles and motorcycles near their TODA tricycle station. This site has background vibration with minimum level at 4.0 mm/s and maximum level at 9.5 mm/s (**Figure 3.3.37**). The recorded peak velocity for this station is 13.6 mm/s which is above the threshold level set at 10 mm/s by the British Standard Guidance. This level of vibration in residential environments will likely be intolerable for any more than a very brief exposure to this level.

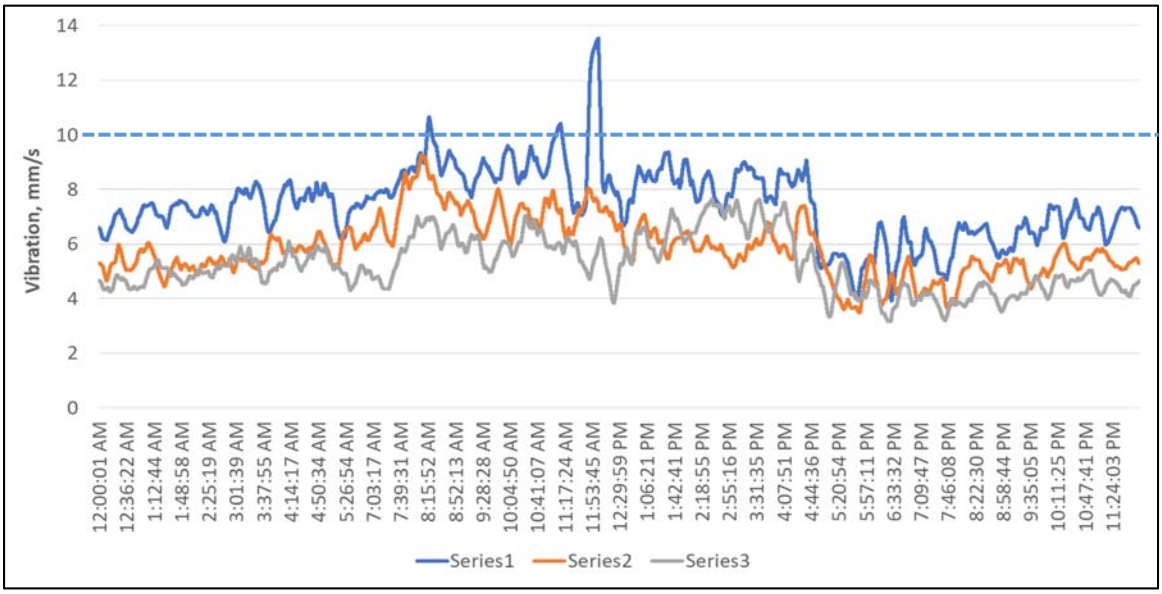


Figure 3.3.37. Angeles Old PNR Station Peak Vibration Level in mm/s at 4.5Hz

V10 Iglesia ni Cristo, Brgy. Santa Teresita

925. The INC/Brgy. Sta Teresita site is located in an urbanized residential area. The vibrations are mostly caused by motorcycles and also by occasional passing of kalesa (horse-drawn cart). This site has background vibration with minimum level at 5.0 mm/s and maximum level at 8.0 mm/s (**Figure 3.3.38**). The recorded peak velocity for this station is 11.8 mm/s which is above the threshold level set at 10 mm/s by the British Standard Guidance. This level of vibration in residential environments will likely be intolerable for any more than a very brief exposure to this level.

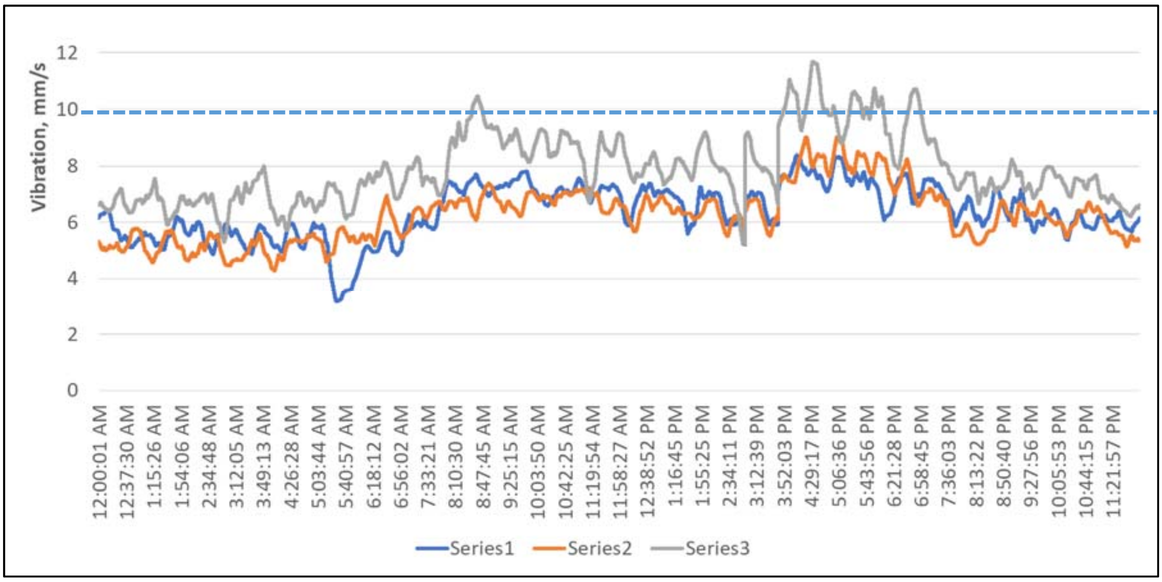


Figure 3.3.38. INC/Brgy. Sta Teresita Peak Vibration Level in mm/s at 4.5Hz

V11 Mabalacat Station in Brgy. Lakandula

926. The Mabalacat Station observation site is a residential area where most vibrations are caused by pedestrians that walk near the site. Vehicles rarely pass by the area. This site has background vibration with minimum level at 2.5 mm/s and maximum level at 5.0 mm/s (**Figure 3.3.39**). This level of vibrations is considered to be unpleasant for people subjected to continuous vibrations. The recorded peak velocity for this station is 7.6 mm/s. Based on the British Standard Guidance, this level of vibration in residential environments will likely cause complaint but can be tolerated if prior warning and explanation has been given to residents.

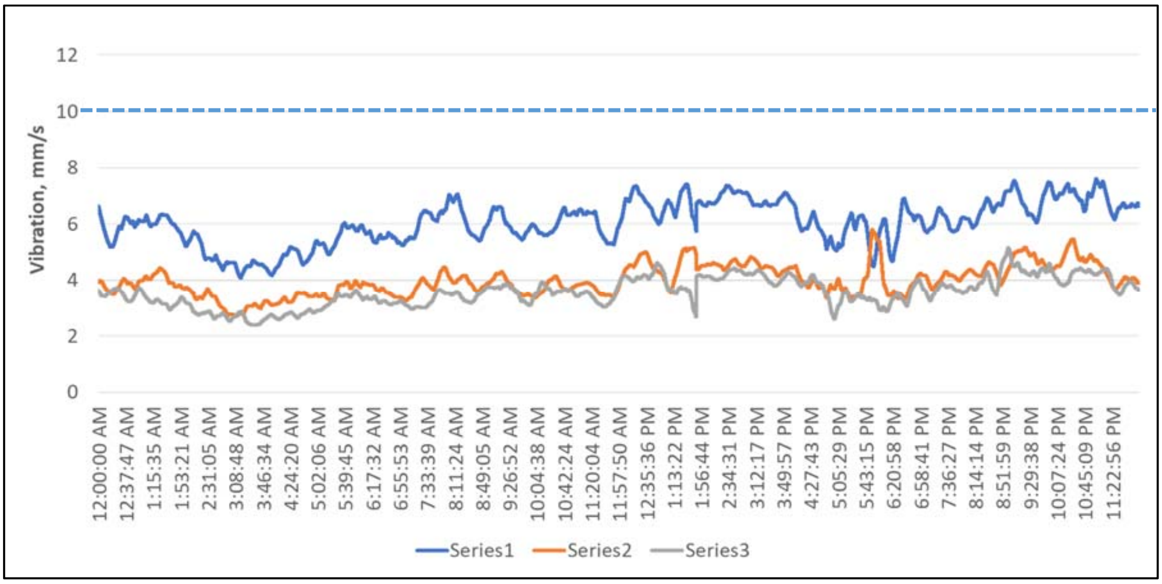


Figure 3.3.39. Lakandula Vibration Peak Level in mm/s at 4.5Hz

V12 Mabalacat Cemetery in Brgy. San Francisco

927. The Mabalacat Cemetery observation site is a residential area where the largest vibrations felt are caused by large aircrafts descending to the ground. The observation site is located near Clark Airbase. This site has background vibration with minimum level at 6.0 mm/s and maximum level at 14.0 mm/s (**Figure 3.3.40**). The recorded peak velocity for this station is 26 mm/s which is above the threshold level set at 10 mm/s by the British Standard Guidance. This level of vibration in residential environments will likely be intolerable for any more than a very brief exposure to this level.

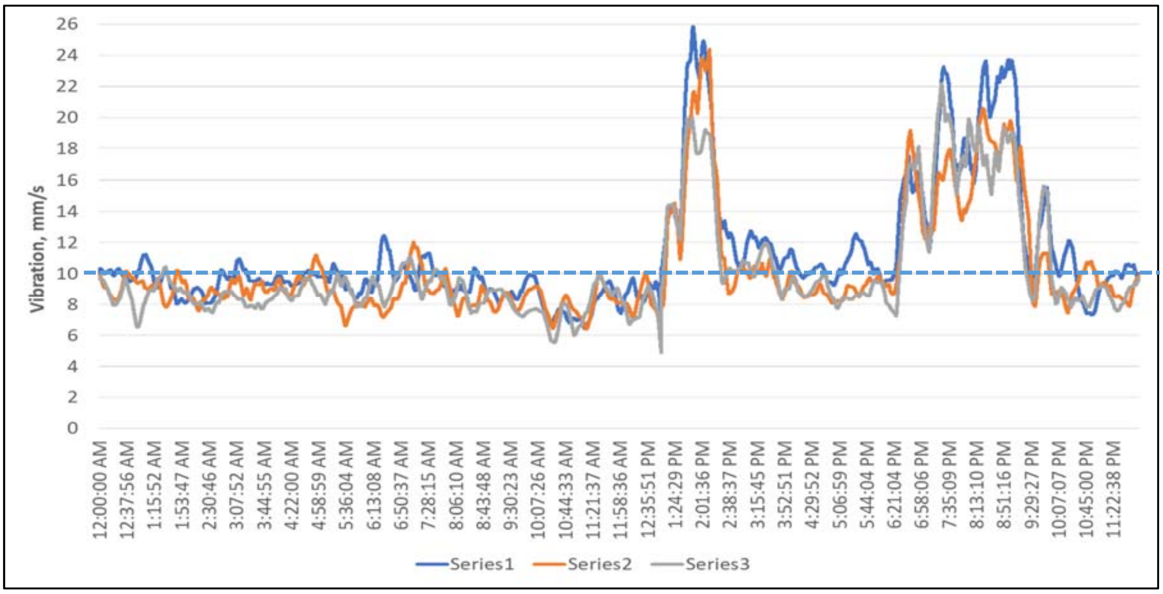


Figure 3.3.40. Mabalacat Site Peak Vibration Level in mm/s at 4.5Hz

V-13 Depot Site in Brgy. Dolores

928. Depot site is located along Subic-Clark-Tarlac-Expressway in Barangay Dolores, Mabalacat, Pampanga. This site has background vibration with minimum level at 7.0 mm/s and maximum level at 11.0 mm/s (**Figure 3.3.41**). the impulsive events may be coming from the road

traffic of heavy trucks in the nearby highway. The recorded peak velocity for this station is 29 mm/s which is above the threshold level set at 10 mm/s by the British Standard Guidance. This level of vibration in residential environments will likely be intolerable for any more than a very brief exposure to this level.

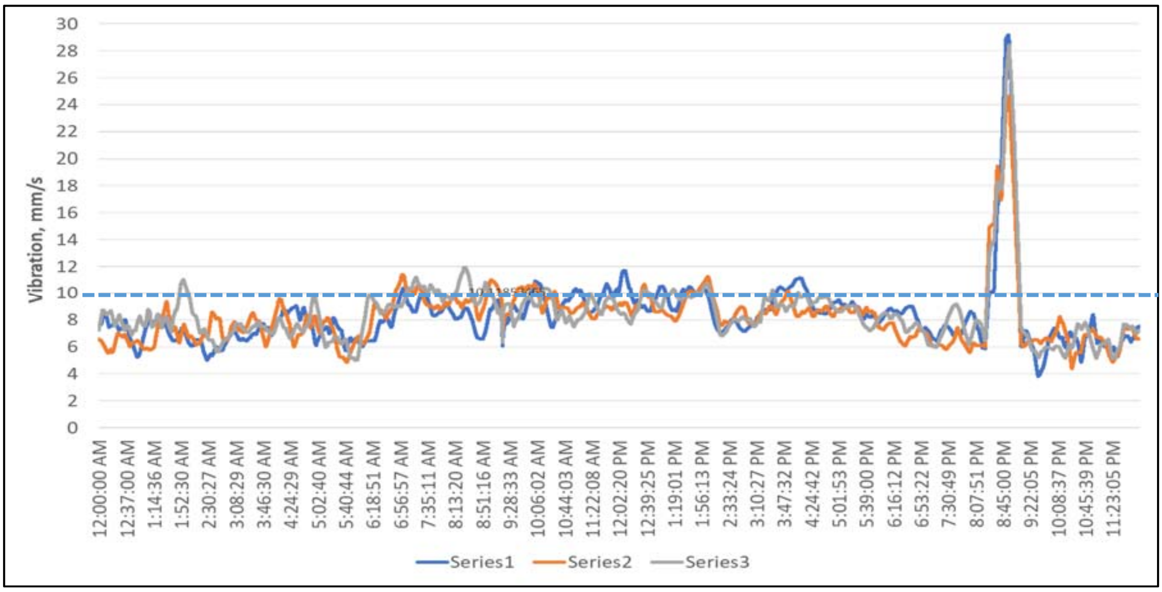


Figure 3.3.41. Depot Site, Brgy. Dolores Peak Vibration Level in mm/s at 4.5Hz

V14 Dapdap Resettlement Site in Brgy. San Roque, Bamban

929. The Dapdap Resettlement observation site is within a residential area where most of the vibrations are caused by passing jeepney and tricycle. There is no prolonged vehicular activity within the observation site. This site has background vibration with minimum level at 4.5 mm/s and maximum level at 7.0 mm/s (**Figure 3.3.42**). This level of vibrations is considered to be unpleasant for people who may be continuously subjected to this level of vibrations. The recorded peak velocity for this station is 10.1 mm/s which is above the threshold level set at 10 mm/s by the British Standard Guidance. Based on the British Standard Guidance, vibration is likely to be intolerable for any more than a very brief exposure to this level.

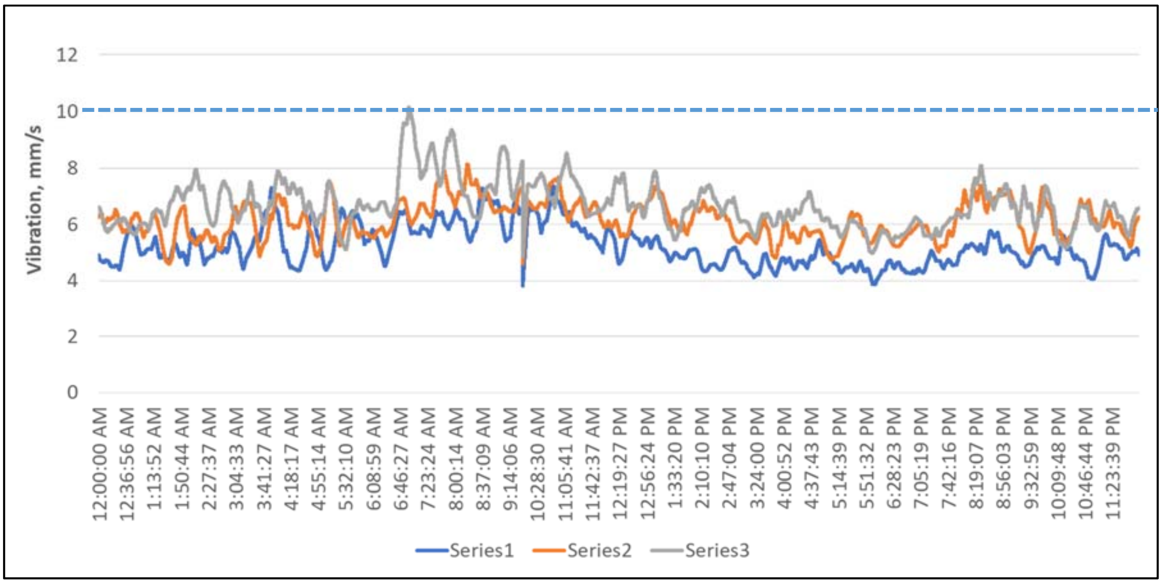


Figure 3.3.42. Dapdap Resettlement Site Peak Vibration Level in mm/s at 4.5Hz

V15 NCC Station

930. The NCC Station observation site is located in a residential area. Sources of vibrations are from trucks carrying backhoe equipment, small vehicles and residents passing by the site. This site has background vibration with minimum level at 4.8 mm/s and maximum level at 5.1 mm/s (**Figure 3.3.43**). The recorded peak velocity for this station is 32 mm/s which is above the threshold level set at 10 mm/s by the British Standard Guidance. This level of vibration in residential environments will likely be intolerable for any more than a very brief exposure to this level.

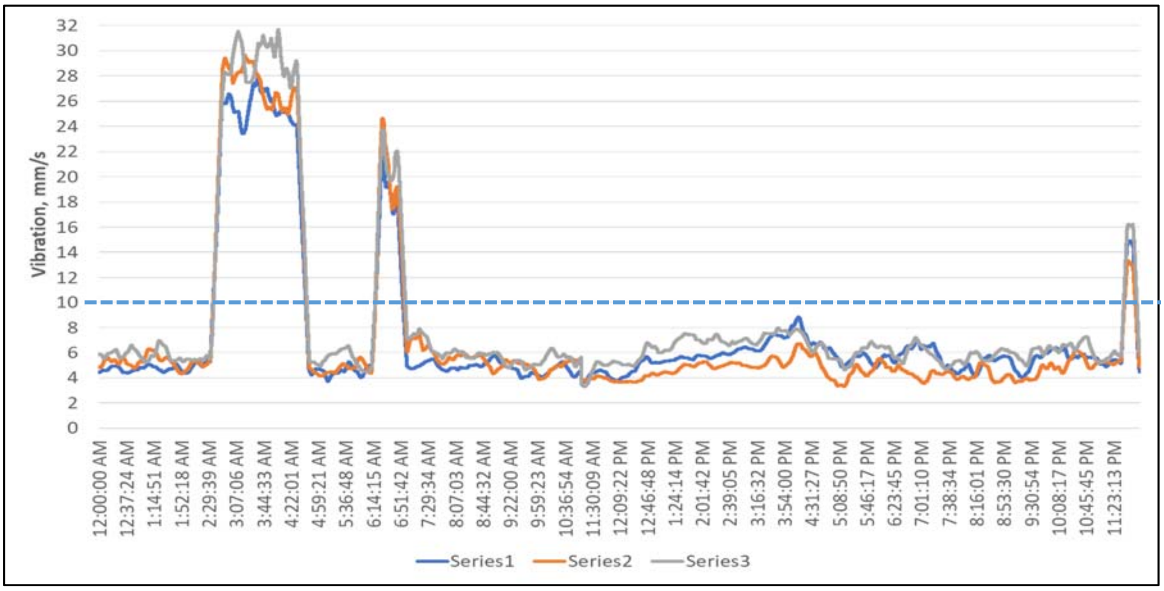


Figure 3.3.43. NCC Station Peak Vibration Level in mm/s at 4.5Hz

3.3.4.2 Impact Identification, Prediction, Assessment, and Mitigation

(1) Pre-construction and Construction Phase

931. Operation of construction machinery, such as pile driver and rock drilling, causes ground vibrations that spread through the ground and diminishes in strength with distance. Ground vibrations from construction activities do not often reach the levels that can damage structures, but can achieve the audible and feelable ranges for human very near the construction site.

1) Prediction method

a. Prediction model

932. The prediction model developed in Technical Handbook for Environmental Impact Assessment of Roads (2007) is applied. Vibration transmits from a source to a receiving point according to the following formula.

$$L_{(r)} = L_{r_0} - 15log_{10}\frac{r}{r_0} - 8.68\alpha(r - r_0)$$

Where, $L_{(r)}$: Vibration level (VL) at receiving point (dB)
$L_{(r_0)}$: Vibration level at reference point (dB)
r : Distance from a source (construction machinery) to receiving point (m)
r_0: Distance of reference point (= 5m)
α: Internal damping ratio

b. Vibration level on reference point

933. The power levels of main construction machinery are shown in **Table 3.3.26**.

Table 3.3.26. Vibration Level of Construction Machinery and Damping Ratio

Construction machinery	Vibration Level at Reference Point (dB)	Internal Damping Ratio
Pile drivers (hydraulic pile hammer)	81	0.01
Rock drilling (soft rock)	64	0.001
Slope surface splay	48	0.01
Asphalt pavement	59	0.01

Source: Technical Handbook for Environmental Impact Assessment of Roads (2007)

c. Location of Vibration Source and Receiving Point

934. The construction machinery, i.e., noise emission source is assumed to be set on the center of the track. During the construction, temporary walls (3.0m) will be set at the edge of the ROW (construction limit). The height of the receiving point is 1.2m.

2) Results of the Prediction and Evaluation

935. The VL on receiving points was calculated based on the said prediction model. The results of the prediction of the construction noise are shown in **Table 3.3.27**

Table 3.3.27. Results of Prediction of Construction Vibration

Construction Work		Distance from the Edge of the ROW to Receiving Point (m)					Perceptive threshold of vibration for human (dB)[2]	BS 5228-2:2009[3] (mm/s)
Type[1]	Vibration Level (dB)	0	5	10	15	20		
Pile drivers	81	79.7	75.3	72.5	70.3	68.4	55	Intolerable: 10
Rock drilling (soft rock)	64	62.8	58.8	56.3	54.5	53.1		
Slope surface splay	48	46.7	42.3	39.5	37.3	35.4		
Asphalt pavement	59	57.7	53.3	50.5	48.3	46.4		

Note:
[1] Technical Handbook for Environmental Impact Assessment of Roads, 2007
[2] Technology and Laws Regulation for Pollution Control, 2000"Japan Environmental Management Association for Industry
[3] BS 5228-2:2009 (BSI British Standards: Code of practice for noise and vibration control on construction and open sites)

Source: JICA Study Team

936. The operations of pile driver and rock drilling will affect the area around the project site, including the old PNR stations since the vibration is beyond the human perceptive threshold. Asphalt pavement will also affect the area within 10m distance from the edge of the construction limit. Only the vibration of slope surface splay is below the human perceptive threshold.

3) Mitigation Measures

937. Pile driving for piers and tunnel driving generate vibrations which may affect the area around the project site particularly when vibration level is beyond the human perceptive threshold. Vibration is more pronounced in sections with hard rock. Tunnel boring machines (TBM) operation generates vibrations, which are transmitted in all directions.

938. The identified impacts will have a high adverse effect to human, thus, mitigating measures must still be implemented to alleviate the impacts.

939. To reduce generation of vibration and its impact to direct recipients, such as the workers and nearby residents, and structures along the MCRP alignment, the following measures will be implemented during pre construction:

- Select sites considering the sensitive receptors including ecologically significant areas (if any) likely to be affected;
- Minimise alteration of topography and removal of vegetation;
- Plan construction activities in consideration of time, duration, and scale of construction to optimize the use construction equipment, machineries, and vehicles. Schedule high vibration generating activities during daytime to reduce disturbance to nearby communities;
- Conduct building condition survey of old PNR structures to maintain and buildings adjacent to the alignment to determine extent of damage to such buildings due to vibration and provide proper protection provision measures and continuous monitoring from the impact of vibration;
- Information dissemination to the public to raise awareness on the impact of vibration from the project activities and establish Grievance Redress Mechanism to handle any complaints, if any; and
- Identify nearby sensitive receptors and ecologically significant areas (if any) likely to be affected and conduct vibration level monitoring.

940. During construction, proposed measures are as follows:

- Select construction equipment and machineries matching the scale of the construction and with minimal vibration generation if possible;
- Regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard;
- Provision of training on vibration mitigation and provide PPE to construction workers; and
- Monitor vibration levels at identified nearby sensitive receptors (residential, school and hospital areas), old PNR strctures, historical heritages including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provide.

(2) Operation Phase

941. Structural vibration of buildings and houses near the MCRP alignment due to train operation may affect people in many ways, such as deterioration of quality of life or decrease of working efficiency.

942. There are no established prediction methods for vibration due to train operation since the mechanism of occurrence and transmission of train vibration is very complicated. Therefore, the vibration levels are often predicted by using the regression equations based on the actual measurements of the similar cases of train operation and structures for reference. The model below is developed for the East-Osaka Urban Rapid Transit by using the vibration data of the similar type of trains and structures at the existing railways. The MCRP will use the similar type of trains and structures as the existing railways in Japan, therefore, the following model is used for the estimate of vibration level.

1) Prediction method

943. The prediction model is proposed for several types of trains and structures as shown in **Table 3.3.28**.

Table 3.3.28. Prediction Model of Vibration Levels

Type	Structure	Model Equations
Train	At-grade (Ballast)	VL= 21.3 log10V - 13.9 log10R + 30.9
	Embankment (Ballast)	VL=42.4 log10V -15.4 log10R - 13.0
	Viaduct (Slab)	VL=12.9log10V -13.2log10R+ 39.3
	Viaduct (Ballast)	VL=18.5 log10V -21.0 log10R+ 44.0
Freight	At-grade (Ballast)	VL=15.3 log10V -20.7log10R+ 54.7
	Embankment (Ballast)	VL=18.6 log10V - 8.2log10R+ 31.4
	Viaduct (Ballast)	VL=10.4 log10V -20.8 log10R+ 66.7

Note. VL: Vibration Level (dB), V: Velocity (km/h), R: Distance from the center of railway track (m)

Source: EIA report for Osaka Outer Ring for East-Osaka Urban Rapid Transit, 2006, Osaka Prefecture

2) Structures

944. The types of structure of the MCRP are viaduct (slab) and embankment (ballast).

Parameter

945. According to the operation plan, the train velocity is 120km/h.

Prediction

946. The vibration level (VL) is estimated in Table 3.3.29. In the case of the viaduct (slab), VL at the edge of the ROW is estimated 54.2 dB and below the perceptible threshold of humans (55dB). However, in the case of embankment (ballast), the estimated VL at distance from 0 m to 10 m will be over the perceptible threshold of human (55dB).

Table 3.3.29. Estimated Vibration Level VL (dB)

Type of Structure	Distance from ROW					Threshold VL (dB)
	0	5	10	15	20	
Viaduct (slab)	54.2	51.4	49.6	48.1	47.0	55

Source: JICA Study Team

3) Mitigation Measures

947. In the case of viaduct (slab), mitigation measures will not be needed to be implemented. On the other hand, the embankment will be used for the section where the alignment goes through the rural areas and no flood-prone area. However, the following measures will be taken to abate the vibration level where the residences are located within 15m distance from the ROW:

- Regular inspection, proper maintenance and reconditioning of trains and tracks such as rail grinding, slip-slide detectors and maintenance or replacement of suspension system, brakes and wheels; and
- Monitor vibration levels at identified nearby sensitive receptors (residential, school and hospital areas), old PNR structures, historical heritages including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provided. Monitor actions on complaints, if any, and attend to unresolved cases based on Grievance Redress Mechanism.

3.3.5 Electric Magnetic Compatibility

948. The railway project and its operating systems have been so designed to address concerns on Electro Magnetic Compatibility (EMC) and Electro Magnetic Interference (EMI). EMC is an issue that is mitigated through the application of EMC industry accepted practice during design and installation of the system, and these conform to the limits provided by the International Commission on Non-Ionizing Radiation Protection (ICNIRP 1998 guidelines). This limits the minimal effects of EMI to the environment.

Table 3.3.30. Summary of Impact Identification, Prediction, Assessment and Mitigation for AIR

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
PRE-CONSTRUCTION / CONSTRUCTION				
• Operation of construction machinery, equipment and vehicles • Removal of trees and other vegetation	Climate Change	Exhaust emissions from movement of equipment and vehicles, excavated soil carried by vehicles and other heavy loaders.	C-	[Pre-Construction] • Plan and design structures that will minimise the removal of vegetation and alteration of topography if possible. [Construction] • Conduct proper inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard • Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation if possible
Climate Risk	Meteorology/ climatology	Restrictions/ disruption of construction due to soil erosion/landslides/ and flooding.	A-	[Pre-Construction] • Take account of change in local micro climate such as rainfall, temperature pattern for 2020 and 2050 in project design criteria and schedule of construction works. • Based on the hydrological and geodetic study, design and install train system which is robust to climate change and related extreme events including drainage, passenger facilities and structures (viaduct and embankment) i.e. train facilities to be above the flood level, installation of drainage pumping system. [Construction] • Adjust construction activities in consideration to local climate / extreme events such as extreme heat to avoid overheating of construction equipment and service vehicles and cause heat stress to workers. • Implement Emergency Response Plan.
		Slower drainage, soil erosion, disruption in construction by increased rainfall	B-	
		Overheating of construction equipment, vehicles / heat stress by high temperature and heat waves	C-	
• Earthworks including excavation activities • Site clearance including removal of topsoil at the depot site	Air Quality	Degradation of air quality due to dust generation from transportation of excessive soil / spoil to fill area construction activities	B-	[Construction] • Minimise alteration of topography and removal of vegetation. • Adjust construction activities in consideration to weather system, identifying periods of high winds and drought that aggravated dust transport. • Conduct prompt inspection and regular maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standards • Control vehicle movement maintaining the speed limit within the construction site to <10kph and minimise vehicle transport by maximising the use of site generated materials • Conduct regular cleaning and clearing of construction access / sites surfaces of spoils and debris from construction equipment and vehicles and wetting of ground soil in the construction site when necessary. Stock pile and trucks loaded with spoils will be covered. • Implement materials handling program or a site protection and rehabilitation program. • Monitor air quality at identified nearby sensitive receptors regularly and evaluate effectiveness of the air pollution reduction measures provided.
• Operation of construction machinery, equipment and vehicles	Air Quality	Degradation of air quality due to gaseous emissions from machineries and service vehicles	C-	
• Operation of construction machinery, equipment and vehicles • Earthworks	Acoustic Noise	• Increase in ambient noise level • Threat to existence and/or loss of important local species and habitat	B-	[Pre-Construction /Construction] • Select sites (i.e. construction yard, temporary facilities, access route) in consideration to sensitive receptors including ecologically significant areas (if any) likely to be affected. • Design and install effective noise barriers and absorbers along the alignment especially in areas with sensitive facilities.

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
		• Threat to abundance, frequency and distribution of species		• Design and adopt long rails and ballast-less track with elastic and absorbent sleeper support to minimize noise generation from train operation [Construction] • Implement construction activities in consideration to time, duration, and scale to optimize the use construction equipment, machineries, and vehicles in accordance to the noise emission standard. • Minimise alteration of topography and removal of vegetation • Install noise control devices such as mufflers and noise suppressors to all construction equipment and machineries. Use of electric instead of diesel powered equipment, hydraulic tools instead of pneumatic tools. • Conduct regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard • Provide appropriate PPE to construction workers • Monitor noise levels at identified nearby sensitive receptors (residential, school and hospital areas) including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provided.
• Conduct of geotechnical investigation • Operation of construction machinery, equipment and vehicles • Pile driving for piers	Ground vibration	• Increase in ambient vibration level and threat to the health and safety of sensitive receptors • Threat to existence and/or loss of important local species and habitat • Threat to abundance, frequency and distribution of species	C-	[Pre-Construction / Construction] • Select sites in consideration to sensitive receptors including ecologically significant areas (if any) likely to be affected. • Conduct building condition survey of old PNR structures and buildings adjacent to the alignment to provide proper protection provision measures and continuous monitoring from the impact of vibration. [Construction] • Implement construction activities in consideration of time, duration, and scale of construction to optimize the use construction equipment, machineries, and vehicles with minimal vibration generation. • Select construction equipment and machineries matching the scale of the construction and with minimal vibration generation if possible • Provide training on vibration mitigation and provide appropriate PPE to construction workers; • Monitor vibration levels including identified nearby sensitive receptors, old PNR structures including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provided.
OPERATION				
Climate Change	Meteorology/ Climatology	Restrictions/ disruption of railway operation due to soil erosion/landslides/ and flooding.	A-	• Regular inspection and preventive maintenance of railway structures and facilities to ensure optimum working condition; • When necessary, install improvement of railway system to make it more resilient to temperature and rainfall increase ; • Planting of vegetation as much as possible in open areas at the depot, around the stations and along the railway track; • Implementation of an Emergency Response Plan;
		Slower drainage, soil erosion, disruption in construction by increased rainfall	B-	
		Overheating of construction equipment and vehicles and overheating of track buckling	C-	

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
		and signalling problems		
Operation of trains, depot, passenger facilities (stations), service vehicles, etc.	Meteorology/ Climatology	Reduction of Greenhouse Gases	B+	• Provide incentives and information dissemination activities to encourage commuters to use rail transit and its benefits over other modes of transport (Modal Shift) • Plant and manage vegetation as much as possible to open areas at the depot, around the stations and along the railway track • Conduct energy/water conservation program such as use energy efficient products (i.e. LED lights) and monitor carbon footprint monitoring • Conduct regular inspection and proper maintenance of railway systems and facilities, and equipment and machinery
	Air Quality	• Degradation of air quality in the vicinity of the station and in depot area • Increase in Vehicle Exhaust emission and entrained dust due of increased movement of people	C-	• Select appropriate operation and maintenance equipment that are fuel efficient to reduce emission. • Conduct regular inspection and maintenance of heavy equipment, machineries, facilities and service vehicles and facilities such as generator etc. to meet the DENR Emission Standard • Regular cleaning and clearing of road from spoils and debris and wetting of ground in the periphery of the depot when necessary. • Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969 at depot area, and provide appropriate PPE for the concerned personnel • Control service vehicle movement by maintaining the speed limit to <10kph within the construction site. Minimise vehicle transport by maximising the use of site generated materials. • Monitor air quality at the identified sampling stations
Operation of trains	Acoustic Noise	Reduction of noise due to decrease in traffic volumes	B+	• Provide incentives to and information dissemination activities to encourage commuters to use rail transit over other modes of transport
Operation of trains, depot, passenger facilities (stations), service vehicles, etc.	Acoustic Noise	Increase in ambient noise level	C-	• Optimize the number of train operation at night time to reduce generated noise • Provision of effective height of noise barriers on each side of the track especially on areas with sensitive receptors such as school, hospital, residential area • Provision of noise control device such as muffler to all stationary sources (i.e. generator set) • Regular inspection and proper maintenance of trains and tracks to ensure its optimal operation and functionality • Monitor noise levels including identified nearby sensitive receptors including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provided.
	Ground Vibration	Increase in ground vibration level	C-	• Monitor vibration levels including identified nearby sensitive receptors, old PNR structures, historical heritages including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provided. • .Regular inspection, proper maintenance and reconditioning of trains and tracks such as rail grinding, slip-slide detectors and maintenance or replacement of suspension system, brakes and wheels

Note:
A+/-: Significant positive/negative impact is expected.
B+/-: Moderate positive/negative impact is expected to some extent.
C+/-: Minor / Negligible positive/negative impact is expected to some extent.
D: Extent of impact is unknown.

3.4 PEOPLE

949. Baseline data are presented at city and municipality level where such data are available. Where data is not available, provincial data is used. The data also sometimes differs in reference years, and this is always reflected in the text and tables to enable the reader to distinguish the timelines of the data. All information are secondary data.

950. The data on the Project Affected Families (PAFs) were derived from the primary socio-economic surveys conducted during the data gathering phase as of April 25th 2018. Given that the alignment from CIA to NCC is being finalized, surveys for the said portion have not yet been conducted.

951. The baseline data covers the LGUs of Malolos and Calumpit in the Province of Bulacan; Apalit, Sto. Tomas, San Fernando, Angeles, and Mabalacat in the Province of Pampanga; and Bamban and Capas in the Province of Tarlac.

3.4.1 Demography

3.4.1.1 Population

952. The population data of the municipalities and cities covered by the proposed MCRP are presented in **Table 3.4.1**.

Table 3.4.1 Total Population and Household Population of the Host LGUs

Municipality/ City	Land Area (km^2)	Total Population		Growth Rate (%)	Population Density (person/km^2)	Household Population	
		2010	2015			2010	2015
Malolos	67.25	234,945	252,074	1.46	3,748	50,949	56,255
Calumpit	56.25	101,068	108,757	1.52	1,933	21,414	24,219
Apalit	61.47	101,537	107,965	1.27	1,756	20,509	22,801
Minalin	48.27	44,001	47,713	1.69	988	8,490	9,527
Sto. Tomas	21.30	38,062	40,475	1.27	1,900	7,696	8,675
San Fernando	67.74	101,537	306,659	40.40	4,527	59,237	66,370
Angeles	63.37	326,336	411,634	5.23	6,496	72,791	94,666
Mabalacat	166.77*	215,610	250,799	3.26	1,503[1]	46,441	55,991
Bamban	251.98	62,413	69,466	2.26	276	12,987	14,739
Capas	377.66	125,852	140,202	2.28	371	25,868	30,762

Note: 1: From Mabalacat City CLUP, 2011-2020

Source: 2010 and 2015 Census of Population and Housing, Philippine Statistics Authority

3.4.1.2 Gender and Age Profile

(1) Gener and Age Profile of Host LGUs

953. In terms of population of the host LGUs, there are slightly more males than females, with 50.37% males and 49.63% females. In terms of age, at least 67 out of 100 individuals are 15-64 years old and above and 33 are dependents with 29 young dependents and five (5) old/elderly dependents (**Table 3.4.2**).

Table 3.4.2 Gender and Age Profile of the Host LGUs

City/ Municipality	TOTAL	Gender Distribution				Age Group					
		Males		Females		0-14 years old		15-64 years old		65 years old and above	
		Total	%	Total	%	Total	%	Total	%	Total	%
Malolos	252,074	126,720	50.27	125,354	49.73	67,222	26.67	172,135	68.29	12,717	5.04
Calumpit	108,757	54,627	50.23	54130	49.77	30,574	28.11	72,314	66.49	5,869	5.4
Apalit	107,965	54,695	50.66	53,270	49.34	31,372	29.06	71,034	65.79	5,559	5.15
Minalin	47,713	24,285	50.9	23,428	49.1	14,420	30.22	30,882	64.72	2,411	5.05
Sto. Tomas	40,475	20,491	50.63	19,984	49.37	11,315	27.96	26,971	66.64	2,189	5.41

City/ Municipality	TOTAL	Gender Distribution				Age Group					
		Males		Females		0-14 years old		15-64 years old		65 years old and above	
		Total	%	Total	%	Total	%	Total	%	Total	%
San Fernando	306,659	154,912	50.52	151,747	49.48	85,815	27.98	206,158	67.23	14,686	4.79
Angeles	411,634	205,207	49.85	206,427	50.15	118,650	28.82	277,574	67.43	15,410	3.74
Mabalacat	250,799	125,548	50.06	125,251	49.94	73,787	29.42	166,090	66.22	10,922	4.35
Bamban	69,466	35.565	51.2	339,01	48.8	22,910	32.98	43,761	63	2,795	4.02
Capas	140,202	72,260	51.54	679,42	48.46	45,750	36.73	88,701	63.27	5,751	4.1
TOTAL	1,735,744	874,310	50.37	861,434	49.63	501,305	28.88	1,155,620	66.58	78,299	4.51

Source: 2015 Census of Population and Housing, Philippine Statistics Authority

(2) Gender and Age Profile of PAPs by LGUs

954. **Table 3.4.3** and **Table 3.4.4** show the distribution of gender and age cohort among project affected families (PAFs). In all LGUs, more females than males are affected. In terms of total number the female headed family are about two times of male headed family.

955. In terms of age, majority of the PAPs (34.15) are 18-40 years old. About 1 in 10 of the PAP are either (1) 6 year old or less (12.7%), (2) 7-12 years old (11.1%), while a small proportion are either (1) 13-16 years old (6.9%) (2) 17-20% (7.5%), and (3) 81 years old and above (6.9%). This indicates that majority of the PAPs in all affected LGUs belong to the working age population and may thus form part of the labor force. The age group 7-12 years who are school group are also affected.

Table 3.4.3 Gender Profile of PAPs

Municipality	Gender					
	Male	%	Female	%	Total	%
Malolos	2	33.3 %	4	66.7 %	6	100.0%
Calumpit	119	41.9 %	165	58.21%	284	100.0%
Apalit	1	33.3 %	2	66.7 %	3	100.0%
Minalin	0	0	0	0	0	0
Sto. Tomas	4	19.0 %	20	81.0 %	24	100.0%
San Fernando	277	33.8 %	543	66.2%	820	100.0%
Angeles	75	39.0 %	117	61.0 %	192	100.0%
Mabalacat	0	0	0	0	0	0
Total	478	36.0 %	851	64.0 %	1,329	100.0%

Note: The SES survey is yet to be conducted since the segment of alignment between CIA to NCC has not been finalized.

Source: JICA Study Team

Table 3.4.4 Age Distribution of PAPs

Municpality	6 YO or less	7-12 YO	13-16 YO	17-20 YO	21-40 YO	41-60 YO	61 Y.O. and above	N/R	Total
Malolos	5	6	3	4	8	5	2	1	34
%	14.7%	17.6%	8.8%	11.8%	23.5%	14.7%	5.9%	2.9%	100.0%
Calumpit	137	126	84	87	378	248	96	21	1177
%	11.6%	10.7%	7.1%	7.4%	32.1%	21.1%	8.2%	1.8%	100.0%
Apalit	4	6	0	0	6	2	0	0	18
%	22.2%	33.3%	0.0%	0.0%	33.3%	11.1%	0.0%	0.0%	100.0%
Sto. Tomas	13	11	9	6	47	27	6	0	119
%	10.9%	9.2%	7.6%	5.0%	39.5%	22.7%	5.0%	0.0%	100.0%
San Fernando	501	407	253	279	1229	632	234	105	3640
%	13.8%	11.2%	7.0%	7.7%	33.8%	17.4%	6.4%	2.9%	100.0%
Angeles	77	87	49	55	301	157	62	5	793
%	9.7%	11.0%	6.2%	6.9%	38.0%	19.8%	7.8%	0.6%	100.0%
Total	737	643	398	431	1969	1071	400	132	5781
%	12.7%	11.1%	6.9%	7.5%	34.1%	18.5%	6.9%	2.3%	100.0%

Note: The SES survey is yet to be conducted for the segment of alignment not finalized - between CIA to NCC.

Source: JICA Study Team

3.4.1.3 Literacy Rate and Education Attainment

(1) Literacy Rate and Educational Attainment Profile of LGUs

956. Basic or simple literacy is the ability of a person to read and write with understanding a simple message in any language or dialect. In 2015, 99.45% of the total household population 10-year old and over of the host LGUs of the proposed MCRP are basically literate (**Table 3.4.5**). Basically, the proportion of literate females is higher (50.29%) than their male counterparts (49.71%).

Table 3.4.5 Literacy of the Household Population 10 Years Old and Over of the Host LGUs, 2015

City/ Municipality	Household Population	Literate					
	Both Sexes	Both Sexes		Male		Female	
	Total	Total	Rate (%)	Total	Rate (%)	Total	Rate (%)
Malolos	204,296	203,562	99.64	100,274	49.26	103,288	50.74
Calumpit	88,440	88,244	99.78	43,885	49.73	44,359	50.27
Apalit	87,075	86,648	99.51	43,694	50.43	42,954	49.57
Minalin	38,109	37,920	99.50	19,199	50.63	18,721	49.37
Santo Tomas	33,133	33,003	99.61	16,606	50.32	16,397	49.68
San Fernando	247,919	247,251	99.73	123,288	49.86	123,963	50.14
Angeles	328,983	327,953	99.69	160,876	49.05	167,077	50.95
Mabalacat	201,892	201,117	99.62	99,622	49.53	101,495	50.47
Bamban	54,210	53,528	98.74	27,167	50.75	26,361	49.25
Capas	108,431	105,612	97.40	53,731	50.88	51,881	49.12
Total	1,392,488	1,384,838	99.45	688,342	49.71	696,496	50.29

Source: 2015 Census of Population and Housing, Philippine Statistics Authority

957. In terms of educational attainment, the population five (5) years old and over of the host LGUs (1,570,831) consist largely of high school educated population at 659,051 persons or 41.96% of the total population, followed by elementary educated population at 428,203 or 27.26% of the total population (**Table 3.4.6**). Those who have reached, but did not complete college comprised 172,505 or 10.98% of the total population, while 188,976 or 12.03% of the total population have finished college and hold academic degree. Post Baccalaureates are about 0.08% or 1,303 persons.

Table 3.4.6 Education Attainment of Population 5 Years Old and Over of the Host LGUs, 2015

City/ Municipality	Total Population 5 yrs <	No Grade Completed		Elementary		High School		College Undergraduate		Academic Degree Holder		Post Baccalaureate	
		Total	%	Total	%	Total	%	Total	%	Total	%	Total	%
Malolos	231,107	4,881	2.11	59,588	25.78	83,017	35.92	28,112	12.16	37,931	16.41	316	0.14
Calumpit	98,805	2,005	2.03	27,761	28.10	38,432	38.90	10,405	10.53	11,805	11.95	64	0.06
Apalit	97,811	1,891	1.93	31,058	31.75	39,863	40.76	9,778	10.00	9,116	9.32	41	0.04
Minalin	42,976	888	2.07	13,721	31.93	17,574	40.89	3,591	8.36	4,765	11.09	9	0.02
Sto. Tomas	36,919	636	1.72	10,813	29.29	14,497	39.27	3,790	10.27	4,958	13.43	16	0.04
San Fernando	278,829	4,731	1.70	70,466	25.27	113,030	40.54	32,170	11.54	44,828	16.08	302	0.11
Angeles	370,728	6,480	1.75	93,590	25.24	169,352	45.68	43,572	11.75	39,189	10.57	344	0.09
Mabalacat	226,624	3,962	1.75	57,865	25.53	102,087	45.05	26,931	11.88	23,635	10.43	92	0.04
Bamban	62,096	1,765	2.84	19,699	31.72	28,503	45.90	4,849	7.81	4,077	6.57	23	0.04
Capas	124,936	4,122	3.30	43,642	34.93	52,696	42.18	9,307	7.45	8,672	6.94	96	0.08
Total	1,570,831	31,361	2.00	428,203	27.26	659,051	41.96	172,505	10.98	188,976	12.03	1,303	0.08

Source: 2015 Census of Population and Housing, Philippine Statistics Authority

(2) Literacy Rate and Educational Attainment of PAPs

958. **Table 3.4.7** shows the distribution of educational attainment among project-affected families. In all LGU, high school level/graduate is the larget group followed by elementaly level/ graduates. This trend is similar to **Table 3.4.6**, where majority are have reached (20.7%) and graduated from high school (17.3%) and a small portion (10.3%) have reached college.

959. In terms of educational attainment, majority of the PAPs have either reached high school (17.9%) or are high school graduates (16.6%). Some PAPs have only reached vocational/technical level (11.2%), with around 20.9% of the PAPs were able to reach elementary level.

960. While this is the general trend among the PAPs, in the Municipalit of Apalit, most of the PAPs have only reached elementary level (27.8%). In Malolos, Calumpit, San Fernando and Angeles, majority of the PAPs have reached high school, with 23.5%, 17.9%, 17.3% and 20.7%, respectively. In San Fernando, while most PAPs have reached or graduated from high school, a small proportion has also reached elementary (14.2%).

Table 3.4.7 Educational Attainment of PAPs

City/ Municipality	Pre-school	Elementary		High School		College		Vocational/ technical	Advance degree	Post-baccalaureate	NA	NR	Total
		level	graduate	level	graduate	level	graduate						
Malolos	3	4	1	8	6	2	3	3	0	3	0	1	34
%	8.8%	11.8%	2.9%	23.5%	17.6%	5.9%	8.8%	8.8%	0.0%	8.8%	0.0%	2.9%	100.0%
Calumpit	42	172	63	211	184	77	130	169	0	63	36	30	1177
%	3.6%	14.6%	5.4%	17.9%	15.6%	6.5%	11.0%	14.4%	0.0%	5.4%	3.1%	2.5%	100.0%
Apalit	1	5	1	2	0	0	1	1	0	7	0	0	18
%	5.6%	27.8%	5.6%	11.1%	0.0%	0.0%	5.6%	5.6%	0.0%	38.9%	0.0%	0.0%	100.0%
Sto. Tomas	2	15	6	16	32	2	6	15	0	1	0	24	119
%	1.7%	12.6%	5.0%	13.4%	26.9%	1.7%	5.0%	12.6%	0.0%	0.8%	0.0%	20.2%	100.0%
San Fernando	119	518	234	631	603	102	357	397	28	326	40	285	3640
%	3.3%	14.2%	6.4%	17.3%	16.6%	2.8%	9.8%	10.9%	0.8%	9.0%	1.1%	7.8%	100.0%
Angeles	20	144	50	164	137	20	82	61	4	63	3	45	793
%	2.5%	18.2%	6.3%	20.7%	17.3%	2.5%	10.3%	7.7%	0.5%	7.9%	0.4%	5.7%	100.0%
MCR Total	187	858	355	1032	962	203	579	646	32	463	79	385	5781
%	3.2%	14.8%	6.1%	17.9%	16.6%	3.5%	10.0%	11.2%	0.6%	8.0%	1.4%	6.7%	100.0%

Note: The SES survey is yet to be conducted for the segment of alignment not finalized - between CIA to NCC.

Source: JICA Study Team

3.4.2 Migration Profile

3.4.2.1 In Migration

Malolos

961. As of the 2010 Census, Malolos' population was 234,945. The annual growth rate of Malolos was 4.31% from 2007 to 2010. The city's growth is largely attributed to an influx of migrants paired with natural growth patterns. Due to Malolos' close proximity to Manila (42 kilometers), the city has become a popular destination for migrants from around the province.

Calumpit

962. The proximity of Calumpit to some towns classified as fast growing and developing towns like Malolos City, and Apalit, Pampanga and the apparent thriving of the local economy of Calumpit may seem advantage for the development of transient housing facilities.

Apalit

963. There is an observed migration of residents from nearby Municipalities due to flooding. This also results to informal settlements in the municipality. Based on the age sex structure of the municipality in 2010, for those ages 15-29 the sex ratio is relatively lower, which may be explained by a prevalence of female in-migration. The sex ratio for ages 30-49 showed a predominance of male population, possibly also indicating out-migration of females.

Minalin

964. "There are no migration database linkages from the barangay level to the municipal level among offices." However, there is a small number of informal settlers living in river easements as of July 2016 according to the Municipal Planning Office.

Sto. Tomas

965. The local government has noticed the influx of immigrants from other regions. Over the years, the population of the municipality has increased gradually due to both natural population increase and in-migration. It now plans an additional 23.80 ha. for its residential land uses to accommodate the projected increase of its population and informal settlers. Sto. Tomas is seen as an expansion area for San Fernando.

966. Another evidence of immigration is that the major dialect in the municipality is Kapangpangan. In, 2007, about 95% of the populace has Kapampangan as their mother tongue. Due to the influx of migrants, the Municipality has been acculturated with dialects other than Tagalog. These dialects include Ilocano, Bicolano, Waray, Cebuano, and other dialects.

San Fernando

967. San Fernando has identified the in-migration barangays, which include San Pedro, Quebiawan, Panipuan, Dela Paz Sur, Pandaras, and Sta. Teresita. The city government identified that these areas have become favored for temporary residences of possibly migrant workers from other areas.

968. The biggest net outmigration barangays are Del Pilar, San Jose, Malino, Dolores and Bulaon. The high net outmigration from Bulaon may either be a trend among those resettled from other places to be returning to their original places twenty years after the eruption of Pinatubo. It may also be an indication of economically active population going to other places in search for jobs and other opportunities. The high net outmigration from Dolores may be a result of the recent resettlement of families living informally along the PNR ROW into the Northville resettlement. In the case of San Jose, the high outmigration maybe a response to economic pressures as more families need employment and livelihood.

Angeles

969. Internal migration in Angeles continues, resulting to the increase of informal settlers in the City. After Metro Manila, Angeles is one of the strongest informal settlements magnets in the country. The city has now recognized the vast influx of in-migrants and is planning to find alternative source for domestic and industrial water.

Mabalacat

970. In 2010, among the 47,198 household population five years old and over who were enumerated in Mabalacat, 97.88% were non-movers. These are persons whose municipality of residence in 2005 was the same as in 2010. The other 2.12% had resided in other municipality/city at the time of the 2010 Census of Population and Housing.

Bamban

971. Due to the in-migration from other provinces, the population of Bamban is made up of 82.01% (51,128) Kapampangan natives out of 62,344 populations as of 2010. They are followed by Tagalog (7.61%) and Aeta with 3.75%. The remaining percentages belong to the other types of local and foreign ethnicities.

Capas

972. The most notable movement of people in the Capas is the influx of IP in the municipality which has led to an increased number of Indigenous peoples in Capas. With the trend of the migration of people from Metro Manila towards Central and Northern Luzon, the municipality sees itself as a developing Municipality due to its accessibility through major thoroughfares to the Subic Clark Economic Development Zone leveraging its competitive advantage in agro-processing and agro-industrial products, which can cater to the demands of Tarlac and neighboring provinces.

3.4.2.2 Profile of Informal Settlers

(1) ISFs Profile of Host LGUs

Malolos

973. There are six (6) locations that are considered as informal settlers' areas: Barangays Atlag, Look 2nd, San Pablo, Sto. Rosario, Taal and Tikay with a total of 550 families. The highest number of informal settlers is in Barangay Tikay (162) while the lowest is in Barangay San Pablo (5).

Calumpit

974. While there is no available information on the number of informal settler families in Calumpit, the 2015 CPH indicates that there were 273 families residing without the consent of the owner. Based on the previous relocation during the Northrail Project, there were 16,270 for Northrail Phase 1 Section 2 (from Malolos to Mabalacat, Pampanga) was 16,270 (Northrail.gov.ph, n.d.), with ISFs in Calumpit transferred to Northville 9. The city's Zoning Map (2007-2020) did not identify spaces for socialized housing, although majority of the land along the Northrail alignment was used for residential purposes, with a few areas used for commercial and industrial use.

Apalit

975. In 2010, there are 9,790 household informal settlers. These informal settlers were located in either danger areas (i.e. waterways, areas prone to landslide/flood and other hazards) or in private lands with impending threats of demolition/eviction orders. Apalit has identified danger areas in the barangays of Sucad, San Vicente, Cansinala, Tabuyuc, Sulipan, Capalangan and San Juan. Specifically, the 1,072 families along the waterways were located along the Pampanga River bank; 8,580 families were located in areas prone to landslide/floods and other hazards; and 138 families were located in private lands (with impending/threats of demolition/ eviction orders. The municipality proposes to relocate these families in an 8-hectare resettlement project area in barangay San Vicente with funding tentatively set to be sourced from the LGU, NHA, and the Provincial Government of Pampanga.

Minalin

976. According to the report of the MPDO on the List of Informal Settlers along river easement in July 2016, the total number of household living along river easement was 309 about 0.007% of Minalin's total population.

Sto. Tomas

977. In 2007, there were 1,307 household informal settlers in Sto. Tomas which were located in the public area of Barangays Poblacion (192), San Bartolome (117), San Matias (435), and Sto. Niño (140), and in the private area of San Vicente (423).

San Fernando

978. Informal Settlers in the city live in Barangays: Saguin, San Jose, Pandaras, Del Rosario, San Agustin and San Pedro; who had lived along the San Fernando River, San Agustin Creek, Saguin Creek and Balimbing Creek in the city. There were also informal settler communities around the rail tracks of the PNR.

Angeles

979. There were 6,443 families considered as informal settlers due to non-ownership of occupied lands, 1666 of which were on riverbanks (**Table 3.4.8**). The most number of occupants were in Barangay Margot with a total 803 informal family settlers. The riverbank informal settlers of Malabañas were the largest in number of families occupying the riverbanks.

Table 3.4.8 Informal Settlers by Barangay in Angeles, 2015

Barangay	Number of Families	Specific Location	Land Owner
Amsic	206	Riverbanks	Government (Easements)
Amsic	133	Bangkusay	Eloisa R. Narciso
Anunas	248	Riverbanks	Government (Easements)
Anunas	292	Purok 4	Narciso
Anunas	75	P3 Beside Basket Bonanza	NEPLUM (Ricky)
Balibago	200	A Santos	R.D. Policarpio
Balibago	400	Hadrian 1,2,3	San Antonio Dev't. Corporation
Balibago	200	Sto. Nino	Paulita N. Galura
Capaya II	100	Violeta Homes	Bank
Cuayan	317	Purok 6	Gawad Kalinga
Cutud	204	Purok 5	Lingat Property
Cutud	50	Purok 1	Guiao Property
Malabanias	511	Riverbanks	Government (Easements)
Margot	32	Riverbanks	Government (Easements)
Margot	71	Proper	Flores-McCrann
Margot	700	Proper	McCrann Estate
Mining	50	Proper	Rivera Property
Mining	30	After Chapel left corner	Rivera Property
Niony Aquino	237	Riverbanks	Government (Easements)
Ninoy Aquino	300	4th and 5th Streets	Rosario Africa
Pampang	190	Riverbanks	Government (Easements)
Pulung Cacutud	120	Purok 7	Gonzales Property
Pulung Maragul	75	Airwolf	Baliton Property
Pulung Maragul	217	Ipil-ipil	Eusebio Chiqui
Pulung Maragul	131	Pallique Ipil-Ipil	Hizon Property
Pulung Maragul	322	Sitio Pader	Jaoville Property
Sapangbato	85	Riverbanks	Government (Easements)
Sta. Teresita	120	Riverbanks	Government (Easements)
Sta. Teresita	500	Araw Malansik – Dona Paz	Don Pepe Henson
Sto. Domingo	130	San Joaquin	-
Tabun	37	Riverbanks	Government (Easements)
Tabun	100	Purok 3 Extension	Alejandro Pineda/Mendiola
TOTAL	6,443		

Source: Angeles City Local Urban Poor Affairs & Housing Office (LUPAHO)

Mabalacat

980. Based on the Urban Poor Affair's Office, the City has a total number of 2, 576 informal settlers in the following barangays: Tabun, Dolores, Cacutud, Atlu Bola, San Joaquin, Mamatitang, Poblacion, Mangalit, Sta. Ines, Sta. Maria, Bundagul, and Dapdap. The barangay with the largest

number of informal settlers is Tabun (507) followed by Dapdap (364) and Cacutud (298). On the other hand, Mangalit, Bundagul and Mamatitang had the lowest of informal settlers with 92, 88, and 33 respectively.

Bamban

981. In 2010, there are 102 out of 13,100 households or 0.78% who are classified as informal settlers, which means that they live in public places or with rented/owned house or lot without consent of the owner. Of the 15 barangays, san Roque has the highest percentage of households who are informal settlers predominantly situated in Bangacal Creek, while Sto. Niño (upland) has the highest percentage of households who live in makeshift housing.

Capas

982. In 2010, there are 254 out of 26,243 households or 0.97% who are classified as informal settlers, which means that they live in public places or with rented/owned house or lot without consent of the owner.

(2) ISFs under the Project by LGUs

983. Given that the Project affected area utilizes the PNR ROW, majority are ISFs encroaching the said area with a small portion (out of PNR ROW). As shown on **Table 3.4.9**, the number of ISFs is 1,080, which is 81.3 % of total affected families (1,329). This is 4 times the number of legal PAFs.

984. The table likewise indicates that there are 1,106 structures, indicating that in some LGUs, (1) there is more than 1 family for each structure, and that (2) there are structures with no occupants (such as Mabalacat). In all the LGUs, there are more ISFs than legal PAFs. The bulk of ISFs are in San Fernando (648 families), Calumpit (248 families) and Angeles (166 families). LGUs with few ISFs are: (1) Santo Tomas (13 families), (2) Malolos (3 families) and Apalit (2). On the other hand, most of the legal PAFs are also in San Fernando (161) – possibly due to the length of the alignment and the additional ROW needed in the said segment. The other remaining legal PAFs are from Calumpit, Angeles, Santo Tomas and Malolos.

Table 3.4.9 Number of PAFs as of May 2018

Municipality	Project Affected Structures	PAFs			
		Legal PAFs	ISFs	No Response	Total
Malolos	12	2	3	1	6
%		33.3%	50.0%	16.7%	100.0%
Calumpit	281	33	248	3	284
%		11.6%	87.3%	1.1%	100.0%
Apalit	2	1	2	0	3
%		33.3%	66.7%	0.0%	100.0%
Sto. Tomas	26	11	13	0	24
%		45.8%	54.2%	0.0%	100.0%
San Fernando	616	161	648	11	820
%		19.6%	79.0%	1.3%	100.0%
Angeles	167	22	166	4	192
%		11.5%	86.5%	2.1%	100.0%
Mabalacat	2	0	0	0	0
%					
MCR Total	1,106	230	1080	19	1329
%		17.3%	81.3%	1.4%	100.0%

Source: JICA Study Team

985. Among the PAFs, there are members of households who are below the poverty line, and who may be elderly, persons with disabilities and/or needing special assistance, and solo parents. The SES also noted these PAPs who may be vulnerable or who may require additional compensation and/or other forms of assistance, as indicated in **Table 3.4.10**.

986. Among the vulnerable groups, majority are dependents – either as babies/toddlers (460) or elderly (146 out of 676). There are also some PAPs who are pregnant (18) and PAPs requiring assistance in walking (18) and PAPs with mental disorder (12).

Table 3.4.10 Vulnerability of PAFs

Municpality	Vulnerability Count									
	Baby/ Toddler	Pregnant	Elderly	Mental Disorder	Needs Assistance Walking/Cannot Walk	Seriously Ill	Blind	Mute/Deaf	Others	Total
Malolos	2	0	3	0	0	0	0	0	0	5
%	40.0%	0.0%	60.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Calumpit	60	2	55	2	4	1	1	0	2	127
%	47.2%	1.6%	43.3%	1.6%	3.1%	0.8%	0.8%	0.0%	1.6%	100.0%
Apalit	1	0	0	0	0	0	0	0	0	1
%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Sto. Tomas	6	0	4	0	0	2	0	0	0	12
%	50.0%	0.0%	33.3%	0.0%	0.0%	16.7%	0.0%	0.0%	0.0%	100.0%
San Fernando	336	15	49	10	8	1	3	3	13	438
%	76.7%	3.4%	11.2%	2.3%	1.8%	0.2%	0.7%	0.7%	3.0%	100.0%
Angeles	45	1	35	0	6	3	0	1	2	93
%	48.4%	1.1%	37.6%	0.0%	6.5%	3.2%	0.0%	1.1%	2.2%	100.0%
MCR Total	450	18	146	12	18	7	4	4	17	676
%	66.6%	2.7%	21.6%	1.8%	2.7%	1.0%	0.6%	0.6%	2.5%	100.0%

Note: The SES survey is yet to be conducted for the segment of alignment not finalized - between CIA to NCC.

Source: JICA Study Team

3.4.2.3 Housing Program and Availability

Malolos

987. The Malolos hosts more than 51 residential subdivisions with a total area of 7,230,097 and 18,273 housing units and the Northville 8 Resettlement Project of the Philippine government. Northville 8 has the highest housing units of 3,205 whereas Altana Subdivision has the lowest of four (4) housing units. Grand Royale Subdivision occupies the biggest area in Malolos Bulacan of 1,697,102 sq. m.

Calumpit

988. At present, about 857 hectares or 15 percent of the total land area of Calumpit are devoted for residential uses. Additional land for settlements of around 96 hectares is needed to accommodate the population increase. Under the Local Inter Agency Committee (LIAC) of Calumpit, 1,455 informal families living along the PNR ROW were relocated to socialized housing called Northville-9 in Barangay Iba O Este funded by the National Housing Authority funded the project. Another 92 ISFs living under the bridge near the Angat and Pampanga Rivers were relocated to Lexber Homes Subdivision in Barangay Pio Cruzcosa.

Apalit

989. The housing units in Apalit has steadily increased by around 37-42 percent since 1960. The biggest increase in occupied housing units in the municipality was between the 1990 and 2000.

In 2010, there are 20,509 occupied housing units, equivalent to a ratio of 99 households for every 100 occupied housing units or 4.95 persons per occupied housing unit. This indicates that there are no doubled-up households in housing units or no shortage in housing. Among the occupied housing units, majority (72%) do not need major minor repairs and 21% are still under construction.

Minalin

990. The Northville 11 relocation site is located in Minalin, this site caters to the needs on informal settlers. There is a Socialized Housing Zone in Brgy. San Isidro.

Sto. Tomas

991. There are four (4) existing open market subdivisions and socialized housing projects in the municipality. At present (2016), there are two (2) resettlement areas managed by the LGU within Sto. Tomas. This is Northville12 located in San Vicente catering to 612 households and Igmidio Ville in Moras dela Paz which caters to 500 households.

San Fernando

992. Three hundred house and lot units located in San Fernando Heights, Barangay Malpitic here were awarded to almost 400 ISFs on May 12, 2014 in compliance to the Supreme Court's Mandamus clearing all waterways of ISF to support the Manila Bay Protection and Clean-up Campaign.

993. The beneficiaries are from Barangays Saguin, San Jose, Pandaras, Del Rosario, San Agustin and San Pedro, who have lived along the San Fernando River, San Agustin Creek, Saguin Creek and Balimbing Creek in this city.

Angeles

994. Angeles' areas comprise the residential portion of the built-up. These are the built houses, private subdivisions, resettlement suites, socialized housing, and public areas This land use category has an aggregate area of about 2,941.90 hectares representing 47.32 percent of the city's total land area.

995. There are eight (8) resettlement areas in Angeles with a total area of 98.00 hectares accommodating 7,662 families as indicated in **Table 3.4.11**. Majority of the families in the resettlement areas in Angeles came from nearby municipalities affected by the Mt. Pinatubo eruption. Northville 15 Resettlement in Cutud, is for families displaced by the proposed North Rail Project.

Table 3.4.11 Resettlement Areas in Angeles, 2015

Resettlement Site	Land Area (Has.)	Number of Families
Sapalibutad Resettlement	2.00	382
Angeles Heights Cabio Bakal, Sapalibutad	3.00	500
Northville 15 Resettlement, Cutud	28.40	3,499
EPZA Resettlement, Pulung Cacutud	38.80	2,034
Capaya II Buklod Resettlement, Purok 7	12.60	253
Ninoy Aquino Bliss Resettlement	3.17	406
Pandan 5A Resettlement	6.00	388
Pandan 5B Resettlement	4.00	200
TOTAL	98.00	7,662

Source: Angeles City Local Urban Poor Affairs & Housing Office (LUPAHO)

Mabalacat

996. There is an existing area– Northville 16- which was used as a relocation site for the ISFs during the Northrail Project.

Bamban

997. Based on the 2016 Socio Economic Profile of Bamban, the municipality has 10,169 out of 11,358 households who are owners or have an owner-like possession of house and lot that they occupy while 752 or 6.62% of the households rent the house/room including the lot.

Capas

998. The Municipality's residential area is approximately 1,977.75 hectares or about 5.25% of the total land area. Settlement areas follow a strip or linear pattern along major thoroughfares and are concentrated in the Poblacion area and barangay centers. Residential subdivisions, socialized housing projects, and resettlement areas such as the Navy Resettlement Area in Barangay Cristo Rey, are also included in this land use. The average lot area per household is 714.28 square meters, while the average municipal residential density is 71 persons per hectare.

3.4.3 Indigenous People(s)

3.4.3.1 Profile of Indigenous People

999. Central Luzon has a total number of 230,270 IPs, which contributes 2.03% in the total population of IPs in the Philippines. Among the IP groups in the Philippines, there are two (2) ethnic tribes near the vicinity of the proposed MCRP, namely, Aeta and Abelling (**Table 3.4.12**).

Table 3.4.12 Indigeneous communities in the area (2006)

IP Group	Aurora		Bulacan		Nueva Ecija		Pampanga		Tarlac		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Aeta	112	0.8%	-	0.0%	1,032	1.9%	18,920	100%	25,503	66.2%	45,567	34.2%
Abelling	-	0.0%	-	0.0%	-	0.0%	-	0.0%	13,032	33.8%	13,032	9.8%
Dumagat/ Remontado	5,049	34.4%	6,861	100%	10,701	19.7%	-	0.0%	-	0.0%	22,611	17.0%
Ibaoloi/ Kalanguya/ Kankanaey	-	0.0%	-	0.0%	42,585	78.4%	-	0.0%	-	0.0%	42,585	31.9%
Ilongot/ Bugkalot	9,517	64.8%	-	0.0%	-	0.0%	-	0.0%	-	0.0%	9,517	7.1%
Total	14,678	100%	6,861	100%	54,318	100%	18,920	100%	38,535	100%	133,312	100%

Source: NCIP Regional Office III

Aeta/Ayta

1000. Aeta/Ayta belongs to the group of indigenous people who inhabit mostly the highlands or mountain regions of Pampanga and Tarlac. Aeta preserved their ethnic identity through their language, belief system and consciousness. Suitably adapted to their ecological niche and environment, the Aeta communities still employ subsistence patterns practiced by their forebears, such as hunting, foraging, and swidden cultivation.

1001. There are approximately 4,200 Ayta in a number of Sitios of Bamban and Capas, Tarlac; Mabalacat and Sapangbato, Pampanga; and Zambales (Stock 2005). In 2010, 0.4% of the household population of Tarlac belongs to ethnic groups of Aeta/Ayta. The 2016 Socio Economic Profile of Bamban also mentioned that Aeta consists of 3.75% or 2,340 of the total population of Bamban. According to the data of Gawad Kalinga (GK), there are currently eight (8) Aeta GK Villages in Bamban, Tarlac. They can be found in three (3) Sitios, namely, San Martin, Sta. Rosa and Burog. There are 120 families in San Martin, 60 already have houses, and the rest are being constructed. There are 100 families in Sta. Rosa but only 63 have houses. The rest are to be built. There are 100 families in Burog, with 75 having houses. The families are organized into a Kapitbahayan (Neighborhood Association) and they have a functional structure.

Abelling

1002. In 2010, 0.3% of the household population of Tarlac belongs to ethnic groups of belongs to Abelling/Abellen/Aberling/Aborling. Abelling tribe is a little known cultural minority found in the mountainous part of Western Tarlac. Around 290 Abelling families dot the mountain ranges in Sitio San Pedro, Barangay Iba, San Jose, Tarlac. Abelling Tribal Vice-Leader Johny Basilio said that according to his ancestor's oral history, they have been hunting and gathering in the province of Tarlac even before the Aetas. Another proof, he said, is that their language, Aberling, is way different from the Aetas' Sambal dialect. Today, most Abellings are farmers, carpenters and fishermen. They rely heavily on the forests around them for food, shelter and medicine.

1003. The Abelling tribe is ruled by a council of elders, composed of 14 individuals, all are well-versed in herbal medicine, hunting, fishing, gathering, trade crafts like weaving, cooking, and bow and arrow making. But one more important unifying factor is that all are portals for the anitos. Each elder can be possessed by the anito spirit upon calling, and it is in this state that important decisions are made on behalf of the tribe.

1004. Like many other indigenous group, they are faced with the temptations of modern city life, technology and to some, even social media. Many of the younger generation have chosen to live and work in the city. Other men have married women from outside their tribes. The Abelling tribe is slowly vanishing, and along with it, its culture, practices and traditions.

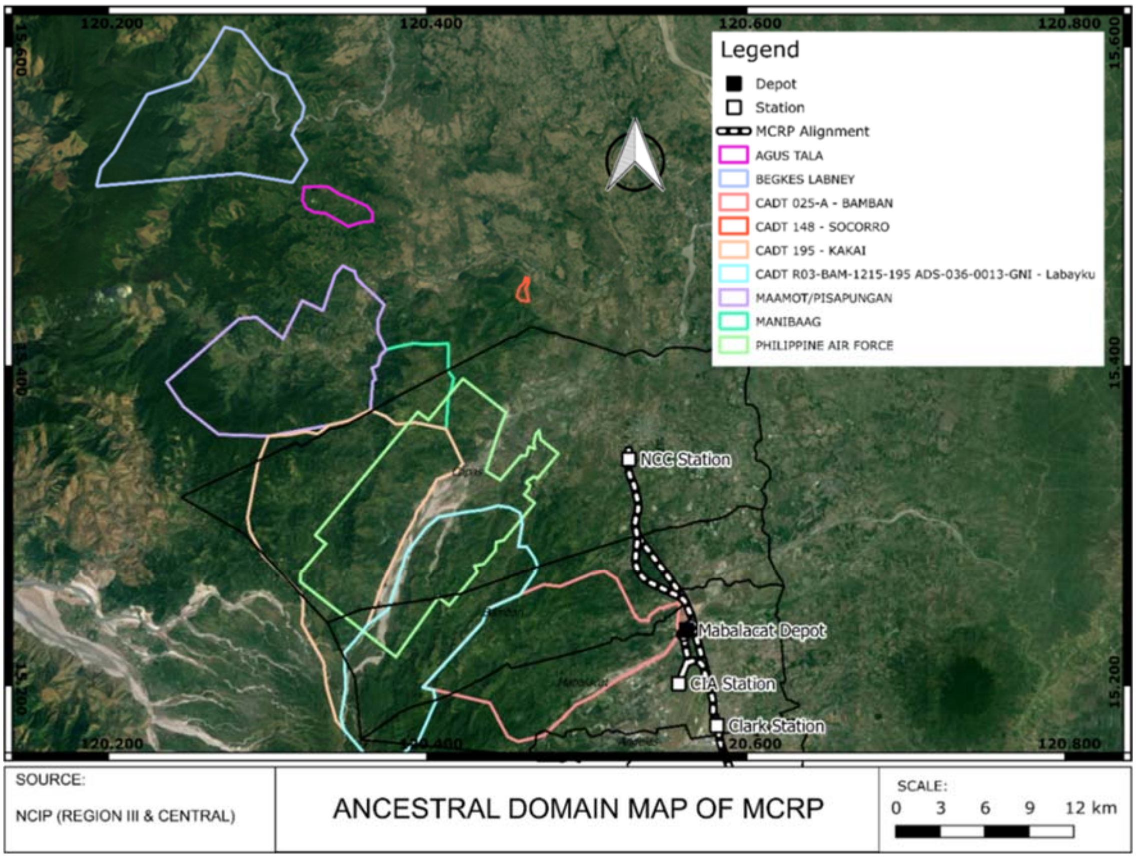
3.4.3.2 Certificate of Ancestral Domain Title

1005. The BCDA is a government agency and development corporation mandated by RA 7277 to strengthen the Philippine Armed Forces while creating economic development and opportunities in the country. In 1980, a location known as the SACOBIA property was designated as part of the U.S. Military Reservation (Clark Air Base) within the CSEZ subject to management of the CDC.

1006. On December 16, 1997, the NCIP issued a CADC No. R03-CADC-107, covering the area of approximately 5,515 hectares of the SACOBIA property in favor of the Aeta tribes. A CADT 025 was issued in 2006 by the NCIP, covering the portions of Mabalacat City in Pampanga and parts of Bamban, Tarlac. To address this issue, BCDA entered a Joint Management Agreement (JMA) also known as the Kasunduan Para sa Sama-Samang Pamamahala, December 6, 2007, with the CDC, NCIP and the Aeta tribes in the area, namely the Samahang Tribung Aeta ng CADT 025, Bamban Aeta Tribal Association (BATA), and the Mabalacat Aeta Tribal Association (MATA).

1007. As of 2010 Census of NCIP Region 3 for Tarlac, the registered CADT-025 has an IP population of 2,973. Adjacent to CADT 025 are the approved CADTs of the Labayku and Kakai. Labayku CADT has an IP population of 2,591 while Kakai CADT has an IP population of 3,052.

1008. A portion of the MCRP alignment will be passing through the municipalities of Bamban and Capas in Tarlac where ancestral domain areas are known to be located. Two options for the alignment leading towards the NCC development and proposed Depot site are currently being studied by the JICA Design Team. Various meeting with the NCIP have been conducted to clarify validation requirements and to gather pertinent data. **Table 3.4.13** indicates a summary of the Ancestral Domains near MCRP.



Source: NCIP Region 3

Figure 3.4.1 The location of CADT in Tarlac

Table 3.4.13 Ancestral Domain nearby Project area

Ancestral Domain	Resident Aeta clan-group	Area (ha.)
Registered CADT		10,323
CADT 025-A	Samahang Tribung Aeta ng CADT 025; BATA, MATA	10,323
Approved CADT		26,188
CADT – RO3-BAM-1215-195, ADS-036-0013- GNI (Labayku)	Ayta Magantsi	11,445
CADT -195 (KAKAI)	Ayta Huengey	14,668
CADT – 148 (Socorro)	Ayta Abelling	75
CADTeables* for verification		22,844
	Maamot / Pisapungan	10,269
	Agus Tala	765
	Begkes Labney	9,130
	Mani Baag	2,680
Total		59,355
Contested Areas		10,972
Philippine Air Force	Ayta Magantsi, Ayta Huengey	15,830 / Overlap on AD land: 10,972

Note: CADTeables are Certificate of Ancestral Domain Claims (CADC) not yet verified on site.

Source: NCIP Region III

3.4.4 Historical and Cultural Heritage

1009. In the Philippines, NHCP declares the heritage in accordance with NHCP Guideline on the Identification, Classification, and Recognition of Historic Sites and Structures in the Philippines (2011) under RA 10066 (2009). Structures and site with 1) Possess demonstrable historical significance, 2) be at least fifty (50) years old, and 3) seventy (70) percent authentic are qualified for consideration. **Table 3.4.14** shows the list of historical and cultural heritage declared by NHCP located in close proximity to the proposed MCRP.

Table 3.4.14 Historical and Cultural Heritage Accredited by NHCP

	Heritage	Location	Distance from the Project (km)
1	Bayan ng Kalumpit	Calumpit	0.12
2	Pamintuan House	San Fernando	0.42
3	Santos-Hizon Heritage House	San Fernando	0.45
4	Lazatin House	San Fernando	0.23
5	Cuyugan-Dayrit Ancestral House	San Fernando	0.70
6	Hizon-Singian Ancestral House	San Fernando	0.41
7	Church of Apalit	Apalit	2.58
8	Death March	San Fernando	0.01
9	Himpilang Daang Bakal ng San Fernando	San Fernando	0.00
10	Artillery Memorial	Mabalacat	0.45

Source: NHCP

1010. Within the project area, there are old PNR stations and Railway Bridge dotted along the proposed alignment. These structures are considered to meet the above-mentioned conditions and need for preservation. DOtr will consult NHCP and PNR for the qualification of those structure and provide necessary protection measure during construction. The PNR structures over 50 years within the proposed MCRP are listed in **Table 3.4.15**.

Table 3.4.15 Old PNR Stations and Bridges with the Project Area

No.	Heritage	Location	Description
1	Old PNR Bridge remnants (1891)	Bulihan Creek, Malolos, Bulacan	Structures are derelict. Bridge posts have flood hazard markings by locals.
2	Old PNR Bridge remnants (1891)	Angat River, Calumpit, Bulacan	Structures are derelict.
3	Calumpit Station (1891)	Calumpit, Bulacan	Structure is in good condition with bricks and iron grills intact.
4	Old PNR Bridge remnants (1891)	Apalit River, Apalit, Pampanga	Structures are derelict.
5	Apalit Station (1892)	Apalit, Pampanga	Structure is derelict with no roof. Walls have been covered with concrete plaster in 1947.
6	Old PNR Bridge remnants (1892)	Minalin, Pampanga	Structures are derelict.
7	Santo Tomas Station (1892)	Santo Tomas, Pampanga	Structure is derelict with no roof. Bricks of the structure remain with renovation works to portions of the structure. These have been removed by PNR.
8	San Fernando Station and restroom structure (1892)	San Fernando, Pampanga	Structure is in good condition with bricks and iron grills intact.
9	Old PNR Bridge remnants (1892)	Baliti Creek, San Fernando, Pampanga	Structures are derelict.
10	Angeles Station (1892)	Angeles, Pampanga	Structures are derelict with no roof. Bricks may have been covered with concrete plaster in 1947.
11	Angeles Station (1947)	Angeles, Pampanga	Structure is in good condition. It is currently being used as a day-care with chapel functions.
12	Old PNR Bridge (1946)	Angeles, Pampanga	Structures are derelict.

Note: The list is based on visual validation conducted in March 2018.

Source: JICA Design Team

3.4.5 Existing Social Infrastructure and Services

3.4.5.1 Power Supply

(1) Power Supply by Host LGUs

Malolos and Calumpit

1011. Manila Electric Company (MERALCO) is Bulacan's main power distributor and provider. MERALCO, with eight (8) sub-stations, supplies electricity in the whole province. Malolos has two (2) sub-stations located in Pinagbakahan and Tikay.

Apalit, Minalin, and Sto. Tomas

1012. MERALCO provides electrical power in two (2) barangays of Apalit, namely Balucuc and Calantipe. In other ten (10) barangays of Apalit, as well as the whole Minalin and Sto. Tomas, the electrical power is provided by Pampanga Electric Cooperative, Inc. (PELCO) III located in Sampaloc, Apalit.

1013. By 2020, a solar power plant in Barangay San Juan, Apalit will be operational, to be established by the joint venture between Novosol Power Company (based in Canada, Africa and the United States of America) and Doña Isabel Power Corporation. The solar power plant will provide power to Apalit and to six (6) towns served by PELCO III, namely Apalit, Masantol, Macabebe, Sto. Tomas, Minalin and San Simon and other forms of waste to energy projects.

San Fernando

1014. The power supply in San Fernando is provided mainly by the San Fernando Electric Light & Power Company, Inc. (SFELAPCO). SFELAPCO has four power distribution substations namely Magdalena, Greenville, Lourdes Heights and Basa Sub-Stations with a combined capacity of 119.2 MVA. It is the seventh largest privately-owned electricity distributor in the country. It procures energy from the government-owned National Power Corporation – TransCo (NPC-TransCo) and from Hedcor, Inc., - a hydroelectric firm of the Aboitiz Group.

Angeles

1015. The power supply in Angeles is provided mainly by Angeles Electric Corporation (AEC), a private company provider of power. It serves the 33 barangays in Angeles and has a total of 16,852 electric post, as of 2015. The source of power supply and its generating capacity are 72 megawatts purchased from the NPC; 22 megawatts generated by the Angeles Power Incorporated (**API**); and 6 megawatts generated by its power plant in PulungMaragul.

Mabalacat

1016. The electricity supply in Mabalacat is provided mainly by the electric cooperative PELCO II.

Bamban and Capas

1017. The power supply in Bamban and Capas is provided mainly by Tarlac Electric Cooperative (TARELCO). The service of the electric cooperative is operating on a 70 MVA capacity.

1018. All 15 barangays of Bamban are being served by TARELCO. Moreover, all the 20 barangays of Capas are also reached by the distribution system, although electricity is not yet available to some houses and remote sitios. According to TARELCO, there is enough supply of electricity for the Municipality but the problem of accessibility to some remote sitios poses hindrances to the delivery of power services to these areas. Barangays Bueno and Maruglu are the two (2) barangays with the lowest number of households with power connections. As identified and recommended in the discussion of the circulatory system of Capas, the construction of the proposed Bueno Bridge with the proposed road improvements to pave standards of all roads leading to all the proposed development nodes will facilitate faster delivery of power supply and other basic services needed or required to stir the envisioned development to these barangays.

(2) Power Supply of PAFs

1019. Majority of the PAPs have access to electricity, with only 1.8% having no connection (**Table 3.4.16**). These PAPs are in San Fernando (14 PAPs) and Apalit (1 PAP). Apart from these, some PAPs (35.3%) have electricity through shared connection. Majority have their own connection to electricity (61.3%), The PAPs who have shared connection – especially in Calumpit, San Fernando and Angeles, may pertain to informal settler families who share electricity with their neighbors and other community members.

Table 3.4.16 Access to Electricity per LGU

Municpality	Access to Electricity						
	Own Electric Meter for Power Connection	Shared Connection	No Connection	Others	N/A	N/R	Total
Malolos	5	1	0	0	0	0	6
%	83.3%	16.7%	0.0%	0.0%	0.0%	0.0%	100.0%
Calumpit	180	88	9	4	0	3	284
%	63.4%	31.0%	3.2%	1.4%	0.0%	1.1%	100.0%
Apalit	1	1	1	0	0	0	3
%	33.3%	33.3%	33.3%	0.0%	0.0%	0.0%	100.0%
Sto. Tomas	23	1	0	0	0	0	24
%	95.8%	4.2%	0.0%	0.0%	0.0%	0.0%	100.0%
San Fernando	516	278	14	2	3	7	820
%	62.9%	33.9%	1.7%	0.2%	0.4%	0.9%	100.0%
Angeles	90	100	0	1	0	1	192
%	46.9%	52.1%	0.0%	0.5%	0.0%	0.5%	100.0%
MCR Total	815	469	24	7	3	11	1329
%	61.3%	35.3%	1.8%	0.5%	0.2%	0.8%	100.0%

Note: Due to the alternative not finlaise between CIA to NCC, the SES survey is yet to be conducted for the said section.
Source: JICA Study Team

3.4.5.2 Water Supply

(1) Water Supply by Host LGUs

Malolos

1020. Water services are provided by the City of Malolos Water District (CMWD). CMWD also provide water services on some barangays in the neighboring towns of Paombong and Hagonoy. Since 2012, the city is suffering from recurring water shortages. Water is also being supplied by the three (3) rural waterworks systems in Babatnin, Bulihan, and Pamarawan. There are also public and privately owned artesian wells to meet the water need of the populace. About 66 pumping stations are owned and maintained by the CMWD.

Calumpit

1021. Water services are provided by the Calumpit Water District (CaWaDi). CWD has a total of 16 production wells. According to the Service Connection Data of CWD, the total number of households served in 2015 were 27,853 and the total service connections were 21,772.

Apalit

1022. Water supply to the various barangays of Apalit and even to the adjacent Macabebe is served by piped water originating from the initial well and pump from Barangay Tabuyoc. Apalit Waterworks has developed this well and has installed a network of PVC piping, as well as developed additional boreholes, with pumps, backup generators and storage reservoirs. Other areas not yet connected to Apalit Waterworks still use traditional shallow wells with cheap hand pumps or small electrical pumps. According to the MPDO, water in Apalit passed the tests for water quality.

Minalin

1023. The main potable water sources in Minalin are from the Municipal Water District (3,354 households 36%), other households from water refilling stations (3,106 households or 33%) and deep well (104 households 1%). Other sources of water are from rain water.

Sto. Tomas

1024. The potable water supply in Sto. Tomas is provided by Crystal Liquid Philippines, Inc.

San Fernando

1025. Water services in San Fernando are provided by the City of San Fernando Water District (CSFWD). CSFWD has water service facilities available in 35 barangays with a total of 28,994 active connectors as of February 1, 2011. Most of the areas served by the system has 24-hour water supply.

1026. CSFWD supplies water to its concessionaires from various sources located in Moras Dela Paz, Sto. Tomas and San Matias, Sto. Tomas. Its spring sources could be found in Brgy. Dolores. There are pumping stations and booster pumps distributed within the City proper and various barangays. Water is distributed through a pipeline network with pipe sizes ranging from 4 inches to 12 inches in diameter. The system also includes water storage facilities.

Angeles

1027. Angeles City Water District (ACWD) serves 30 barangays in the city except Barangays Amsic, Balibago and part of Malabañias. These barangays are served by private waterworks systems as well as the other subdivisions in the city.

Mabalacat

1028. Water services in Mabalacat are provided by Mabalacat Water District. It has 35,421 water connections that serve 22 barangays.

Bamban

1029. The water supply in Bamban is provided by a lone private company, the Crystal Liquid Philippines, Inc. (CLPI), formerly Balibago Waterworks Systems, Inc. (BWSI). Under this company, the Bamban Branch serves the lowland area of the Municipality while the Dap-dap Waterworks serve the upland communities.

1030. The Bamban Branch has a water capacity of 108,614 cu.m. per month and serve 4,347 households in the municipality. It has four (4) pumping stations located in Barangays Dela Cruz, Anupul and Lourdes which serve Barangays Anupul, Dela Cruz, Lapaz, San Roque, san Nicolas, Banaba and Lourdes. On the other hand, Dap-dap Waterworks has a total production of 86,664.67cu.m. It serves 3,496 households in the Dap-dap Resettlement Area with seven (7) pumping stations.

Capas

1031. Only 12 barangays out of 20 barangays in Capas are being served by BCBI-Capas Waterworks Branch of BWSI, albeit not all households on these 12 barangays have an access to the water supply system. As of 2010, there are only a total of 3,411 connections as compared to the estimated 26,062 total households on Capas. The main source of water supply is underground with five (5) existing pumping stations strategically located within the municipality with a total aggregate output of 100,027 cu.m. per month.

1032. Three (3) pumping stations located in Barangays Sto. Domingo II, Sto. Rosario, and Talaga are interconnected and providing water supply to the Poblacion and nearby barangays of Cutcut I, Cutcut II, Sto. Rosario, Cubcub, Sto. Domingo I and II, Aranguren, Manlapig, Dolores and Talaga. The other two (2) pumping stations which are both located in Barangay Patling are alos interconnected serving Patling and Sta. Lucia. The Kalangitan Resettlement Area Water Supply System, which is being managed by O'Donnell Resettlement Waterworks Multipurpose Cooperative (ORWAMCO) serves mainly the water supply requirements of Barangay Cristo Rey.

1033. The water requirements of other barangays outside the servie area of BCBI-Capas Waterworks and ORWAMCO still rely on deep wells, shallow wells and rain water or depend mainly of water traders.

(2) Water Access of PAFs

1034. Most PAPs (99.6%) have access to water. Among these, almost half (54.8%) have access through the water service providers (i.e. Maynilad, MWSS, or local service providers). Some share access to water, possibly with community other members or through water cooperatives and organization – in Malolos, Apalit, San Fernando and Angeles. There are still a few (8.7%) who use deep wells and some (18%) who buy from water vendors. Among the PAFs, only one family in Capalit mentioned the use of shallow well, as indicated in **Table 3.4.17**.

Table 3.4.17 Access to water by PAFs

City/ Municipality	Access to Water								
	Maynilad/ Manila Water (Piped Connection)	Shared with Neighbor (Community Faucet)	Deep well	Shallow Well	Buy from Water Vendors	Others	N/A	N/R	Total
Malolos	4	1	0	0	0	0	0	1	6
%	66.7%	16.7%	0.0%	0.0%	0.0%	0.0%	0.0%	16.7%	100.0%
Calumpit	163	64	20	1	6	23	3	4	284
%	57.4%	22.5%	7.0%	0.4%	2.1%	8.1%	1.1%	1.4%	100.0%
Apalit	1	1	0	0	1	0	0	0	3
%	33.3%	33.3%	0.0%	0.0%	33.3%	0.0%	0.0%	0.0%	100.0%
Sto. Tomas	24	0	0	0	0	0	0	0	24
%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
San Fernando	427	137	96	0	11	145	2	2	820
%	52.1%	16.7%	11.7%	0.0%	1.3%	17.7%	0.2%	0.2%	100.0%
Angeles	109	68	0	0	0	14	0	1	192
%	56.8%	35.4%	0.0%	0.0%	0.0%	7.3%	0.0%	0.5%	100.0%
MCR Total	728	271	116	1	18	182	5	8	1329
%	54.8%	20.4%	8.7%	0.1%	1.4%	13.7%	0.4%	0.6%	100.0%

Note: Due to the alternative not finlaise between CIA to NCC, the SES survey is yet to be conducted for the said section.

Source: JICA Study Team

3.4.5.3 Open Space and Recreational Area

Malolos

1035. The most common sports facilities present in the town are basketball court distributed in almost all barangays. In support the sports and recreation facilities of the municipality, some school has a park, playground of athletic activities.

Calumpit

1036. Small areas of open space in urban areas of Calumpit provide an important local amenity and offer recreational and play opportunities. These areas include the Sergio Bayan Park or the Municipal Government Plaza, and other public recreational open spaces such as basketball courts.

Apalit

1037. All barangays of the Municipality have at least one sports facility, mainly a basketball court, as shown in the table below. In agricultural communities, said basketball courts also convert as aerated dryers for rice produce.

Table 3.4.18 Access to water by PAFs

Barangay	Area (has)	Sports Facility	Recreation Facility	Ownership	Physical Condition (Good, Poor, Critical)
Balucuc - BalucucCaingin - Balucuc Dungan - BalucucCabioBacal	 0.0420 0.0448 0.0420	Basketball Court		Barangay	Good
2. Calantipe	0.0448	Basketball Court		Barangay	Good
3. Cansinala - P3-Cansinala - P6-Cansinala	 0.0420 0.0448	Basketball Courts		Barangay	Good
4. Capalangan	0.0448	Basketball Court		Barangay	Good
5. Colgante	0.0448	Basketball Court		Barangay	Good
6. Paligui	0.0420	Basketball Court		Barangay	Good
7. Sampaloc - P2-Sampaloc - P3-Sampaloc	 0.0448 0.0448	Basketball Courts		Barangay	Good
8. San Juan	0.0420	Basketball Court		Barangay	Good
	0.0500		Municipal Park		
9. San Vicente - Villena - Sampaga - Northville	 0.0448 0.0420 0.0448	Basketball Courts		Barangay	Good
10. Sucad (P-6)	0.0420	Basketball Court		Barangay	Good
11. Sulipan - Sulipan - Riverside Sulipan	 0.0448 0.0420	Basketball Courts		Barangay	Good
12. Tabuyuc (Purok 1)	0.0420	Basketball Court		Barangay	Good

Minalin

1038. Minalin has several covered courts with schools or institutions but these are no for public use. It is a requirement that for every town there should be at least 500 sq.m space for every 1,000 population. For Minalin, there should be at least 88 sq.m of space allocated for sports and recreation or about 1.8% of the total land area of Minalin or a projected need of at least 35 hectares in 2025. This could be divided into several parks located strategically near neighborhoods and areas that need a carbon sink such as industrial sites.

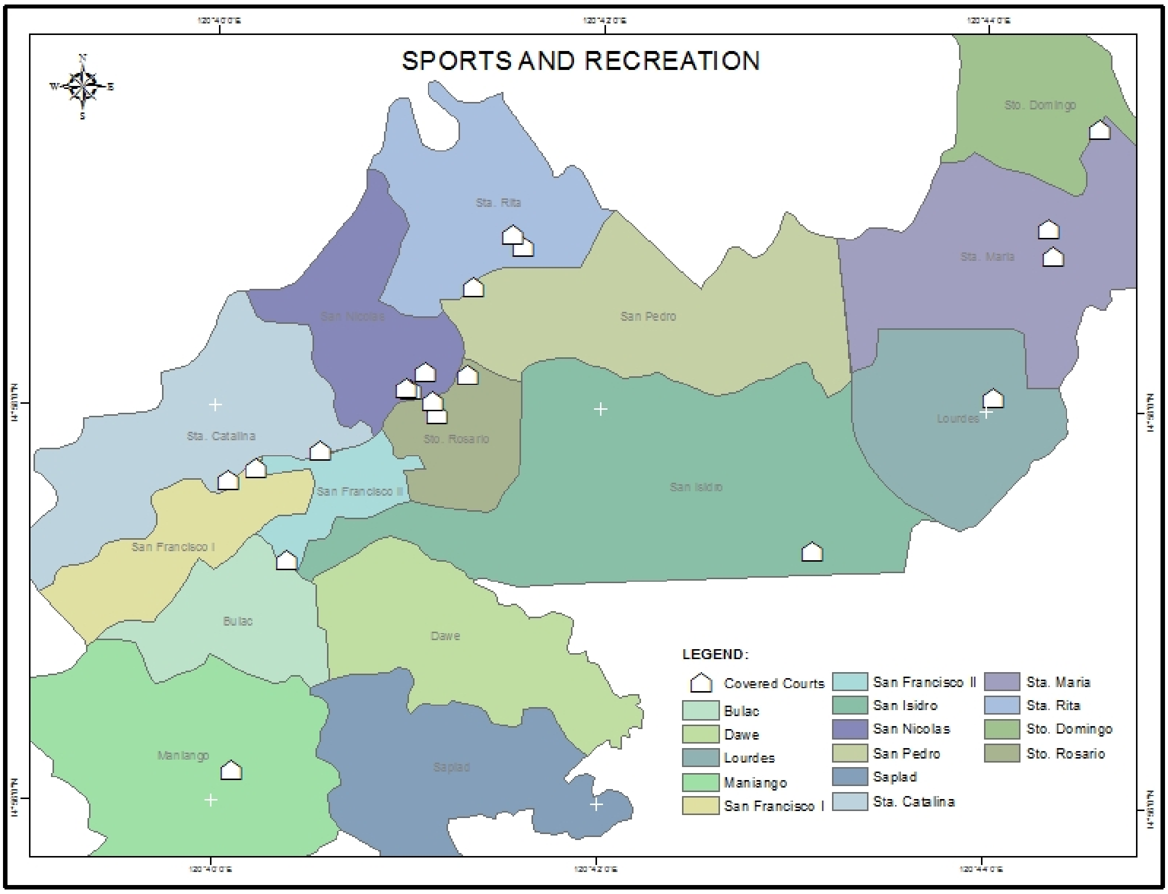


Figure 3.4.2 Sports and Recreational Facilities, Minalin, Pampanga

Sto. Tomas

1039. There are seven (7) covered basketball courts and one (1) municipal gym in Sto. Tomas. In addition to these sports facilities, other recreation facilities include open courts and private clubhouses in La Corona Subdivision and Villa Lyka Pool Resort. The municipality also has a day-long festivity known as Sabuaga Festival or Flower Showering Festival celebrated during Easter Sunday.

1040. Based on the standards for recreational facilities, a minimum of 500 sq.m. per 1,000 population for municipal park is needed. The municipality currently exceeds this requirement to support their recreational activities, and also suffices the demands for the projected population for 2016-2025.

Table 3.4.19 Current and Projected Needs for Sports and Recreation

	2010	2016	2017	2018	2019	2020	2025
Population	38,062	41,961	42,611	43,260	43,910	44,560	47,809
Min. area for municipal park (500 sq. m or 0.05 ha)	1.90	2.10	2.13	2.16	2.20	2.23	2.39
Open spaces/parks (in ha.) in Sto. Tomas	13.07	13.07	13.07	13.07	13.07	13.07	13.07
Requirement (in ha.)	-11.17	-10.97	-10.94	-10.91	-10.87	-10.84	-10.68

Table 3.4.20 Sports and Recreation Issues Analysis Matrix

Technical Findings/Observations	Implications (Effects)	Policy Options/Interventions
Some sports/recreational facilities are located in flood-prone areas	Limited opportunity for residents to indulge in sports and recreation for their health and wellness programs	Ongoing flood mitigation programs can lessen impacts

San Fernando

1041. Bren Z. Guiao Sports Complex and Convention Center is a multi-purpose complex with imposing venues for concerts, convention, basketball games, beauty pageants and other sport activities. The 3,000-seat, air-conditioned convention center inside the complex is one of Pampanga's pride.

Table 3.4.21 Extent of Proposed Land Uses

Proposed Land Use	2021 Proposed Land Uses		% Change
	Area (sq.m.)	% Share	
Agricultural	30,516,870	45.05	-6.42
Agri-Industrial	2,743,470	4.05	69.28
Crop Production	27,448,248	40.52	40.85
Park / Open Space	142,254	0.21	

Angeles

1042. Angeles has a variety of recreational and sports facilities/activities such as parks/open spaces for walking and/or jogging, basketball courts and swimming pools. At present, of the 33 barangays in the city, 30 have their own basketball courts. There are also 14 private basketball courts in the city, wherein 8 are located in different private schools and 6 in private subdivisions. These basketball courts are either open court or covered court. There are also other sports and recreational facilities like a city park with an area of 55,382 sq.m., 6 open spaces in subdivisions, 2 sports complex, 2 gymnasiums, 10 swimming pools/resorts, 3 tennis courts. For the movie goers, cinema houses located inside malls, some of which already have state of the art facilities like 3D and IMAX. There are a total of 19 cinemas in these malls, 7 in SM Clark and 4 each at Jenra Mall, Robinsons Place and Marquee Mall.

Table 3.4.22 List of Basketball Courts per Barangay in Angeles

	Name of Basketball court	Location
1	Agapito del Rosario	G. Valdez, Barangay Agapito del Rosario
2	Amsic Basketball Court	Bankal St., Barangay Amsic
3	Anunas	Purok 4, Barangay Anunas
4	Bayanihan Park Basketball Court	Bayanihan Park, Balibago
5	Capaya Basketball Court	Abad Santos St., Barangay Capaya
6	Claro M. Recto Basketball Court	Susana St., Barangay Claro M. Recto
7	Cuayan Basketball Court	Purok 4, Barangay Cuayan
8	Cutcut Basketball Court	Rizal Extension, Barangay Cutcut
9	Cutud Basketball Court	Bagong Silang, Northville 15, Barangay Cutud
10	Lourdes Sur East Basketball Court	Fajardo St., Barangay Lourdes Sur East
11	Malabanias Basketball Court	Saudi and Salome St., Barangay Malabanias
12	Margot Basketball Court	Barangay Margot
13	Mining Basketball Court	Purok 4, Barangay Mining
14	Marisol Basketball Court	Broadway St., Marisol, Barangay Ninoy Aquino
15	Pampang Basketball Court	Purok 4, Barangay Pampang

	Name of Basketball court	Location
16	Pandan Basketball Court	San Pablo St., Barangay Pandan
17	Pulungbulu Basketball Court	M. Cano St., Barangay Pulungbulu
18	Pulung Cacutud Basketball Court	Lot 15, Block 2, Barangay Pulung Cacutud
19	Pulung Maragul Basketball Court	Sitio Pader, Barangay Pulung Maragul
20	Sapalibutad Basketball Court	Centro Resettlement, Barangay Sapalibutad
21	Sapangbato Basketball Court	Rizal St., Purok 3, Barangay Sapangbato
22	San Jose Basketball Court	Tibag St., Barangay San Jose
23	San Nicolas Basketball Court	Justin St., Barangay San Nicolas
24	Sta. Teresita Basketball Court	Majapahit St., Barangay Sta. Teresita
25	Sta. Trinidad Basketball Court	Miranda Extension, Barangay Sta. Trinidad
26	Sto. Cristo Basketball Court	Caballero St., Doña Belen, Barangay Sto. Cristo
27	Sto. Domingo Basketball Court	Sto. Domingo Integrated School, San Pedro St., San Angelo Subd., Barangay Sto. Domingo
28	Sto. Rosario Basketball Court	Sandra St., Barangay Sto. Rosario
29	Tabun Basketball Court	Tabun Rd., Barangay Tabun
30	Remedian Basketball Court	Lourdes St., Barangay Virgen Delos Remedios

Table 3.4.23 List of Private Basketball Courts in Angeles

	Name of Basketball court	Location
1	Angeles University Foundation	Mac Arthur Highway, Barangay Lourdes Sur East
2	Angeles University Foundation	Marisol Broadway, Barangay Ninoy Aquino
3	Angeles University Foundation	Marisol T.V. Pavilion, Barangay Ninoy Aquino
4	Chevalier	Mac Arthur Highway, Barangay Sto. Domingo
5	Holy Angel University	Sto. Rosario St., Barangay Sto. Rosario
6	Holy Family Academy	Sto. Rosario St., Barangay Sto. Rosario
7	Holy Family Academy	Circumferential Rd., Barangay Sto. Domingo
8	Republic Central College	Plaridel St., Barangay Lourdes Sur
9	Metro Gate Subdivision	Barangay Capaya
10	Savannah Subdivision	Barangay Cuayan
11	Hensonville Subdivision	Barangay Malabanias
12	Villa Gloria Subdivision	Barangay Sto. Domingo
13	Villa Angelina Subdivision	Barangay Sto. Domingo
14	L & S Subdivision	Barangay Sto. Domingo

Table 3.4.24 Existing Sports and Recreational Facilities in Angeles

Sports and Recreational Facilities	Name	Location
City Park	Bayanihan Park	Barangay Balibago
Coliseum / Sports Center	Angeles University Foundation Sports Complex	Mc Arthur Highway, Barangay Lourdes Sur
	Holy Angel University Sports complex	Sto. Rosario St., Barangay Sto. Rosario
Gymnasium	Angeles University Foundation Gym	Mc Arthur Highway, Barangay Lourdes Sur East
	Holy Angel University Gym	Sto. Rosario St., Barangay Sto. Rosario
Swimming	Rand Swimming Pool	Sto. Maria II, Barangay Balibago
	Jazz Swimming Pool	Metro Gate Clubhouse, Barangay Capaya
	Forest Park	Barangay Pampang
	Pampang Resort	Barangay Pampang

Sports and Recreational Facilities	Name	Location
	Amandos	Barangay Sto. Domingo
	Hensonville Plaza	Hensonville Plaza Clubhouse
	Sunset Subdivision Clubhouse	Sunset Subdivision, Barangay Cutcut
	Enclave Clubhouse	Enclave, Barangay Cuayan
	City Sports Center	Villa Angelina, Barangay Sto. Domingo
	Carmenville Clubhouse	Carmenville, Barangay Cutcut
Tennis	Hensonville Plaza	Hensonville Plaza Clubhouse
	L & S Subdivision Clubhouse	L & S Subdivision, Barangay Sto. Domingo
	Diamond Clubhouse	Diamond Subdivision, Barangay Balibago
	Bayanihan Park	Barangay Balibago
Volleyball	Bayanihan Park	Barangay Balibago
Cinema Houses	SM Cinema (7)	SM Clark, Barangay Malabanias
	Robinsons Cinema (4)	Robinsons Place, Barangay Balibago
	Jade Cinema (4)	Jenra Mall, Barangay Sto. Rosario
	Marquee Cinema (4)	Marquee Mall, Barangay Pulung Maragul

Table 3.4.25 Existing and Potential Open Spaces

Name and Location of Open Space	Area (m^2)	Brief Description
Don Bonifacio Subdivision Open Space	5,968	With existing basketball court and barangay hall bldg.
Diamond Subdivision Open Space	7,372	With existing basketball court and public offices
Sta. Maria Village Open Space	1,454	With existing basketball court and education and training bldg.
L & S Subdivision Open Space	17,071	With existing basketball and tennis court
Villa Dolores Open Space	9,298	With existing basketball court
Villa Leoncia Subdivision Open Space	1,644	With existing basketball court

Table 3.4.26 Neighborhood Parks, Playground, Play Lots

Name of Park / Playground / Play Lots	Location	Area (m^2)	Brief Description
Bayanihan Park	Barangay Balibago	55,382	With existing basketball court and transport terminal
Heritage Park	Barangay Sto. Rosario	6,167	
Railway Park	PNR ROW	16,500	
Senior Citizen's Park	Rotonda, Henson St.	$\pm$ 170	

1043. The 2-kilometer PNR railway is convereted to a park filled with ornamental plants, vegetables, sports, and recreational activities. It stretches at Barangays Agapito del Rosario, Claro M. Recto, Lourdes Sur East and Lourdes Sur. There are also two basketball courts.

1044. The 6.2 km of PNR ROW is converted to the pocket park to meet to needs of local communitis. Length of park approx. 300 meters with an area of approx. 0.5 ha. (From Westerways Ave. until Guzman st.). There are a bascketball court, benches which is used among the local communites. Basketball courts, playgrounds, vegetable plots, gardens, concrete pathways, sand tracks, and public toilets dot the first 2-km stretch of the PNR line in this city. Residents and private companies are building jogging parks and biking tracks on another 1.8 km of the PNR line. Lourdes Sur Day Care Center which utilising old PNR statsion building is also located in the park.

Mabalacat

1045. The Mabalacat city has following recreational faicilities.

- Mauaque Resettlement Center Covered Court, Sapang Biabas, Mabalacat, Pampanga
- Sapang Biabas Resettlement Covered Court, Sapang Biabas, Mabalacat, Pampanga
- Lakandula Covered Court, Dau Mabalacat Pampanga
- Marcons-2 Covered Court, Dau Mabalacat Pampanga
- 2 Multi-Purpose Halls, Xevera
- Basketball Courts, Xevera
- Amusement Park, Xevera

1046. Moreover, there are parks/open spaces that are located in both Mabalacat and Angeles. These are the Air Force City Aircraft Park, Bayanihan Park and Bicentennial Park in Clark.

1047. The Air Force City Aircraft Park park was developed to give local and foreign visitors to Clark an opportunity to witness a variety of aircrafts and other aviation equipment used by the Philippine Air Force (600th Air Base Wing). On display in an open field along CM Recto Avenue are a host of flying machines. A favorite spot for local and foreign visitors.

1048. Bayanihan Park is located in front of Clark main gate and formerly known as Astro Park, Bayanihan Park is a beehive of activities everyday from basketball, volleball to kite flying. It is a perfect venue for carnival fairs, religious rites and political rallies

1049. The Bicentennial Park is a favorite place for picnickers and nature lovers as it is lined with shady acacia trees and ornamentals built by Clark Development Corporation as an alternative picnic area for local and foreign visitors into Clark. It has become a favorite place for company outings and events.

Bamban

1050. There are presently 13 covered courts in the municipality, nine (9) of which are located in the mother barangays while the remaining 4 are in the Dap-Dap Resettlement area. Dap-dap Gym, which is located in the Dap-Dap Resettlement area has the largest area of 840 sq.m. while the smallest is the covered court of Virgen Delos Remedios with 392 sq.m.

Table 3.4.27 Location and Size of Covered Courts

	Name / Location of Covered court	Dimension	Floor Area (m^2)
1	Sitio Pandan Court, Barangay Anupul	30 x 11	540
2	Sitio Pag-asa Court, Barangay Anupul	30 x 11	540
3	Barangay La Paz Court	30 x 11	540
4	Mainang Court, Barangay San Nicolas	30 x 11	540
5	San Nicolas Gym	33x17	561
6	Dap-Dap Gym, Barangay San Nicolas	35x24	840
7	Barangay San Roque Court	30x18	540
8	Barangay Sto Niño Court	30x18	540
9	Barangay Virgen de los Remedios Court	28x14	392
10	Barangay Banaba Court (Dap-Dap Resettlement)	32x17	544
11	Barangay Culubasa Court (Dap-Dap Resettlement)	30x18	540
12	Barangay Malonzo Court (Dap-Dap Resettlement)	30x15	450
13	Barangay Anupul Covered Court	30x18	540

Capas

1051. There is at least one (1) hectare of land area allocated for open space per urban barangay for parks, recreation and disaster evacuation purposes.

3.4.5.4 Education

Malolos

1052. Malolos has 38 public elementary schools under the authority of Department of Education (DepEd) Division of City Schools of Malolos, the city schools are divided into two educational districts for representational purpose. The office of DepEd Division of City Schools of Malolos is currently located at the Malolos City Integrated School in barangay Santo Rosario.

Calumpit

1053. Calumpit has a lot of schools, mostly in elementary and secondary levels. It also has private colleges and the most well-known of it is Colegio De Calumpit which is established in 1940 and over many decades has maintain its quality education. Calumpit does not host big universities so most of its students study in Malolos where Bulacan State University and other universities are located.

Apalit

1054. Apalit has 15 elementary and six (6) secondary public schools. It should be noted however that for the 2014-2015 recorded enrolment of students, there are seven (7) listed secondary public schools for Apalit, the addition being Calantipe High School.

Minalin

1055. Minalin has 12 public elementary schools, and 3 public secondary schools; 2 private elementary schools and 2 private secondary schools. There are no tertiary and vocational schools in the municipality.

Sto. Tomas

1056. There are 13 elementary (8 public and 5 private) schools, three (3) secondary (2 public and 1 private), and one (1) tertiary/vocational school in the municipality.

San Fernando

1057. There are 37 elementary (37 and 28 private) schools and 16 tertiary level schools scattered in the City.

Angeles

1058. Angeles has one (1) city college, seven (7) private universities, 43 public elementary schools, 67 private elementary schools, 13 public secondary schools, and 35 private secondary schools.

1059. The Lourdes Sur Day Care Center is converted old PNR stations (constructed 1947 (American era), 71 years old), which located in the the Angeles People's Park.

Mabalacat

1060. Mabalacat City, as of SY 2012-2013, has 40 public elementary schools, 16 public secondary schools, and 31 private schools. Of the 31 private schools, 15 offered both elementary and secondary education.

Bamban

1061. Bamban has a total of 24 public schools, 22 of which offered elementary education while the other two (2) offered secondary education. Bamban has a total of 8 private schools, all of which offered elementary education while 6 of which offered junior and senior high school education. There are two (2) privately owned tertiary schools, namely, Centro Colegio de Tarlac which offers Criminolohy and Whitestone Bible College.

Capas

1062. Capas has 31 public elementary schools covering 21.13 hectares and eight (8) public high schools accounting to 9.61 hectares.

3.4.5.5 Communication

Malolos

1063. The major telecommunications companies offering their services in Malolos incude: Suncellular-Digitel; Globe Telecom, Inc.; Smart Communications, Inc.; and PLDT. The major internet providers include: Bayan Telecommunications, PLDT, Infinivan, Big Sky Nation, Globe Telecom, Sun Telecom, and Smart Telecom. There are more than 70 internet access services in Malolos. There is no AM station in Bulacan. AM Radio stations have relay into Metro Manila in Bulacan. The FM stations in Malolos include: 90.3 Radyo Bandera News FM Malolos and 103.9 Radyo Bulacan.

Calumpit

1064. The major telecommunication providers offering their services in Calumpit include: Bayan, Digitel, and PLDT.

Apalit

1065. Apalit is served by the major telecommunications networks, where even the outlying farmlands has a good network coverage. Various internet shops can be found along the major business areas. Postal service can be found at the Municipal Hall.

Minalin

1066. Minalin has internet connection serving 15 barangays and telephone lines to 15 barangays through private companies- digital and PLDT.

Sto. Tomas

1067. As of 2011, Sto Tomas shares most of its communication facilities such as postal services, internet providers, telephone service provider, cell site network, public calling stations, broadcast and television network and telegraphy with the adjacent municipalities.

San Fernando

1068. The leading telecommunication companies in San Fernando are the Philippine Long-Distance Telephone Co. (PLDT), Digital Telecommunications Phils. (DIGITEL), Globe Telecom, and Smart Communications. They have vital transmission towers located in San Fernando. With regard to internet service, there are several Internet Service Providers offering dial-up, dedicated and DSL types of service. Over a hundred internet cafés are available in strategic areas. Availability of inexpensive broadband access infrastructure is significant in developing a widespread information economy and facilitative of e-commerce. There are four TV stations namely KTV Channel 12, Infomax Channel 8, CLTV 36 and ABS-CBN TV46 Pampanga. There are also two radio stations, RW 95.1 of the Radio World Broadcasting Corporation of the Philippines and the Power 92.7 of the Love Radio Network. Several local newspapers are published in the City, which includes SunStar Pampanga, The Probe, Coffee Punch, Pampanga Times and the Observer.

Angeles

1069. There are five (5) telecommunications in the city with three (3) offering landline services namely: Datelcom Corporation, DIGITEL, and PLDT. Globe Telecom, Smart Telecommunications, Inc. and Sun Cellular (Digitel Mobile Philippines, Inc) are offering mobile services. At present, there are fifty or more Cellular Mobile Telecommunication System (CMTS) Cell Sites in the city. The extent of cell site distribution in the city corroborates the fact that mobile communication coverage and services has expanded sufficiently. The following are the internet providers in the city namely: Globe Telecom, Smart Communications, Sun Cellular (Digitel Mobile Philippines, Inc.), PLDT and Com Clark.

1070. Angeles City Observer and Central Luzon Timesare the newspapers operating in the city. Both are of local circulation and cover the province of Pampanga. Aside from Angeles Observer and Central Luzon Times, there are several national and local newspapers circulating in the city like the Philippine Star, Daily Inquirer, Malaya, Manila Bulletin, some tabloids and local newspapers like Sunstar Pampanga, Central Luzon Daily, Headline Gitnang Luzon and Punto.

1071. There is only one (1) radio station operating in the city. This is Radio Station GV both in FM and AM frequency. Its transmitter is located at Royal Golf and Country Club, Porac Pampanga. GV/FM Station has a frequency of 99.1 MHz. It offers music and entertainmentprograms; GV/AM has a frequency of 792 KHz and offers news, information and public affairs programs. Both FM and Am stations cover Central Luzon.

1072. As of 2015, the Post Office of Angeles has twenty-two (22) letter carriers. It offers the following products and services: Postage Stamps/Letter Posts (ordinary, registered and express both domestic and international), Parcel Post (ordinary, registered, International Express and Domestic Express), Money Order Services (Paper Based and Electronic), New Postal Identification Cards (using Data Capturing Equipments, Bayad Center, 2ndand 3rdClass Mail, Door to door Delivery of Packages, and Door-to-Door deliveries of mails by letter carriers.

1073. In addition, hereunder are the private firms in the city that provide courier and forwarding services as per record of the BPLD: JRS Express, LBC Express, Universal Stonefront Services Corp. (**USSC**) Republic Courier Services, Inc.

Mabalacat

1074. According to the CLUP, the City is well-linked up with communication services all communities are with telephone and communication facilities.

Bamban

1075. Communication service facilities in Bamban include postal, internet, land-based and cellular phones as well as print media, broadcast and television. The mobile phone services providers in the municipality are Globe, Smart, Sun. As of 2015, there are nine (9) cell sites. Four (4) are located in Brgy. Anupul, one (1) in Dap-Dap, one (1) in Dela Cruz, two (2) in San Nicolas, and one (1) in Brgy. Banaba. The land-based phone company is the PLDT.

1076. Cable televisions is also available through the Angeles City Cable Television Network (**ACCTV**), located at Brgy. Anupul and Leal Cable Television Network, located at Brgy. San Nicolas. ACCTN offers both internet and cable connection, while the other is a cable service provider. The former reaches 12 barangays with 2,650 household connections for cable and 1,715 household connections for internet with cable. The latter serves 8 barangays and offers cable connection to 300 households.

1077. Facts and Figures is the only print media company in Bamban, located at Sitio Pag-asa Brgy. Anupul, Bamban. Its publication is likewise titled Facts and Figures with a province-wide circulation. The telegraph/ Post Office is located at the public market at brgy. San Nicolas and is operated by the Department of Telecommunications.

Capas

1078. The major telecommunication providers in Capas are the PLDT, and DIGITEL, while mobile phone services are provided by Globe Telecom, Smart Telecommunications, Inc., and Sun Cellular Network.

1079. Landline telephone services are still limited within the Poblacion area and its immediate environs while mobile phone services have still some dead spots or partial service interruptions in some areas.

1080. National and provincial newspaper publications are in regular circulation in the Municipality while internet services are accessible. Government postal services are also available at the municipal center with satellite branch or sub-office located in Barangay O'Donnell. Postal and cargo services are likewise provided by private carriers or forwarders.

3.4.5.6 Peace and Order (Protective Services)

Malolos

1081. The city police of Malolos has a new headquarters beside the Malolos City Sports and Convention Center in Bgy. Bulihan where the new city hall is also being constructed. Aside from a new building, the City police department will also have their own Special Weapons and Tactics (**SWAT**) unit equipment with two new SWAT mobile command vehicles, motorcycles and brand new automatic assault rifles. Likewise, there are three (3) outpost and one (1) traffic outpost located in front of the Malolos Public Market. The fire fighting unit on the other hand has sixteen (16) firemen, with two (2) fire trucks. Barangay Tanod and Private Security also provide protective services in the city. These existing manpower services support facilities and equipment must be provided for the essential delivery of such services.

Calumpit

1082. The Municipal Police Station of Calumpit is situated within the vicinity of the municipal hall and sited in a residential zone. Calumpit Police Station is composed of 27 PNCO and 3 PCO under the overall supervision of Police Superintendent and equiped with three (3) Mobile Patrols and six (6) Motorcycle Patrol Unit. Calumpit Police Station has created a Community Public Assistance Center located at the Heart of Metro San Marcos vicinity of Brgy San Marcos, Calumpit Bulacan which is manned by four (4) PNCO. Calumpit Police Station is now augmented with TASK FORCE BAHAGHARI, a volunteer group led by Calumpit rendering assistance with the duty PNP members 24 hours daily.

Apalit

1083. Crime incidences in Apalit are mostly of the following types: murder, homicide, physical injury, rape robbery, theft, carnapping, castle rustling, violation of special laws, and other non-index crimes which were bulked together. The most prevalent crime is of physical injuries, which comprises 34.5 percent of total recorded crimes for the last three years. This is followed by violations of special laws (7.19%) which do not pose severe threat to the peace and order condition within the municipality, theft (6.2%), and murder (4.2%).

1084. From 2010-2014, an average of four fire incidences per year occurred in the municipality. These fires were mainly caused by electrical short circuit/electric gadgets, unattended cooking, fires from unattended garbage fire or other fire sources. Of the twelve barangays, it is barangay San Vicente which has the highest recorded number of fire incidences, closely followed by barangay Sampaloc.

1085. According to current requirements for police and firemen which is based on the population, Apalit's 31 police personnel does not comply with the minimum requirement of 102 persons (deficit: 71 police personnel). In the case of firemen, Apalit is also not compliant, with only a total of 10 personnel which is way below the requirement of 51 personnel. Furthermore, while the current firetrucks are within the minimum standard of 1 per 14 firemen, it should be noted that it is still below the required 1 firetruck for every 28,000 persons in the population or 1 firetruck for every 14 firemen.

Minalin

1086. The Minalin Police Headquarters is located in barangay San Nicolas with 20 personnel, 2 serviceable vehicles and with only 2 MC. Substation is located in barangay Sto. Domingo with 5 personnel 1 MC. Outposts or Community Police Assistance Centers are in Sta Rita with 8 personnel, 1 serviceable vehicle. There is only one lock-up cell in Minalin.

1087. Minalin has 102 peace and order volunteers. Out of which, there are 48 traffic volunteers. There are minimal crimes and traffic offenders recorded.

1088. As per standard, Minalin lacks 3 firemen for a minimum standard of 1:2,000 population requirement. Minalin has a total of 35 evacuation centers and pickup points that can hold 3,210 individuals. These sites are mostly barangay halls, covered courts and schools. Minalin has 20 vehicles for evacuation transportation for the rescue and operation purposes with a 210 pax capacity.

Sto. Tomas

1089. The primary guardian of peace and order in Sto.Tomas is the local Philippine National Police (PNP) which is located at the ground floor of the Municipal Building. The police station 70.50 square-meter floor area and is manned by 44 PNP personnel. One Kababayaan Center or Outpost is located at Barangay San Matias within the vicinity of the public market, with an area of 60 sq.m. floor area. Near the police station is the fire protection facility with 30 sq.m. floor area with 16 personnel and 1 firetruck. The police station is also equipped with two (2) PNP mobile cars, a van, and two motorcycles.

1090. With NSO/PSA population of 38,062 recorded in 2010 and a police force of 44, the police to population ratio in Sto.Tomas is 1:866 which exceeds the minimum standard of one (1) policeman for every 1,000 population. There are also16 personnel of the Fire Protection office. Auxiliary protective services such as escort, crowd control, neighborhood patrol, etc. are also provided by Barangay Tanods which number from 10-15 Tanods per barangay.

1091. From 2003-2007, there were a total of seven (7) fire incidence that happened in Sto. Tomas with break down as follows: 2003 = 2; 2004 = 1; 2005 = 2; and 2006 = 2. There were no fires that happened in 2007. Three (3) fire incidents happened in the Poblacion, once in 2005 and twice in 2006. The cause of fire incidents were all attributed to unattended kerosene lamp, firewood, or candle, and electrical wiring.

1092. Also on the same period, there were 12 types of crimes reported ranging from frustrated homicide (7 cases), robbery (4), 3 cases each for illegal possession of firearms, homicide, theft, and murder. These crimes were perpetuated by a number of 78 offenders (70 males and 8 females). The number of crimes have risen from only two cases in 2007 to 15 cases in 2010 giving an average number of 6 crimes per year.

San Fernando

1093. In 2007, the most number of crimes committed in the City pertains to illegal drugs. For 2008, recorded at 33.09 percent, the highest crime incidence was on theft. Data do not show whether or not those involved in theft were under the influence of drugs.

Angeles

1094. Angeles City Police Office (ACPO) is located at Camp Tomas J. Pepito, Barangay Sto. Domingo. It has six (6) police stations with fifteen (15) Community Police Action Centers or COMPACs, one (1) City Public Safety Company (CPSC), one (1) Angeles City Traffic Management and Enforcement Unit (ACTMEU), one (1) City Anti-Illegal Drug Special Operation Task Group (CAID-SOTG), one (1) Mobile Patrol Unit (MPU) and a Women and Children Protection Center (WCPC). The ACPO has a complement of 490 policemen, 55 of which are Police Commissioned Officers and 435 are Police Non-Commissioned Officers. ACPO has a total of sixty – four (64) vehicles, ten (10) of these are mobile cars, twelve (12) are patrol jeeps, and forty-one (42) are motorcycles. Among those vehicles, eight (8) of which are organic, twenty-three (23) are from the LGU and thirty-three (33) from NGOs.

1095. Likewise, Angeles has three (3) fire stations located in Pulung Maragul, San Nicolas and Anunas. Angeles has a total of 42 firemen, 5 fire trucks, 1 ambulance and 1 rescue trucks.

Mabalacat

1096. Mabalacat has one police station located at barangay Poblacion serving as headquarters and four sub-stations located at Dau, Poblacion, Mabiga and Dapdap. Mabalacat City has a total of 75 office personnel. Mabalacat has 21 firefighters and 3 fire trucks. The firefighter to population ratio is 1:10,992, which is far from the ideal ratio of 1:2,000.

Bamban

1097. The Headquarter Stations of the Municipal Police and Fire Station, as well as the Municipal Jail are located along the Municipal Town Hall in McArthur Highway, Barangay Anupul. Bamban has two (2) Police Sub-Stations, one is in Barangay San Nicolas and the other is in Dapdap Resettlement beside Bahay Pagbabago.

1098. Bamban has a total of 70 policemen and 11 firemen. The police headquarter is equipped with two (2) patrol vehicles and ten (10) motorcycles. In addition, there exists a police outpost with one (1) patrol vehicle, while the fire station has one (1) fire truck for use.

Capas

1099. Capas has four (4) police stations and two (2) fire stations.

3.4.5.7 Sewerage

1100. Among the host municipalities and cities, the sewerage system located in the CSEZ is the sole existing complete sewerage system in the study area. The sewerage system is being managed by the Clark Water Corporation (CWC) and has two separate subsystem for storm drainage and sewage. The present sewage effluent is being treated in the biologival wastewater treatment plant with a capacity of 8,023m^3/day to accommodate the effluent of about 16,280 population and receive the effluent from a number of industrial, commercial and institutional houses/buildings with the CSEZ. The rest of the municipalities and cities have no sewerage system and the effluent is discharge directly into the nearest stream.[3]

[3]The Study on Integrated Water Resources Management for Poverty Alleviation And Economic Development in the Pampanga River Basin, January 2011, NWRB

3.4.5.8 Solid Waste Management

1101. The following paragraph briefly describes the solid waste management of the host LGUs. The solid waste management of the host LGUs was discussed in *Section 3.1.1.5. Land Value* of this report.

Malolos

1102. The wastes materials within the barangays of Malolos especially in the commercial area are being collected by a garbage truck owned by the LGU. A sanitary landfill is used as dumping site of the municipality. Households in other barangays burn their waste in their backyards or thrown them down to a ready-made dugout.

Calumpit

1103. The closure of the Sapang Bayan dumpsite in Calumpit was imminent due to the implementation of RA 9003 or the Ecological Solid Waste Management Act. Calumpit has its own Materials Recovery Facility (MRF), which serve as final disposal site for residual and/or wastes that can no longer be processed in barangay. The solid waste disposal facility will be strictly regulated and monitored to prevent scavenging and squatting in the disposal site. Installation of functional and operational MRFs in all of the 19 barangays were also considered to take care of the solid wastes problems of residents/households.

Apalit

1104. Seven (7) out of the twelve (12) barangays of Apalit have Barangay MRF and one (1) MRF for segregation of solid wastes. Metro Clark Waste Management Corporation after segregation takes care of the collected garbage for disposal at the sanitary landfill at Sitio Kalangitan, Capas, Tarlac. As of 2015, fourteen (14) units of dump trucks are being utilized for the collection of generated waste, two for the MRF and twelve (12) for the Barangay MRF. An acquisition of other equipment and tools is being plan for the improvement of the waste management system including additional personnel and staff.

Minalin

1105. Two (2) out of the fifteen (15) barangays of Minalin have a barangay MRF for re-use, recyling and composting of wastes. The LGU’s final disposal of wastes is at Metro Clark Sanitary Landfill at CSEZ.

Sto. Tomas

1106. Sto. Tomas has two (2) dump trucks used for collecting segregated wastes among households and dumped in the controlled dumpsite located at Barangay San Matias. The same barangay has MRF where wastes are segregated into biodegradable and non- biodegradable. Moreover, in order to facilitate and finance the crafting of its Solid Waste Management Plan, the local leaders of Sto. Tomas initiated and availed of a loan through Landbank of the Philippines Apalit Branch. The said loan will be utilized to purchase a lot with an area of 5.6906 hectares located at Mesalipit Road, San Vicente wherein a MRF will be constructed. The MRF will service the municipality for sorting and segregation of biodegradable/compostable and non-biodegradable municipal waste. The LGU’s final disposal is at Metro Clark Sanitary Landfill at CSEZ.

1107. In the conduct of formulating the SWMP, the municipal government is continuous in addressing the concerns on the increasing volume of solid waste. One of these actions is the WACS conducted on October 2014. The main objective of the WACS is to determine the type and amount of materials discarded in the waste stream of Sto. Tomas. The study was useful in the formulation of strategies to address the irrational generation of wastes. This also serves as the baseline data in designing the MRF to determine the alternative methods for recycling and re-using of materials and in determining the quality of composting drums to be utilized by the biodegradables.

San Fernando

1108. San Fernando's Solid Waste Management Board is currently updating the City's Ten-Year Solid Waste Management Plan for 2012-2022. The Barangay Solid Waste Management Committees are also in the process of reorganization. As of February 21, 2011, the City's controlled dumpsite has been closed. Presently, the City is operating the City Transfer Station, wherein only residual waste are accepted for final sorting and transportation to Metro Clark Waste Management Corporation's Sanitary Landfill.

Angeles

1109. Angeles City's daily production of waste is estimated to range from 100-150 metric tons that is equal to 33, 500-54, 750 MT per year. The city has already closed its open dump site facility several years back and it has since used the Kalangitan sanitary landfill.

1110. The city may establish its own sanitary landfill within its territory due to the increase of tipping fee in Kalangitan sanitary landfill. It can also jointly develop a solid waste management facility with neighboring areas. It can also expand its existing material recovery facilities to reduce the volume of waste at the same time create livelihood. It can dump the remaining non-recoverable wastes in the Metro Clark Sanitary Landfill.

Mabalacat

1111. Mabalacat has two (2) materials recovery facilities located at barangays Duquit and Sapang Balen. The Duquit MRF collects garbage from barangays Dau, Duquit and Lakandula while the central MRF in Sapang Balen collects wastes from all other barangays.

1112. The Solid Waste Management Office has ordered all open dumpsites to be closed in accordance with existing laws. One of the policies being implemented is refusal by the MRFs to accept non-segregated waste from the barangays. This compels barangays to oblige households to practice segregation. The city has also tied up with Holcim Philippines, Inc. on reducing the volume of waste, being disposed at the landfill. Recyclable materials or "Holcimables" are collected by the company, and used in cement production. Biodegradable wastes are turned into fertilizer, and are later given to farmers. in this connection, only residual wastes are left and compose the only materials hauled to the sanitary land fill, and this process redounds in reduced fees paid by the city.

Bamban

1113. The garbage generated in Bamban are collected and transported by the private and public Garbage Haulers to Metro Clark Sanitary Landfill at CSEZ for final disposal. Moreover, the municipality has a Garbage Truck Monitoring Station, a checkpoint established at the entrance of the Anupul–Pag-asa-Dapdap (Phase 1) Road wherein all garbage loaded vehicles bound for Metro Clark Sanitary Landfill are inspected and issued bill ticket.

Capas

1114. The waste materials within the barangays of Capas are being disposed in the Metro Clark Sanitary Landfill in Sitio Kalangitan, Barangay Cutcut II spans approximately 100 hectares.

3.4.6 Public Health and Safety Profile

3.4.6.1 Public Health Services

Malolos

1115. Malolos currently operates seven (7) health centers. The Bulacan Medical Center (formerly Bulacan Provincial Hospital), operated by the provincial government of Bulacan, is also located in the city. Private hospitals can also be found in the city such as the Sacred Heart Hospital, Santos General Hospital, Malolos Maternity Hospital, Malolos San Ildefonso County Hospital, Ofelia Mendoza Maternity and General Hospital, and the Graman Medical and Maternity Hospital.

Calumpit

1116. Calumpit has two (2) Rural Health Units (RHUs). Calumpit also has five (5) hospitals namely, Calumpit District Hospital, Sta. Cruz Hospital, Accucare Diagnostic Center, MVC Maternity and Women's Health Care Clinic, and Palad Dental Clinic.

Apalit

1117. Apalit has two (2) RHU. RHU-I is located at barangay San Juan and provides OPD (PCB), Lying-in and TB-DOTS facilities. RHU-I also services barangays Colgante, Paligui, San Vicente, Sampaloc, San Juan, Sucad, and Sulipan. RHU-II is situated at barangay Balucuc and has OPD (PCB) and Lying-in facilities. RHU-II services barangays Balucuc, Calantipe, Capalangan, Cansinala, and Tabuyuc. The RHUs are being run by a total of 28 medical manpower, broken down into two (2) doctors, one (1) dentist, seven (7) nurses, sixteen (16) midwives, one (1) sanitary inspector and one (1) medical technician.

1118. Apalit also has three (3) private primary hospitals, seven (7) medical clinics, and three (3) optical clinics which are being operated with sufficient doctors and other health personnel. For health conditions that require more sophisticated medical attention, and equipment, consultations and hospitalization are referred/availed at San Fernando and Angeles City both of which are approximately 10-22 kilometers away from Apalit.

Minalin

1119. Minalin has one (1) RHU, the Dr. Emegdio A. Bondoc Memorial Health Center based in the barangay San Nicolas. Other barangays have one (1) Barangay Health Unit (BHU) each. The Minalin has 1 physician, 1 nurse, 20 midwives, 1 dentist, 3 sanitary inspectors and 1 Medtech. There is no hospital in Minalin.

Sto. Tomas

1120. Sto. Tomas has one (1) RHU located in the Poblacion and manned with Municipal Health Officer, one (1) nurse, six (6) midwives, and one (1) sanitary inspector and the volunteer nurses of the DOH. One (1) private hospital located at Moras dela Paz caters to the health and hospitalization needs not only of the town but also of the two (2) neighboring municipalities, Minalin and San Simon.

1121. The RHU is complemented by seven (7) Barangay Health Stations scattered in the barangays to dispense basic health care i.e. maternal and child care, immunizations, treatment of simple medical conditions, nutrition, family planning, sanitary health care, emergency treatment and health education.

San Fernando

1122. San Fernando operates 11 hospitals, two (2) public hospitals and nine (9) private hospitals. The two public hospitals are tertiary and secondary namely Jose B. Lingad Memorial Regional Hospital (JBLMRH) with a 250-bed capacity hospital and Ricardo P. Rodriguez Memorial District Hospital which is a 42-bed capacity hospital. The nine (9) private hospitals have a combined capacity of 551 beds, which brings the total number of hospital beds in the City to 843. This translates to a combined bed-to-population ratio of 2.90 which is a relatively high ratio compared to the other towns of Pampanga. Though there is a high hospital bed to population ratio, majority of these come from private hospitals thus there is now increasing trend of request for medical assistance in order for the patients to be discharged.

1123. Complementing the 11 hospitals are two (2) polyclinics located in St. Ferdinand Ong Yu Building. The Pampanga Medical Society who has 830 members has 60 percent actively practicing in the different hospitals and private clinics in the City. There are four (4) RHUs and 42 Barangay Health Centers, which serve the public health needs of the City's constituency. In 2010, the City Health Officers of San Fernado have six (6) doctors, three (3) dentists, 33 midwives, three (3) nutritionists, 8 sanitary inspectors, 12 nurses, 135 project based nurses, 357 barangay health workers, and 55 barangay nutrition specialists.

Angeles

1124. Angeles has nine (9) private hospitals and one (1) government-owned. Among the hospitals, government-owned Rafael Lazatin Memorial Medical Center is the largest in terms of bed capacity having a total of 180. Angeles University Foundation Hospital ranks second in terms of bed capacity with a total of 170.

1125. There are thirty-eight (37) licensed clinics, nine (16) birthing homes including the six (6) RHUs of the government and twenty (29) diagnostic laboratories. Angeles City Health Office has a total of 427 personnel deployed in several health facilities in the city. The six (6) RHUs are situated strategically to cover the thirty three (33) barangays. The government-owned Rafael Lazatin Memorial Medical Center has 493 personnel.

Mabalacat

1126. The major health facilities in Mabalacat City include one (1) government hospital, two (2) private hospitals, three (3) RHUs and 23 Barangay Health Stations (BHS). There are a total of 29 public health facilities and 20 private health facilities. Public health facilities include barangay health stations, rural health centers, birthing homes, and government hospitals. All barangays in the city have barangay health stations except for Dolores, Mamatitang, Mangalit, and Sapangbalen. Although not all barangays have their own barangay health stations, there are three rural health centers situated at barangays Poblacion, Dau, Mabiga, and one government hospital located at Camatchiles. Private health facilities like lying-in clinics, birthing clinics, and medical health centers can be found in barangays Atlu Bola, San Joaquin, Tabun, Camatchiles, Dau, Sapang biabas, Mabiga, and Mawaque.

1127. As of 2014, Mabalacat has a total of four (4) doctors, one (1) dentist, four (4) nurses, 20 midwives, two (2) medical technologists, four (4) sanitary inspectors and 181 health workers.

Bamban

1128. Bamban has an existing hospital which is the Divine Mercy Hospital located in Manila North Road (MNR)/McArthur Highway, Barangay Anupul. It is a privately owned hospital with a capacity of 18 beds.

1129. Bamban also has two (2) Rural Health Units located in Barangay San Nicolas (Dap-Dap) and in Barangay San Roque. Both RHUs are being serviced by one (1) doctor, one (1) dentist, and one (1) sanitary inspector, and each has a resident nurse on duty. RHU 1 in San Nicolas has four

(4) midwives, one (1) medical technician, one (1) pharmacist, and one (1) administrative aide, while RHU 2 in San Roque has five (5) midwives and no other personnel.

1130. Additionally, there are seven (7) Barangay Health Stations, two (2) of which are in the urban barangays of Anupul and San Nicolas and the rest are located in the rural barangays of Lourdes proper, Lourdes (Dap-Dap) Banaba, San Rafael and Virgen Delos Remedios. Bamban also owns four (4) ambulances on a 24/7 duty and fifteen (15) mini-ambulances assigned to each barangay.

Capas

1131. Capas has one (1) public hospital, two (2) RHUs and 12 Barangay Health Stations. The health personnels in Capas are consist of one (1) RHU health doctor, two (1) RHU health dentists, one (1) RHU health medtech, five (5) RHU health nurses, 16 RHU health midwives, and three (3) sanitary inspectors.

1132. Health programs in Capas include Tuberculosis Program, Maternal Care Program, Child Care Program, Expanded Program in Immunization, Control of Diarrheal Diseases, Family Planning Program, Dental Care Program, Nutrition Program, Micronutrient Supplementation Program, Environmental Sanitation Program, Leprosy Control Program, Medical Care Program, Animal Bite Program, Dengue Program, Malaria Program, Operation Tuli Program, and Mass Blood Donation Program.

3.4.6.2 Morbidity and Mortality

(1) Morbidity and Mortality by LGUs

Malolos

1133. The top leading causes of morbidity in Malolos as of 2012 are Acute Upper Respiratory Infection (AURI)/Acute Respiratory Infection (ARI), Skin Disease, Diarrhea, Urinary Tract Infection, and Gastrointestinal Tract Infection. The top leading causes of mortality include heart disease, pneumonia, PTB and CVA followed by CA, DM, enteritis, accident, prematurity and rental failure.

Calumpit

1134. The top leading causes of morbidity in Calumpit are Acute Respiratory Infection, Skin Disease, Urinary Tract Infection, Diarrhea, Chronic Obstructive Pulmonary Disease, and Gastrointestinal Tract Infection. The top leading causes of mortality include heart disease, pneumonia, Pulmonary Tuberculosis, Cardiovascular Disease, Diabetes Mellitus, enteritis, and accident.

Apalit

1135. The top leading causes of morbidity in Apalit as of 2014 are Acute Respiratory Infection, Wounds, Cardiovascular Disease, Skin Diseases, Diarrhea, COPD, Musculo-Skeletal Disease, Animal Bite, Urinary Tract Infection, and Pneumonia. Acute Respiratory Infection is consistently the leading cause of morbidity in Apalit from 2012 to 2014.

1136. The top leading causes of mortality in Apalit as of 2014 are Cardiovascular Disease, Asthma, Cerebrovascular Disease, Acute Myocardial Infarction, Cancer (all kinds), Diabetes Mellitus, Organ Failure, Pneumonia, Koch's Infection/Disease and Respiratory Arrest. Cardiovascular diseases have consistently been the top cause of mortality from 2012-2014.

Minalin

1137. The top leading causes of morbidity in Minalin are Acute Respiratory Infection, Cardiovascular Disease, Skin Diseases, Diarrhea, Chronic Obstructive Pulmonary Disease, Animal Bite, Urinary Tract Infection, and Pneumonia. The top leading causes of mortality are Cardiovascular Disease, Asthma, Cancer (all kinds), Diabetes Mellitus, Organ Failure, Pneumonia, and Pulmonary Tuberculosis.

Sto. Tomas

1138. For the year 2009-2011, the leading cause of mortality recorded in the municipality is Acute Respiratory Infection. Another indicator of population change is the fertility and mortality rates of the population, expressed as crude birth rate (number of births in a given year per 1,000 mid-year population) and crude death rate (number of deaths per 1,000 population), respectively.

1139. For the years 2010 to 2015, Sto. Tomas registered a continued decrease in Crude Birth Rate (CBR). From a CBR of 19.55% in 2010 it decreased to a rate of 7.1% in 2015.

1140. The mortality rate of Sto. Tomas showed fluctuation for the period 2010-2015. From a high of 206 in 2010, the Crude Death Rate (CDR) decreased to 162 in 2014 and increased to 186 in 2015.

1141. Maternal mortality rate was recorded to be 0 for the last five (5) years. However, infant mortality rate has increased from 7.86% in 2010 to 17.18% in 2015. There was a slight decrease in 2011with 6.28%.

San Fernando

1142. Majority of the causes of morbidity recorded in the City are all communicable. However, the leading causes of mortality are mostly noncommunicable and are lifestyle related diseases. These can be attributed to the growing number of malls, fastfood chains, and decreased open lots for sports and exercise. In-migration is also a definitive contributing factor since there are more than 7,000 commercial establishments in the City. Influx of transient and informal settlers availing health services is also contributory to both leading causes of morbidity and mortality. In 2009, the top leading causes of mortality in San Fernando are Heart Diseases, CVA, Cancer (all forms), Kidney Failure, Pneumonia (all forms), Pulmonary TB, Sepsis, Hypertension, Multiple Organ Failure and Vehicular Accident.

Angeles

1143. The top causes of morbidity in Angeles in 2015 include Respiratory Disease, Pneumonia, Hypertension, Diarrhea, Diabetes Mellitus, Heart Disease, Dengue, UTI 1,218 342.88, Influenza Like Illnesses and Pulmonary Tuberculosis. Acute respiratory infection is consistently the leading cause of morbidity in Angeles from 2013 to 2015.

1144. The top causes of mortality in Angeles in 2015 include Heart Disase, Malignant Neoplasm, Cerebrovascular Disease, Hypertension, Kidney Disease, Multiple Organ Failure/Old Age, Diabetes Mellitus, Pneumonia, Septicaemia (Unspecified) and Pulmonary Tuberculosis. Heart Disease is the top cause of mortality in Angeles in 2013 and 2015. But in 2014, it went down to second giving way to Diabetes Mellitus.

Mabalacat

1145. The top causes of morbidity in Mabalacat in 2013 include Acute Respiratory Infection, Skin Diseases, Gastrointestinal Disorders, Urinary Tract Infection, Hypertension, Bronchitis, Pneumonia, Pumonary Tubercolosis, Influenza, and Eye, Ear, Mouth Disporded. Acute respiratory infection is consistently the leading cause of morbidity in Mabalacat from 2011 to 2013.

1146. The top causes of mortality in Mabalacat in 2013 include heart diseases, cancer (all forms), cerebrovascular disease, hypertension, diabetes mellitus, kidney disease, Pneumonia, Chronic Obstructive Pulmonary Disease, Multiple Organ Failure, and Pulmonary Tubercolosis. The health profile of city populace in terms of disease trends is a mix of communicable or infectious diseases (acute respiratory infection, diarrhea, and tuberculosis) and non-communicable diseases, which are lifestyle-related (cancer, heart diseases, and diabetes).

Bamban

1147. The top leading causes of morbidity in Bamban are Diarrhea, Bronchitis, Influenza, Acute Respiratory Infection, Pneumonia, Chicken Poz, Measles, and Hepatitis. The top leading causes of mortality in Bamban are Cardiovascular Disease, Pneumonia, Cancer (all form), Bronchial Asthma, Pulmonary Tuberculosis, Still Birth, and Cardiac Arrest.

Capas

1148. The top leading causes of morbidity in Capas as of 2017 are Acute Upper Respiratory Infection, Hypertension, Acute Gasrtro Enteritis, Diabetes Mellitus, Urinary Tract Infection, Infected Wound, Pulmonary Tuberculosis, Acute Gastritis, Skin Diseases, and Bronchial Asthma.

1149. The top leading causes of mortality in Capas are Cerebro Vascular Disease, Cancer (all form), Diabetes Mellitus, Vehicular Accident, Chronic Obstructive Pulmonary Disease, Renal Failure, Pulmonary Tuberculosis, Gunshot Wound, Bronchial Asthma, and Pneumonia.

(2) Morbidity and Mortality of PAFs by LGUs

1150. The Socioeconomic Survey (SES) also noted the PAPs with members who experienced health problem in the past year (morbidity) and the (2) causes of death for members of the family (mortality).

1151. **Table 3.4.28** indicates that most of the PAPs have members who experienced flu (34.4%), hypertension (12%) and diabetes (5.1%). However, majority of the PAPs (36.2%) report other factors (apart from illness) as causes of death among the members (Table 3.1.18). In particular, 22.1% of the PAFs have members who died due to heart problems while 21.2% reported that some died due to hypertension. A few (3.8%) reported dengue as one of the casues, while other reported casees include: pneumonia (0.8%), flu (0.8%), diarrhea (0.3%), malaria (0.1%) and typhoid fever (0.1%).

Table 3.4.28 Morbidity of PAFs by LGUs

Municipality	Morbidity														
	HIV/AIDS	Malaria	Dengue	Typhoid fever	Diarrhea	Skin diseases	Pneumonia	Flu	Cancer	Heart problems	Hypertension	Diabetes	None	Others	Total
Malolos	0	0	0	0	0	0	0	2	0	0	1	0	3	0	6
%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	33.3%	0.0%	0.0%	16.7%	0.0%	50.0%	0.0%	100.0%
Calumpit	0	0	1	1	2	1	4	63	0	5	32	12	53	12	284
%	0.0%	0.0%	0.4%	0.4%	0.7%	0.4%	1.4%	22.2%	0.0%	1.8%	11.3%	4.2%	18.7%	4.2%	65.5%
Apalit	0	0	0	0	0	0	0	1	0	0	0	0	1	2	3
%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	33.3%	0.0%	0.0%	0.0%	0.0%	33.3%	66.7%	133.3%
Sto. Tomas	0	0	1	0	0	0	0	4	0	2	2	1	16	0	24
%	0.0%	0.0%	4.2%	0.0%	0.0%	0.0%	0.0%	16.7%	0.0%	8.3%	8.3%	4.2%	66.7%	0.0%	108.3%
San Fernando	0	1	6	9	17	11	17	351	5	50	108	51	265	74	820
%	0.0%	0.1%	0.7%	1.1%	2.1%	1.3%	2.1%	42.8%	0.6%	6.1%	13.2%	6.2%	32.3%	9.0%	117.7%
Angeles	0	0	4	1	3	1	9	54	2	4	23	6	81	4	192
%	0.0%	0.0%	2.1%	0.5%	1.6%	0.5%	4.7%	28.1%	1.0%	2.1%	12.0%	3.1%	42.2%	2.1%	100.0%
MCR Total	0	1	12	11	22	13	30	475	7	61	166	70	419	92	1379
%	0.0%	0.1%	0.9%	0.8%	1.6%	0.9%	2.2%	34.4%	0.5%	4.4%	12.0%	5.1%	30.4%	6.7%	100.0%

Source; JICA Study Team

Table 3.4.29 Mortality of PAFs by LGUs

Municipality	Mortality														
	HIV/AIDS	Malaria	Dengue	Typhoid fever	Diarrhea	Skin diseases	Pneumonia	Flu	Cancer	Heart problems	Hypertension	Diabetes	None	Others	Total
Malolos	0	0	0	0	0	0	0	0	1	0	1	0	4	0	6
%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	16.7%	0.0%	16.7%	0.0%	66.7%	0.0%	100.0%
Calumpit	0	0	11	0	0	0	1	1	3	27	53	22	74	5	197
%	0.0%	0.0%	5.6%	0.0%	0.0%	0.0%	0.5%	0.5%	1.5%	13.7%	26.9%	11.2%	37.6%	2.5%	100.0%
Apalit	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Sto. Tomas	0	0	2	0	0	0	1	0	2	8	7	8	8	0	36
%	0.0%	0.0%	5.6%	0.0%	0.0%	0.0%	2.8%	0.0%	5.6%	22.2%	19.4%	22.2%	22.2%	0.0%	100.0%
San Fernando	0	1	40	2	3	0	8	9	29	199	180	35	373	73	952
%	0.0%	0.1%	4.2%	0.2%	0.3%	0.0%	0.8%	0.9%	3.0%	20.9%	18.9%	3.7%	39.2%	7.7%	100.0%
Angeles	0	0	1	0	0	0	2	1	14	79	59	14	50	0	220
%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.9%	0.5%	6.4%	35.9%	26.8%	6.4%	22.7%	0.0%	100.0%
MCR Total	0	1	54	2	3	0	12	11	49	313	300	79	512	78	1414
%	0.0%	0.1%	3.8%	0.1%	0.2%	0.0%	0.8%	0.8%	3.5%	22.1%	21.2%	5.6%	36.2%	5.5%	100.0%

Source; JICA Study Team

3.4.6.3 Environmental, Health and Sanitation Profile

(1) Health and Sanitation per LGU

1152. Based from 2010 Census of Population and Housing of the PSA, eight (8) out of ten (10) host municipalities/cities of the proposed MCRP mainly source their drinking water from their own faucet tapped from the community water system (**Table 3.4.30**). On the other hand, Malolos and Bamban use bottled water as the main source of their drinking water. Other households of the host LGUs source their drinking water from the shared faucet tapped community water system, own use tubed/piped deep well, shared tubed/piped deep well, tubed/piped shallow well, dug well, protected spring, unprotected spring, lake/river/rain and peddler.

1153. Most of the garbage generated by the host LGUs are collected by the garbage trucks and dispose to the sanitary landfill in Capas, Tarlac. Other households dispose their garbage by dumping in individual pit (not burned), burning, composting, burying, and feeding to animals (**Table 3.4.31**).

1154. Majority (96.61%) of the total households of the host LGUs are using water-sealed toilet of which 85.29% or 258,184 households have their own water-sealed toilet with septic tank, and 5.30% or 17,650 households use shared toilet with septic tank (**Table 3.4.32**). About 6.02% of the total households use water-sealed toilet with pipe leading to depository other the septic tank. However, there are still households that do not have sanitary toilet facilities.

Table 3.4.30 Sources of Water Supply for Drinking, 2010

City/ Municipality	Total Number of Households	Source of Water Supply for Drinking											
		Own use faucet community water system	Shared faucet community water system	Own use tubed/piped deep well	Shared tubed/piped deep well	Tubed/ piped shallow well	Dug well	Protected spring	Unprotected spring	Lake river rain and others	Peddler	Bottled Water	Others
Malolos	51,851	11,723	1,567	2,009	1,817	460	401	47	-	-	459	32,635	733
Calumpit	21,900	11,918	1,136	100	573	77	75	60	-	-	10	7,906	45
Apalit	20,787	9,151	1,580	1,552	1,740	428	88	60	-	21	86	5,880	202
Minalin	8,651	5,148	708	458	850	776	43	10	4	-	-	653	-
Sto. Tomas	7,948	5,510	887	50	47	17	-	-	-	-	9	1,351	76
San Fernando	60,561	27,020	2,975	3,621	3,732	1,511	740	956	12	-	228	19,359	408
Angeles	74,510	54,173	3,752	1,526	1,952	567	738	439	5	15	121	10,969	253
Mabalacat	47,198	22,208	1,755	2,148	2,311	751	313	315	25	5	97	17,122	146
Bamban	13,100	2,826	1,078	1,751	2,374	1,229	321	197	55	-	5	2,839	426
Capas	26,243	5,863	1,183	5,709	5,118	3,308	348	72	20	92	26	4,407	97
Total	332,749	155,540	16,621	18,924	20,514	9,124	3,067	2,156	121	133	1,041	103,121	2,386

Source: 2010 Census of Population and Housing, Philippine Statistics Authority

Table 3.4.31 Usual Manner of Garbage Disposal in the Host LGUs

City/ Municipality	Total Number of Households	Usual Manner of Garbage Disposal						
		Picked up by garbage truck	Dumping in individual pit (not burned)	Burning	Composting	Burying	Feeding to animals	Others
Malolos	51,851	32,367	2,469	14,525	690	1,005	536	259
Calumpit	21,900	16,631	1,143	3,627	181	285	5	29
Apalit	20,787	17,039	742	2,672	76	70	58	131
Minalin	8,651	6,847	412	1,090	28	115	159	-
Sto. Tomas	7,948	7,355	37	479	43	25	10	-
San Fernando	60,561	52,970	1,905	4,679	383	499	25	100
Angeles	74,510	63,322	5,137	3,924	338	526	5	1,258
Mabalacat	47,198	40,125	2,415	3,615	264	365	48	367
Bamban	13,100	8,025	233	4,109	161	165	402	5
Capas	26,243	13,503	1,501	10,354	232	537	80	36
Total	332,749	258,184	15,994	49,074	2,396	3,592	1,328	2,185

Source: 2010 Census of Population and Housing, Philippine Statistics Authority

Table 3.4.32 Kind of Toilet Facilities at the Host LGUs

City/ Municipality	Total Number of Households	Toilet Facility							
		Water-sealed (sewer septic tank)		Water-sealed (other depository)		Closed Pit	Open Pit	Pail system and others	None
		Used exclusively by household	Shared with other households	Used exclusively by household	Shared with other households				
Malolos	51,851	43,225	2,644	2,796	820	611	115	1,433	207
Calumpit	21,900	18,834	1,034	1,250	490	77	93	35	87
Apalit	20,787	16,601	1,346	1,869	352	99	11	202	309
Minalin	8,651	6,559	550	239	138	788	173	51	152
Sto. Tomas	7,948	7,221	333	219	34	40	86	10	5
San Fernando	60,561	53,129	3,205	2,150	496	497	74	877	132
Angeles	74,510	66,562	3,247	1,738	644	754	211	1,178	176
Mabalacat	47,198	40,561	2,605	2,532	472	164	198	615	51
Bamban	13,100	11,160	867	570	124	83	170	73	54
Capas	26,243	19,933	1,819	2,318	771	378	386	70	569
Total	332,749	283,785	17,650	15,681	4,341	3,491	1,517	4,544	1,742

Source: 2010 Census of Population and Housing, Philippine Statistics Authority

Malolos

1155. Bottled water is the main source of drinking water of the 32,635 households on Malolos. Other households source their drinking water from the dug well and other types of piped water system. There are still some (47) households that source their drinking water supply from spring.

1156. The main routine of garbage disposal in Malolos is through pick-up by garbage truck. Every barangay has different schedule of garbage collection since they use their own dump trucks. All intended responsibilities, i.e. collection of segregated wastes, are being transferred gradually from the City Government to barangay in the proper implementation of Republic Act 9003. Aside from the Central Facility in Barangay Mambog, most barangays have established MRF.

1157. About 43,225 households of Malolos exclusively use water-sealed toilet (with septic tank). On the other hand, open pit have the smallest toilet facility occupying 115 households. Since there is no centralized waste water treatment facility/plant in the city, domestic and commercial waste waters are discharged through the tributaries even it is untreated. Majority of the households and commercial establishments have individual specific tanks, effluent will traverse through tributaries till it reaches the Manila Bay. However, there are still households that do not have sanitary toilet facilities.

Calumpit

1158. Based on 2010 data of the 21,900 households of Calumpit, 63% uses piped wells to supply their needs for drinking water. A little less than 2 percent of the total number of household uses community water system to supply their needs. It is also important to note that more than 35 percent utilizes bottled water provided by private water providers for their drinking water needs.

1159. For the data on Garbage Disposal, almost 50 percent of the households' garbage are being picked up regularly by garbage trucks. A little less than 40 percent burns their garbage. It is important to note this statistic as burning garbage greatly contributes to the condition of the air within the community.

1160. Almost 90 percent of the household, according to the 2010 data, installed a water sealed type of toilet facility. Among the water sealed toilet facilities, it is predominated by those that have its own septic tank. There are other households that still uses pit type of toilet facility.

Apalit

1161. Based on 2010 data, 9,151 household uses their own faucet connected to a water pipeline from the community water system and 5,880 households are using bottled water from private water providers. Water supply to the various barangays of Apalit and even to the adjacent Macabebe is served by piped water originating from the initial well and pump from Barangay Tabuyoc. Apalit Waterworks has developed this well and has installed a network of PVC piping, as well as developed additional boreholes, with pumps, backup generators and storage reservoirs. Around 20 households are using the lake river rain and other open water areas for the supply of drinking. Other areas not yet connected to Apalit Waterworks still use traditional shallow wells with cheap hand pumps or small electrical pumps.

1162. Almost all of the households in Apalit are collecting their wastes through a garbage truck. There are seven (7) out of the twelve (12) barangays of Apalit have Barangay Materials Recovery Facilities and one Municipal Recovery Facility for segregation of solid wastes. Metro Clark Waste Management Corporation after segregation takes care of the collected garbage for disposal at the sanitary landfill at Sitio Kalangitan, Capas, Tarlac. Some are still doing the old practice of composting, burning, dumping in their individual pit, burying and feeding to animals as an act of environment-friendly way except for burning of wastes.

1163. In Apalit, most of the households have their own water-sealed sewer septic tanks of 16, 601 families based on the 2010 data and several households have septic tanks shared with other households and other depository used solely by households.

Minalin

1164. For Minalin Municipality, 8,651 households were surveyed, of this, almost 70% were reliant on community water system that is being provided by the local government unit. This is where they get their drinking water. A big part also of the total number of households were reliant on piped well systems. This comprise more than 20% of the total number of households surveyed. Since the area of Pampanga is generally vulnerable to saltwater intrusion, there are people that choose their drinking water to be provided by private companies that market purified bottled waters.

1165. Almost 80 percent of the households in Minalin rely on the regular garbage collection provided by the local government unit as their way of disposing their solid wastes. Of the remaining 20%, almost 13% still choose burning as a method to dispose of their solid waste. Other methods, composting, and dumping in individual pits are being applied by some of the households, but Minalin generally rely on the regular garbage collection as the main method for solid waste disposal.

1166. For the toilet facility that is employed in Minalin, it is generally of the water sealed type. Almost 87% of the total households are using this type of toilet facility. There are still households that use the pit type especially the closed pit type of toilet facility.

1167. The main potable water sources in Minalin are from the Municipal Water District (3,354 households 36%), other households from water refilling stations (3,106 households or 33%) and deep well (104 households 1%). In the recorded total household population by the municipality of 9,299, only 8,198 was surveyed.

Sto. Tomas

1168. Of the 7,948 households surveyed in Sto. Tomas, almost 80% is reliant on community water systems for their drinkable water needs. Of the remaining, more or less, 20%, 17 percent relies on bottled water as their source for drinkable water. Only 2% relies on piped wells.

1169. For the solid waste disposal of the municipality, the municipality has done a great job on their regular collection of garbage because more than 90 percent of the households rely on the regular collection of these solid wastes. Of the remaining 10 percent, 6 percent of the surveyed households rely on burning their wastes as a way of disposing it. Two dump trucks are used for collecting segregated wastes among households and dumped in the controlled dumpsite located at Barangay San Matias. The same barangay has Material Recovery Facility where wastes are segregated into biodegradable and non- biodegradable.

1170. In Sto. Tomas, 98 % of the households surveyed said that they are using water sealed toilet facilities. There were still households that use pit-type of toilet facility but they just comprise a part of the remaining 2 percent.

1171. As per NSO data, the town's household survey in the year 2007 shows that out of 7,795 households, 5,539 or 71 % have access to water-sealed, sewer/septic tank toilet facilities. A total of 7,567 of the households have sanitary toilet systems while a total of 228 householdshave no known toilet systems at all.

San Fernando

1172. San Fernando has a household of about 60, 561 families. Most of the households are dependent to the community based water system (own use faucet, shared faucet, own use tubed/piped deep well, shared piped deep well and piped shallow deep well) as their major supply of potable water. Moreover, 19,359 households rely on bottled water as their source of drinking. At present, the City of San Fernando Water District (CSFWD) has its water service facilities available in 35 barangays with 28,994 total number of active connectors as of February 1, 2011. Most of the areas served by the system enjoy 24-hour water supply.

1173. Based on the data below, out of 60, 561 households, 52,970 families rely on the collection of wastes governed by the local government units are predominant to the City as their easier way of disposing their wastes. Moreover, some households preferred in burning their wastes and few households are using the traditional practice such as composting, burying and feeding to the animals.

1174. The most common type of sewer septic tank in the City are water sealed that is exclusively in each of the houses. Few of the families still using close and open pit type of toilet facility.

Angeles

1175. Almost 80 % of the households are using piped wells as their source of drinking and some of the families are still using the outdated sources of drinking water such as dug well, Spring, Lake, River, Rain and Peddler. In addition, bottled water or gallons are also present in the Municipality administered by private water service provider to supply mineral/distilled water.

1176. Angeles City are disposing their wastes by regular collection of the local government as their main source of proper disposal. Some families are still doing the environment friendly way as dumping their garbage into their own pit. The city established a Materials Recovery Facility (MRF), three (3) of which are individual MRFs while two (2) are clustered MRFs where it sorts wastes accordingly. Those materials that can be reused and recycled are sold, while bio-degradable and other organic wastes are processed into organic fertilizer. The remaining non-recoverable materials are disposed in Kalangitan Sanitary Landfill, an inter-regional sanitary landfill owned and operated by Clark Development Corporation (CDC).

1177. Almost 80 % of the households have water sealed toilet facilities. There were still other households that use pit-type of toilet facility comprising a part of the remaining 20 %.

Mabalacat

1178. Out of 47, 198 households in Mabalacat, almost 60 % of families have their own community piped wells as their source of water supply for drinking. Other households preferred to have bottled water from the water supply provider to ensure the cleanliness of the water. The remaining household are still drinking water coming from dug well, lakes, rivers and rains.

1179. In the households of Mabalacat City, the most common disposal of waste is by regular collection provided by the local government encompasses more than 40,000 families. While on the other hand, other methods are still practicing in some families such as dumping of individual wastes and burning.

1180. For the toilet facility available in the City, water sealed type are the most common type of toilet facility. Few of the households that still use the pit type of toilet facility.

Bamban

1181. Of the 13, 100 households in Bamban Municipality, bottled water or gallon are their main sources of drinking water and at the same manner, the owned piped community water system to supply their needs. Other factors such as dug well, springs and peddler are also exists in the municipality. Only 12 barangays out of the total 20 barangays are being served by BCBI-Capas Waterworks, albeit not all households on these 12 barangays have an access to the water supply system. The main source of water supply is underground with five (5) existing pumping stations strategically located within the Municipality with a total aggregate output of 100,027 cubic meters per month in 2010.

1182. Based on the data below, disposal of wastes through regular collection is the most common in the Municipality (8,025) while burning of wastes are also being practiced in Bamban. Moreover, burning of wastes may affect the air quality of the community.

1183. In Bamban Municipality, most of the households have their own water-sealed sewer septic tanks of 11,160 families based on the 2010 data and several households have septic tanks shared with other households and other depository used solely by households. More than 10% of households are not equipped with toilet facilities. This may lead to further contamination of ground water resources. Directly linked with water-borne diseases, this could be a major factor in the inadequacy of clean drinking waters, particularly outside of the Poblacion where diarrhea is one of the main health issues.

Capas

1184. Based on 2010 data of the 26,243 households that is present in Capas, almost 50 percent uses piped wells to supply their needs for drinking water. A little less than 25 percent of the total number of household uses community water system to supply their needs. It is also important to note that more than 15 percent utilizes bottled water provided by private water providers for their drinking water needs.

1185. For the data on Garbage Disposal, almost 50 percent of the households' garbage are being picked up regularly by garbage trucks. A little less than 40 percent burns their garbage. It is important to note this statistic as burning garbage greatly contributes to the worsening condition of the air.

1186. Almost 90 percent of the household, according to the 2010 data, installed a water sealed type of toilet facility. Among the water sealed toilet facilities, it is predominated by those that have its own septic tank. There are still some that uses pit type of toilet facility.

(2) Access to Water and Sanitation Aceess of PAFs per LGU

1187. At least 5 out of 10 PAfs have access ot water through piped connection as inidicated in **Table 3.4.33**. This proportion is higher in other LGUs such as Malolos (66.7%), Calumpit (57.4%) and Angeles (56.8%). The remaining proportion of the population obtain water from shared community faucet (20.4%), other sources (13.7%), and deep well (8.7%). Those who have a relatively high proportion with shared water connection may pertain to informal settlers who are sharing the said resources with neighbors – as seen in San Fernando, Angeles and Calumpit.

Table 3.4.33 Access to Water of PAFs per LGU

Municipality	Access to Water								
	Maynilad/ Manila Water (Piped Connection)	Shared with Neighbor (Communit y Faucet)	Deep well	Shallow Well	Buy from Water Vendors	Others	N/A	N/R	Total
Malolos	4	1	0	0	0	0	0	1	6
%	66.7%	16.7%	0.0%	0.0%	0.0%	0.0%	0.0%	16.7%	100.0%
Calumpit	163	64	20	1	6	23	3	4	284
%	57.4%	22.5%	7.0%	0.4%	2.1%	8.1%	1.1%	1.4%	100.0%
Apalit	1	1	0	0	1	0	0	0	3
%	33.3%	33.3%	0.0%	0.0%	33.3%	0.0%	0.0%	0.0%	100.0%
Sto. Tomas	24	0	0	0	0	0	0	0	24
%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
San Fernando	427	137	96	0	11	145	2	2	820
%	52.1%	16.7%	11.7%	0.0%	1.3%	17.7%	0.2%	0.2%	100.0%
Angeles	109	68	0	0	0	14	0	1	192
%	56.8%	35.4%	0.0%	0.0%	0.0%	7.3%	0.0%	0.5%	100.0%
MCR Total	728	271	116	1	18	182	5	8	1329
%	54.8%	20.4%	8.7%	0.1%	1.4%	13.7%	0.4%	0.6%	100.0%

Source: JICA Study Team

1188. **Table 3.4.34** indicates that at least 7 out of 10 (79%) have their own water-sealed toilet. The remaining have acces to toilets through other means (8.3%) or through community or shared toilet facilities (7.3%), with a few (3.1% or 23 families) with no toilets. Families with no toilets in their place of residence are in San Fernando (55 PAFs), Angeles (14 PAFs) and Calumpit (7 PAFs).

Table 3.4.34 Access to Sanitation of PAFs per LGU

Municipality	Access to Sanitation							
	Own Water Sealed Toilets	Open Pit	Communal/ Barangay Toilet	No Toilet	Others	N/A	N/R	Total
Malolos	6	0	0	0	0	0	0	6
%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Calumpit	255	0	7	7	11	1	3	284
%	89.8%	0.0%	2.5%	2.5%	3.9%	0.4%	1.1%	100.0%
Apalit	2	1	0	0	0	0	0	3
%	66.7%	33.3%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Sto. Tomas	24	0	0	0	0	0	0	24
%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
San Fernando	700	1	55	10	47	2	5	820
%	85.4%	0.1%	6.7%	1.2%	5.7%	0.2%	0.6%	100.0%
Angeles	152	1	14	6	16	1	2	192
%	79.2%	0.5%	7.3%	3.1%	8.3%	0.5%	1.0%	100.0%
MCR Total	1139	3	76	23	74	4	10	1329

Source: JICA Study Team

3.4.6.4 Community Conncers

1189. Although the community issues vary per LGU (**Table 3.4.35**), majority of the PAPs' concerns are related to flooding and garbage collection – two environmental issues, which, if not mitigated, may pose risks to the PAPs. In particular, most PAFs in Malolos (33.3%) and Angeles (11.2%) cited flooding as one of the community issues. In Calumpit, Santo Tomas and San Fernando, flooding is one of the major issues – with 43.4%, 43.8% and 22.6% indicating this as one of the issues, respectively. Apart from these, other issues commonly cited include: (1) drugs (10.2%), job/ employment (7.0%) and safety/security (6.4%).

Table 3.4.35 Community issues among PAFs per LGU

City/ Municipality	Community Issues									
	Health	Water/ Sanitation	Flooding	Safety/ Security	Drugs	Job/ Employment	Garbage Collection	Others	N/R	Total
Malolos	0	0	0	0	0	0	2	0	4	6
%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	33.3%	0.0%	66.7%	100.0%
Calumpit	3	2	63	12	13	13	24	10	5	145
%	2.1%	1.4%	43.4%	8.3%	9.0%	9.0%	16.6%	6.9%	3.4%	100.0%
Apalit	0	0	1	1	1	0	0	0	1	4
%	0.0%	0.0%	25.0%	25.0%	25.0%	0.0%	0.0%	0.0%	25.0%	100.0%
Sto. Tomas	1	1	14	3	0	3	1	5	4	32
%	3.1%	3.1%	43.8%	9.4%	0.0%	9.4%	3.1%	15.6%	12.5%	100.0%
San Fernando	23	63	217	57	110	49	228	128	86	961
%	2.4%	6.6%	22.6%	5.9%	11.4%	5.1%	23.7%	13.3%	8.9%	100.0%
Angeles	1	9	15	14	15	30	24	59	48	215
%	0.5%	4.2%	7.0%	6.5%	7.0%	14.0%	11.2%	27.4%	22.3%	100.0%
MCR Total	28	75	310	87	139	95	279	202	148	1363
%	2.1%	5.5%	22.7%	6.4%	10.2%	7.0%	20.5%	14.8%	10.9%	100.0%

Note: The SES survey is yet to be conducted for the segment of alignment not finalized - between CIA to NCC

Source: JICA Study Team

3.4.7 Socio-economic Profile

3.4.7.1 Local Economy

1190. Department of Finance, Department Order No. 23-08, July 29, 2008 prescribes the Income brackets for re-classification of Provinces, Cities and Municipalities in the Philippines. Among others, this serves as basis for the determination of the financial capability of LGU's to provide in full or in part the funding requirements of development projects and other priority needs in their locality.

Table 3.4.36 Classification of Provinces, Cities and Municipalities

DEPT OF FINANCE, DO 23-08			
Classification based on Income	PROVINCE	CITY	MUNICIPALITY
First Class (1st Class)	Php 450M or more	Php 400M or more	Php 55M or more
Second Class (2nd Class)	Php 360M or more but less than Php 450M	Php 320 or more but less than Php 400M	Php 45M or more but less than Php 55M
Third Class (3rd Class)	Php 270M or more but less than Php 360M	Php 240M or more but less than Php 320M	Php 35M or more but less than Php 45M
Fourth Class (4th Class)	Php 180M or more but less than Php 270M	Php 160M or more but less than Php 240M	Php 25M or more but less than Php 35M
Fifth Class (5th Class)	Php 90M or more but less than Php 180M	Php 80M or more but less than Php 160M	Php 15M or more but less than Php 25M
Sixth Class (6th Class)	Below Php 90M	Below Php 80M	Below Php 15M

Malolos

1191. Malolos is a first class city and capital of Bulacan. Its major economic activities are commerce and industry. Malolos is rapidly becoming commercialized and industrialized due to its proximity to Metro Manila and for lying between Manila and Clark, Pampanga.

1192. Many of the businesses and industries in the city include Banking; Business Process Outsourcing; Courier Service; Education; Food Service; Hospitals; Hotels, Resorts and Restaurants; Information and Communications Technology; Insurance; Manpower; Realty/Real Property Development; Trade; Transport Services; Travel and Tours; and other services. Robinsons Place Malolos is a major shopping mall located at MacArthur Highway, Barangay Sumapang Matanda. Other shopping malls in Malolos include the Maunlad Malls 1 and 2, Graceland Mall, and Bulacan Eco-Commercial Complex. Chimera Land is an amusement park under construction located in Barangay Sumapang Matanda. Malolos also serves as the Banking Capital of Bulacan, having the highest number of banking institutions in the province. Industrial estates, such as First Bulacan Industrial City, where are more than 20 corporations and companies operating their factories inside the estate are a boom. Mighty Corporation, a major player in the Philippine tobacco industry, operates a tobacco factory in the city. Other industries such as agribusiness, aquaculture, bag making, ceramics, construction, cement making, flowers/ornamentals, furniture, food processing, garments, gifts, houseware making, decor making, jewelry, leather tanning, marble polishing, metallurgy, printing, shoe manufacturing, and textile manufacturing are also present in the city. Some of the food products produced in Malolos include Ensaymada Malolos, Inipit, Otap Bread, Atsara, and Bagoong.

Calumpit

1193. Calumpit is a first class urban municipality and its major economic activities are commerce and agriculture.

1194. Commerce in Calumpit include wholesale/retail trading; business services; office; and community, personal, and social services. These strips of commercial establishments are located in all barangays and have established specifically along the arterial road. The most extensive production area in Calumpit is the area devoted to agriculture, which are mostly crops production. Calumpit is also involved in fishery, poultry and livestocks. Agriculture and fishery are mostly in the western and southern portion of Calumpit comprising the barangays of Bulusan, Sta. Lucia, Meysulao, San Miguel, Meyto, San Jose and Panducot. Other industries in Calumpit are ceramics, pottery and ornamental plants. The major products of Calumpit are handicrafts, pottery and religious articles.

Apalit

1195. Apalit is a first class municipality in and its ecomonic activities are agriculture, commerce and trade, industry, and tourism.

1196. Agriculture, which is the major economic activities in the municipality involve crop production, fish production (aquaculture), and livestock and poultry raising (agri-industrial). Rice is the dominant crop being planted throughout the municipality. The productivity of the farmlands could be attributed to the availability of adequate water needed for planting crops. Irrigation services in Apalit are supplied mostly by Angat-Maasim River Irrigation System (AMRIS) from Bulacan and from various pumping irrigations sytems adjacent to the Pampanga River. Fishponds throughout the municipality cover an area of 608.77 hectares and operated by 152 aqua farm cultivators as of 2016. Major kinds of fishes being raised are tilapia, catfish, and mudfish. Although fish is being raised commercially, most fishponds have an average size of below one hectare only are located in Barangays Colgante, San Vicente, Sampaloc and Paligui. Livestock and poultry raising in Apalit are categorized as backyard and commercial type. Barangays Tabuyuc, Calantipe, Balucuc and Cansinala have the most number of livestock and poultry raisers.

1197. Commerce and trade in Apalit as of 2014 involved 1,283 registered businesses. Most of these businesses are located in Brgy. San Vicente, where there are 818 registered businesses. Out of the 282 new businesses that registered in 2014, 164 are into "wholesale and retail trade; repair of motor vehicles and motorcycles." Thirty-nine of these are auto/motorcycle parts retailers and auto repair shops, while thirty-six (36) are sari-sari stores/general merchandising businesses.

1198. Manufacturing industries in Apalit consist of garments manufacturers/ tailoring, rice mills, metal craft businesses, furniture makers, hollow block manufacturers, ice cream manufacturers, handicraft manufacturers, pottery makers, and printing presses, among others. The largest manufacturers are Far East Alcohol Corporation, which occupies approximately 8.5 hectares, and Linde Philippines, Inc., which occupies approximately four (4) hectares.

1199. Tourist attractions in Apalit include the historic St. Peter the Apostle Parish Church in Barangay San Juan, the ancestral house of Mr. Pedro Espiritu in Barangay Sulipan, and the ancestral House of Mr. Macario Arnedo in Barangay Capalangan.

Minalin

1200. Minalin is a fourth class municipality and its economic activities are agriculture, commerce and trade, and tourism.

1201. The major agricultural crop production in Minalin produces 818 metric tons of mix crops in 2015. Minalin is known as the "Egg Basket of Central Luzon" because of its large scale production of eggs and chickens. The livestock and poultry can produce 1,250 kg/day and 1,260,000 eggs/day respectively. Other livestock and poultry products are meats, pigs ducks, quails, carabaos, goats and penoy and balut eggs. Minalin is predominantly fishpond. It produces fish products about 25,398 metric ton a year. The main aquaculture products are tilapia, shrimps, crabs, milkfish and mudfish.

1202. Commerce and trade in Minalin as of 2016 involved 368 registered business establishments such variety stores, grocery stores, wet and dry market, RTW stores, electronic, electrical and mechanical stores, medicine/drug stores, mini marts, hardware, agri products stores and amusement centers. Minalin has also wood and metal crafts, filling materials and lahar products.

1203. Tourist attractions in Minalin include the Santa Monica Parish Church in San Nicolas, Dr. Sabas Pingol Sun Set Boulevard, Pasac-Culcul Road in San Pedro and San Isidro, Poultry Buildings in Culcul in San Pedro. The Sta. Monica Parish Church is characterized with magnificent heritage religious structure.

Sto. Tomas

1204. Sto. Tomas is a fourth class municipality and its economic activities are agriculture, industry, commerce and trade, and tourism.

1205. Sto. Tomas is primarily an agricultural based economy (farming, livestock, fishing and/or fishing production, etc.). About 65% of the total land area of Sto. Tomas are devoted to agriculture and aquaculture. Of the total agricultural land, about 40% account for rice production and 24% of the total households are engaged in livestock and poultry production either for home consumption or market. The total fishing ground area of this municipality is approximately 308 hectares located in Barangays Poblacion, San Bartolome, and Sto. Rosario. Fishing industry in this area generates a total volume of 276 metric tons of mist annually.

1206. Industries in Sto. Tomas involve manufacturing and agri-industrial activities. In the records of Department of Trade and Industry (DTI), Sto. Tomas holds the title "Casket Capital of Central Luzon." It is home to 300 family-owned casket businesses that each produces about 80 caskets monthly or a total production of 24,000 a month. Other industries involve pottery and automotive making. These are located in Barangays Sto.Niño, San Vicente, and San Matias. Agri-industrial activities such as poultry farms serve as other sources of income and livelihood of the residents. These are located in Barangays Poblacion, San Bartolome, and Sto.Rosario.

1207. Commercial activities in the municipality are restaurants, banks, and private schools mostly located in San Matias and Moras dela Paz. Major supermarkets such as Robinson's Minimart, Puregold, and Chuzon’s Supermarket are also present in the municipality. Commercial areas occupy a total land area of 50 hectares or 10.28%.

1208. Tourist attractions in Sto. Tomas are the old churches of St. Thomas the Apostles in Barangay Poblacion and the Sto. Niño Chapel because of its altar made of terra cotta.

San Fernando

1209. San Fernando is a first class city and capital of Pampanga. Its economy has taken the turn from a predominantly agricultural economy (35 years ago) to one oriented toward Industry and Services. Employment in the city is shown to concentrate in the Services Sector with about 75 percent of the City’s labor force accounted. The Industry sector comes in second in employment share with 36 percent, while Agriculture, Fishery and Forestry (AFF) accounts for the least share with 9 percent.

1210. Service establishments and commercial activities are largely located in Central Business District, along the Jose Abad Santos Avenue and the MacArthur Highway. Wholesale and manufacturing establishments combine with retail outlets including malls, tourism-related establishments such as hotels/motels and restaurants, and financial, educational and government institutions to make up the economic base of the San Fernando.

1211. Agricultural activities while still occupying a good portion of the city’s land area are now elegated in its peripheries – those parallel the megadike and the North Luzon Expressway and areas at the southern end of the city. These remaining agricultural areas are mainly planted to rice, sugarcane, and high value commercial crops, which are interspersed with livestock and poultry production and fish farming. In some areas though, especially those adjacent to populated areas, encroachment of settlements into livestock/poultry farm areas is becoming an issue because of environmental concerns.

Angeles

1212. Angeles is a first class highly urbanized city in the region of Central Luzon. Investors continue to be convinced of the viability of Angeles as a viable location to operate businesses. For 2015, the top businesses in the city in terms of their number, as classified by the Business Permit and License Division following that of the City Treasurer’s Office, are (1) Retailer, (2) Services, (3) Real Estate, closely followed by 4) Food/Nocturnal, then 5) Manufacturer and lastly (6) Farm.

1213. Big mall chain operators have long made their presence felt in the city. First was the Robinson’s Place, followed by SM Clark and lastly the Ayala-operated Marquee. Even before these malls, there were already locally operated malls or shopping centers like the JENRA Mall and the Nepo Mall. The city abounds with a number of fast food chains such as McDonalds, Burger King, KFC, Greenwich, Jollibee, Chowking, Pizza Hut, Shakeys, Yellow Cab, and many more. A relatively new entrant that is experiencing a boost in the business scene of the city is the business process outsourcing (BPO) industry or more commonly known as call centers. The city has one (1) Universal/Commercial/ International, 34 Universal banks, 13 Commercial banks, 12 Savings banks, 15 Rural and 2 Thrift banks, 1 Banking, 1 Micro Finance Banking and 1 government bank. There are 30 registered operational cooperatives in the city in 2015. These cooperatives are classified as either credit, multi-purpose, consumer, service, or transport cooperatives.

1214. In spite of being a highly urbanized, the City Veterinary Office implements its programs/projects/ activities to support the livestock and poultry industry since they are the breeding ground for even greater opportunities. Angeles also engage in backyard fishpond. For 2014 and 2015, the area utilized for backyard fishpond is only 2.7 hectares in Barangays Amsic, Sapangbato, Cutcut, Margot, Mining, Sapalibutad and Sto. Domingo).

1215. Angeles, still, has natural attractions that can draw tourists such as the Sibol and Puning Hot Spring, all in Barangay Sapangbato and other historical sites. Angeles City is famous for being a recreation center, especially its night spored by the decades-long presence of American military forces. Angeles also has a forest with an area of 2.5 hectares located at Brgy. Sapangbato. The forest is a good source of economic activity of the people (Indigenous Peoples-IPs and even non-IPs) living in Sitio Target. These residents have practiced eco-tourism, acting as tourist guides.

Mabalacat

1216. Mabalacat is a first class city and its economy revolves around its primary sector (agriculture, fisheries, livestock, and poultry), secondary sector (business establishments), and tertiary sector (commerce and trade, industries, and tourism).

1217. Crop production of rice and corn is one of the main economic activities of Mabalacat. Of the 800 hectares used for rice production in the city, 692.5 hectares are devoted to irrigated rice cultivation. There are 92 hectares allotted to green corn production with 86 farmers while 85 hectares are allocated to yellow corn production with 67 farmers. Agriculture areas in Mabalacat City are located in Sta. Maria, Dapdap, Mawaque, Calumpang, CABCOM I, CABCOM II, Mabiga, Bical, Sapang Biabas, Duquit, Dau, Macapagal Village, Dropzone, Mangalit, Sapangbalen, Cacutud, Mamatitang, Atlu Bola, Bundagul. CABCOM I and II, which stands for Clark Air Base Command I and II, are agricultural areas located within the Clark Freeport zone. Dropzone, on the other hand, refers to the agricultural areas within the boundaries of barangay Dolores and Clark Freeport zone.

1218. Twenty-one establishments provide post harvest facilities and support services in Mabalacat. Two of these are milling facilities located at Dapdap and Camachiles. The city further boasts of 14 multi-purpose drying pavements found in several areas, three market centers located in Clark, Dau, and Poblacion, one warehouse in Mabiga, and one fish storage at Camachiles.

1219. In 2013, Mabalacat's livestock production consisted of 873 cattle, 4,225 pigs, and 1,088 carabaos. Cattle and carabao raising are classified backyard production while pig production is considered commercial. Chicken production is classified commercial while duck production is categorized backyard. In the past year, poultry production yielded 353,000 chickens and 2,854 ducks. Finally, fish production accounted 433.44 tons of fish in 2013.

1220. According to the city's business permits and licensing office, the types of business permits issued in Mabalacat include trading, services, manufacturing, lessors, and finance. In 2014, 2,002 business permits were given, of which, 967 business permits were issued to trading being the most prominent business type. This is followed by services, lessors, finance, and manufacturing with 634, 283, 66, and 52 permits respectively. In terms of economic activities, the 2013 data reveal that wholesale and retail trade have largest number of activities accounting 967, followed by real estate renting and business with 68 activities; financial intermediation (66); education (33); and communication (1).

1221. There are ten (10) tourist attractions in Mabalacat, of which, two (2) are considered historical: Kamikaze East in Tabun and Kamikaze (HODM) in San Francisco. Two are religious establishments, namely, Goddess of Peace Shrine located in the Clark Freeport Zone, and Our Lady of Parish Church found in Barangay Poblacion. Four are man-made establishments: Capt. Colin Kelly Drive at Clark, Paradise Ranch and Zoocobia at Calumpang, and Marina Golf and country club at barangay Dolores. Finally, two are natural establishments found in Calumpang (Hanauan Falls and Sacobia River), considered protected areas in the city.

Bamban

1222. Bamban is a second-class municipality and its economic activities are agriculture, industry, and commerce and trade.

1223. Bamban's total agricultural land area is 5,651 hectares, of which, 3,000 hectares are dedicated to rice production in all 15 barangays. Other than rice, other major crops that are produced in Bamban include corn, coconut, and mango. Carabao, cattle, goat, sheep, hog, chicken, and duck comprise the backyard and commercial livestock and poultry production in Bamban. Communal fishing grounds are present in the creeks in Barangays San Nicolas, Sto. Niño, Lourdes, San Vicente and Anupul. Barangays Bangcu, Culubasa, San Nicolas, San Vicente, Dela Cruz, Anupul, Lourdes and Virgen Delos Remedios have fishponds.

1224. Industries in Bamban include gas and water supply and construction firms, while the commerce and trade are wholesale and retails/repair of motor vehicles, motorcycles, personal and household goods and education.

Capas

1225. Capas is a first class municipality and its economic activities are commerce and trade, agriculture, industry and tourism.

1226. Commerce and trade in Capas consists different business enterprises including sari-sari stores, restaurants, fast food chains, beauty parlors, commercial banks, hardwares, agricultural supply stores, and the productivity center in Barangay Cristo Rey, which is currently being managed by the National Housing Authority (NHA), logistic support and even BPO. These are concentrated in the Poblacion area and different barangay centers. The public market, located in Barangay Cubcub, is considered the largest single commercial area in Capas with an approximate land area of 6,112 square meters.

1227. Agricultural land in Capas is approximately 2,832.83 hectares or 7.53 % of the total land area. The figure, however, does not include prime agricultural lands, as well as agricultural areas inside the Military Reservation. High-value commercial crops produced include corn, taro (gabi), sweet potato, and other vegetables, while 1,908 hectares are rain-fed rice lands. The biggest mango plantations are located in Barangays O'Donnell, Aranguren, and Cutcut II while banana plantation is located in Barangay Talaga and Sta. Juliana. On the other hand, fishponds are present in Barangays Dolores, Lawy, Manlapig, and Sta. Lucia.

1228. Existing agro-industrial activities include bricks factory in Barangays Sto. Rosario and Talaga, smoked fish (tinapa) factory in Barangay Talaga, and a crocodile farm in Barangay Estrada. Similarly, bio-ethanol products are being produced in Barangays O'Donnell and Sta. Lucia.

1229. Tourist attractions in Capas are the historical sites, which include Capas National Shrine in Barangay Aranguren and the People's Park in Barangay Cutcut I. Other tourism area includes the Tambo Lake and the gateway to Mt. Pinatubo, which also doubles as a one-of-a-kind wellness spa in Barangay Sta. Juliana.

3.4.7.2 Labor Force and Employment

(1) Labour Force and Employment Profile by Host LGUs

1230. In the absence of available data on employment at municipality/city level, the regional level data from the Philippine Statistics Authority (PSA) were used in the study (**Table 3.4.37**).

1231. The Labor Force Participation Rate (LFPR) of Region 3 for 2015 is 60.90%. It is slightly lower than years 2014 and 2013 with 62.30% LFPR and 62% LFPR, respectively. The LFPR is the percent out of the total population that makes up the Labor Force, which are those individuals that are aged 15 years and above who are either employed or unemployed. Out of the LFPR, the employment rate of Region 3 for 2015 is 93.9%, which has a slight increase from 2014 and 2013 with 91.70% and 91.30%, respectively. Moreover, an average of 12.4% of the employed individuals in 2015 is underemployed. Meanwhile, the unemployment rate for 2015 is 6.1%. This means that 6.1% individuals have no job/business but actively looking for work and/or those who are looking for work because of their belief that no work was available or because of temporary illness/disability, bad weather, pending job application or waiting for job interview.

Table 3.4.37 Labor Force and Employment Data of Region 3

Labor Force Characteristics	2013	2014	2015
LFPR (%)	62.0	62.3	60.9
Employment Rate (%)	91.3	91.7	93.9
Unemployment Rate (%)	8.7	8.3	6.1
Underemployment Rate (%)	14.5	13.5	12.4

Source: 2013, 2014, and 2015 Labor Force Survey, Philippine Statistics Authority

1232. The total gainful workers of the host LGUs of the proposed MCRP, as based on the 2015 Census of Population and Housing of the PSA, are presented in **Table 3.4.38**. The data shows that Malolos and Calumpit contribute gainful workers of about 11.49% of the total gainful workers of Bulacan. Apalit, Minalin, Sto. Tomas, San Fernando, Angeles and Mabalacat have gainful workers of about 56.319% of the total gainful workers of Pampanga. Bamban and Capas have gainful workers of about 15.04% of the total gainful workers of Tarlac. Majority of the gainful workers are males.

Table 3.4.38 Gainful Workers of the Host LGUs (2015)

Municipality/ City	Total Gainful Workers 15 Years Old and Over	Male	Female
Bulacan	1,406,498	882,107	524,391
Malolos	114,335	67,915	46,420
Calumpit	47,225	30,110	17,115
Pampanga	856,085	574,658	281,427
Apalit	44,256	28,981	15,275
Minalin	18,113	12,632	5,481
Sto. Tomas	16,017	10,537	5,480
San Fernando	123,758	77,945	45,813
Angeles	177,047	107,010	70,037
Mabalacat	102,835	65,177	37,658
Tarlac	543,041	369,564	173,477
Bamban	26,432	17,833	8,599
Capas	55,216	38,249	16,967

Note: Figures are based on 20-percent sample households. Details may not add up to total due to rounding off

Source: 2015 Census of Population and Housing, Philippine Statistics Authority

(2) Income of PAFs by LGUs

1233. Based on **Table 3.4.39**, in total, the highest proportion of PAPs (16.5%) receive an income of P12,000 to 15,999 per month. This pattern can be observed in Caluumpit and Apalit, as well as in the City of San Fernando, with 14.1%, 33.3% and 17.4%, respectively. However, in the Cities of Malolos and Angeles, majority earn at least P30,000-P49,999 per month. This pattern suggests that

PAPs in some municipalities (i.e. Calumpit, Apalit) may be less well-off compared to the other cities (i.e. Malolos, Angeles). However, in the City of San Fernando, the income pattern is more diverse, with PAPs earning at least 12,000-15,999 (17.4%) and a proportion earning P30,000 to P49,999 (12.9%). The trend in may also be observed in Calumpit.

In terms of employment, five (5) out of 10 PAFs (50.8%) are not employed. Among those employed, majority are under wage-based employment (25.3%), with a small portion (10.8%) engaged in enterprise-based employment. In Malolos and Apalit, most of the employed are enterprise-based, with 14.7% and 16.7%, respectively. This may pertain to the PAPs engaged in businesses for the project-affected area. In Calumpit, Santo Tomas, San Fernando and Angeles, however, most are engaged in land-based employment. Among those employed in land-based, majority are from Calumpit, with 25 families. The bulk of wage-based and enterprise-based workers are in San Fernando, with 930 and 344 families, respectively. There are also remittance-based families, or those depending on remittances from relatives working abroad – with 47 families in San Fernando, 26 families in Calumpit, 9 families in Angeles and 1 family in Malolos. Only a small proportion of families have no members who are employed (or not applicable, which is 1.9%).

Table 3.4.39 Income Bracket of PAFs

Municipality	Income Bracket													
	Below 2k	2k-3.9k	4k-5.9k	6k-7.9k	8k-9.9k	10k-11.9k	12k-15.9k	16k-19.9k	20k-24.9k	25k-29.9k	30k-49.9k	50k above	N/R	Total
Malolos	0	0	0	0	1	0	0	0	0	1	2	2	0	6
%	0.0%	0.0%	0.0%	0.0%	16.7%	0.0%	0.0%	0.0%	0.0%	16.7%	33.3%	33.3%	0.0%	100.0%
Calumpit	3	12	9	20	23	30	40	24	34	20	33	26	10	284
%	1.1%	4.2%	3.2%	7.0%	8.1%	10.6%	14.1%	8.5%	12.0%	7.0%	11.6%	9.2%	3.5%	100.0%
Apalit	0	0	0	0	1	0	1	0	0	0	0	1	0	3
%	0.0%	0.0%	0.0%	0.0%	33.3%	0.0%	33.3%	0.0%	0.0%	0.0%	0.0%	33.3%	0.0%	100.0%
Sto. Tomas	2	1	0	1	8	2	2	2	0	0	2	4	0	24
%	8.3%	4.2%	0.0%	4.2%	33.3%	8.3%	8.3%	8.3%	0.0%	0.0%	8.3%	16.7%	0.0%	100.0%
San Fernando	4	12	28	60	87	75	143	88	79	47	106	62	29	820
%	0.5%	1.5%	3.4%	7.3%	10.6%	9.1%	17.4%	10.7%	9.6%	5.7%	12.9%	7.6%	3.5%	100.0%
Angeles	1	5	9	10	20	19	33	21	17	17	28	11	1	192
%	0.5%	2.6%	4.7%	5.2%	10.4%	9.9%	17.2%	10.9%	8.9%	8.9%	14.6%	5.7%	0.5%	100.0%
MCR Total	10	30	46	91	140	126	219	135	130	85	171	106	40	1329
%	0.8%	2.3%	3.5%	6.8%	10.5%	9.5%	16.5%	10.2%	9.8%	6.4%	12.9%	8.0%	3.0%	100.0%

Source: JICA Study Team

Table 3.4.40 Main Occupation of PAFs

STATION	Main Occupation								
	Land Based	Wage Based	Enterprise Based	Remittance Based	No Occupation	Others	Not Applicable	No Response	Total
Malolos	0	3	5	1	24	0	0	1	34
%	0.0%	8.8%	14.7%	2.9%	70.6%	0.0%	0.0%	2.9%	100.0%
Calumpit	25	273	161	26	619	27	24	22	1177
%	2.1%	23.2%	13.7%	2.2%	52.6%	2.3%	2.0%	1.9%	100.0%
Apalit	0	1	3	0	13	1	0	0	18
%	0.0%	5.6%	16.7%	0.0%	72.2%	5.6%	0.0%	0.0%	100.0%
Sto. Tomas	2	29	15	0	51	1	0	21	119
%	1.7%	24.4%	12.6%	0.0%	42.9%	0.8%	0.0%	17.6%	100.0%
San Fernando	17	930	344	47	1881	38	64	320	3641
%	0.5%	25.5%	9.4%	1.3%	51.7%	1.0%	1.8%	8.8%	100.0%
Angeles	0	229	98	9	348	15	20	74	793
%	0.0%	28.9%	12.4%	1.1%	43.9%	1.9%	2.5%	9.3%	100.0%
MCR Total	44	1465	626	83	2936	82	108	438	5782
%	0.8%	25.3%	10.8%	1.4%	50.8%	1.4%	1.9%	7.6%	100.0%

Source: JICA Study Team

3.4.8 Public Access

3.4.8.1 Road Networks and Transportation

1234. Manila North Road, also known as McArthur Highway, is the oldest inter-regional highway that connects Northern and Central Luzon provinces from the national metropolis. The Central Luzon section of the MacArthur Highway starts at Km 17+270 in Meycauayan City in Bulacan and ends at Km 168+275 in San Manuel, Tarlac, giving a total length of 151.005 km. The 5.44 kilometer portion in Angeles City starts at Km 81+260 (boundary with the City of San Fernando) and ends at Km 86+700 (boundary with Mabalacat City).

1235. North Luzon Expressway (NLEX) formerly known as North Diversion Road is a limited-access toll expressway that connects Metro Manila to the provinces of the Central and Northern Luzon Regions. NLEX begins in Quezon City specifically at a cloverleaf interchange with Epifanio Delos Santos Avenue (EDSA), and then passes through Caloocan City and Valenzuela City in Metro Manila, Meycauayan, Marilao, Bocaue, Guiguinto, Plaridel and Pulilan in Bulacan, San Simon, City of San Fernando, Mexico and Angeles City in Pampanga. The expressway currently ends at Mabalacat and merges with the MacArthur Highwayand the Subic-Clark-Tarlac Expressway (SCTEx), which continues northward into the rest of Central and Northern Luzon for the former and westward for the latter.

1236. SCTEx is a 94-kilometer four-lane expressway that serves as a direct and exclusive road connection between major development areas of Central Luzon (Subic, Clark, Tarlac). Its southwestern terminus is at the Subic Bay Freeport Zone in Zambales, then passes through the interchanges with the NLEX near the CSEZ in Angeles City, and Central Techno Park in Tarlac City, Tarlac; and its northeaster terminus is in La Paz, Tarlac.

<u>Malolos</u>

1237. Public transportation in Malolos is served by buses, jeepneys, and UV Express AUVs. The city is also served by Tricycles, which offer their services on a for-hire basis.

1238. Malolos is known for its Karatig Jeepneys which serves as an intra-city public transportation. The name itself came from the word karatig, which means nearby places or barangays. The Karatig jeepney is the smaller version of the jeepneys which usually have the size of about 3-meters long and can board 8-10 commuters at the back plus 2 passengers in the front seat. Longer models can accommodate about 10-12. Its capacity varies according to the jeep's length and size.

1239. There was a railway service in the city served by the PNR. However, in 1988 the North Main Line of the PNR was closed and train services in Malolos ceased immediately.

<u>Calumpit</u>

1240. In Calumpit, there is one (1) existing major road – Manila North Road (commonly known as the Mac Arthur Highway), which is its access to Metro Manila and to Central Luzon. Supporting this road is the Calumpit Hagonoy Road, Pulilan-Calumpit Road and the municipal and barangay roads, which most of them are concentrated in the urban area of the town.

1241. In Calumpit, there are two major provincial roads namely the Calumpit-Hagonoy Provincial Road and Calumpit-Paombong-Malolos Provincial Road.

1242. An impending transportation system is the North Rail Project (Northrail) parallel to the McArthur Highway traversing the barangays of Pio Cruzcosa, Iba Este, Iba O'Este, Balungao, Poblacion and Gatbuca. Initial construction in Phase I of the Project will be the 32-kilometer stretch, or Section 1, between Caloocan and Malolos.

Apalit

1243. The Manila North Road serves as the main road artery that crosses various towns and municipalities in Bulacan, and all the way to Pampanga, running almost alongside the NLEX. Apalit can be accessed via the San Simon NLEX exit, or through the Guiginto-McArthur Exit in Guiginto, Bulacan.

1244. Traffic at the central business areas along Manila North Road experiences regular slow down, due to the stop light in the intersection with Gonzales Avenue. Otherwise all other roads and highways are observed to be relatively smooth flowing, except when accidents occur, and when road works and bridge repairs are done, which can cripple traffic to and from Apalit, to the neighboring Pampanga and Bulacan municipalities.

1245. The main arteries leading to the town proper from all sides (Macabebe, Minalin, San Simon Pampanga, and Calumpit Bulacan) are mostly two-lane concrete or asphalt roads, with minimal sidewalks, and open trenches for drainage.

1246. Most of the National roads in Apalit are asphalt, while the barangay roads are either concrete, gravel or unpaved roads. The road artery leading to the eastern farmlands, particularly Tabuyuc Road, is a two lane road, which has minimal to no sidewalk, with no drainage along the road, since the rear of the houses and structures along the road are adjacent to farmlands and fishponds. The roads are alternating concrete, asphalt, and rough roads. The Tabuyuc-Balucuc Road is a concrete road elevated from the farmlands, which is just enough to allow two vehicles to pass through each other. There is no sidewalk nor barriers that delineate the road. The minor roads connecting to the Tabuyuc-Balucuc Road are concrete roads with minimal to no sidewalks, with open drainage directly connected to farmlands and fishponds.

1247. Apalit has a total of 69.2 kilometers of road, which is 2.85% of the total road network of Pampanga. This total length does not include the NLEX, and does not include the new farm to market roads at Barangays Cansinala, Tabuyuc, Calantipe and Balucuc.

1248. There are four bridges in the municipality. The Sampaloc Bridge along Manila North Road is the northernmost bridge within Apalit. This bridge crosses a tributary of the Pampanga River. The New Sulipan Bridge along Manila North Road, replaces the old Sulipan Bridge, and connects the Barangay of Tabuyuc to the rest of the Municipality, through a ramp that leads to a two-lane roadway underneath the New Sulipan Bridge. The Sulipan-Tabuyuc Bridge, also in Barangay Sulipan, connects Calumpit, Bulacan, to Barangay Tabuyuc and Barangay Cansinala. The Colgante Bridge along the Apalit-Macabebe Road connects the Macabebe to the Apalit. These bridges are vital for access to all municipalities within the region, for normal traffic, trade and emergencies. Closure of any one of these bridges would result in economic losses for all municipalities, and would entail travelling within nearby towns and municipalities, or passing through the NLEX, which will entail cost for toll fees. In the event of that the Sulipan or Calumpit-Apalit Bridges are closed, the alternative routes would be the municipal and provincial roads traversing the Municipalities of Macabebe and Masantol, or through the NLEX.

1249. Various tricycles and jeepney routes and mini-buses are available, connecting Apalit to the nearby towns and municipalities. Motorcycles can be crossed through the Pampanga River, for a cost via boat.

Minalin

1250. The existing land transport network consists of 6.095 kilometers national road and 30.383 kilometers Municipal/Barangay roads. Seventeen bridges are integrated to the entire existing road network. Transport conveyances in the municipality consist of jeepneys, private vehicle and motorboats in the coastal barangays.

Sto. Tomas

1251. Sto. Tomas is connected to and accessible from the nearby city and municipalities of Pampanga, namely: San Fernando on the northwest, San Simon on the northeast, Minalin on the southeast, and Bacolor on the west. It is accessible through major road networks such as the Manila North Road and road arteries coming from the different provinces of Central Luzon and Metro Manila.

1252. Sto. Tomas has a total road length of approximately 47.92kilometers, which is classified into four (4) categories namely: national (3.5 km.), provincial (9.55 km.), municipal (2.50 km.) and barangay roads (32.37 km). At present, the road network is considerably sufficient although it necessitates improvement to facilitate the movement of goods and services from large commercial centers.

1253. Bridges are used to link road networks over bodies of water. At present, there are fifteen (15) bridges in different barangays of Sto. Tomas. These bridges are wood, steel and concrete type and are in fair physical condition. The table below shows the list of bridges, location, type, capacity and physical condition of bridges that are present in the municipality.

1254. In order to support traffic flow in and out of the city, a transport hub has been planned along Manila North Road. There are also jeepney and tricycle terminals strategically located along main roads in Sto. Tomas. Currently, there are four (4) jeepney driver associations (BATOVI, SAPA JODA, SN MATIAS JODA) and two (2) tricycle driver associations (SAMATODA, SRPANTODA) in the municipality.

San Fernando

1255. There are two interregional arterial roads and one major eastwest lateral connection passing through San Fernando, namely, Manila North Road, NLEX and the Jose Abad Santos Avenue (JASA) formerly known as Gapan–San Fernando-Olongapo (GSO) road respectively.

1256. The City has a total road length of 280.13 kilometers with classified National accounting for 13.8 percent, Provincial 2.0 percent, City 1.2 percent and Barangay 83.1 percent. Except for the remaining 55.19 km of barangay roads, almost all of these roads are already paved, either concrete or asphalt. The local roads are regularly maintained by the City Government in coordination with the Department of Public Works and Highways (DPWH).

1257. The road density of the City was computed at 4.14 km of road per km2 of land which is way above the national standard of 1.00 km per km2. There are a total 33 bridges within San Fernando. Per latest assessment of the City Engineer's Office, six needs rehabilitation while another five are being proposed for construction.

1258. The mode of public transport in the City of San Fernando is purely road-based consisting largely of jeepneys for primary routes, tricycles, pedicabs and kalesas for feeder routes. Buses are available for long-distance travels. There are bus companies serving the City inward to other destinations such as Victory Liner Inc., Genesis Transport Service, Inc., Bataan Transit Co., Inc. (BTCI) among others. The buses load and unload passengers in the city central terminal and in the parking area of Robinson's Starmalls (for Victory Liner buses) and the Mexico side parking area of SM Mall. Taxi service is not that well-established, however, there are some groups operating independently.

1259. The City also serves as a terminus for jeeps plying routes from the rest of Pampanga such as Lubao-Guagua-Bacolor, Apalit, Arayat-San JuanMexico, Angeles, and Dau, and from neighboring provinces such as Bataan (Balanga-Hermosa-Dinalupihan), Nueva Ecija (Cabanatuan-Gapan-Cabiao), and Tarlac (Tarlac City-Capas-Bamban).

Angeles

1260. As of 2015, Angeles has a total of 229.113km road length, giving a road density of 3.615km for every square kilometer. Using the Angeles' projected population data of 2015, its kilometer road density per 1,000 population is 0.63 which is lower that the standard urban road density of 2.4km per 1,000 population ration. Furthermore, Angeles has a paved road ratio of 0.89.

1261. Angeles has a total of eighteen (18) city bridges and five (5) national bridges. These bridges have a good to fair condition.

1262. Jeepneys and tricycles are the common mode of transportation in Angeles. As of 2015, Angeles has 7,418 public utility vehicles (PUVs) and 10,627 public utility tricycles. There are four (4) transport terminals which cater the outside city limit PUVs. These are:

- SM Clark Terminal/Bayanihan Clark catering to the north bound sector such as Angeles to Bamban, Capas, Concepcion, Mabalacat, Madapdap, Sta. Lucia, Dau-Check point, Clark to Main Gate via Ex-Way-SM and Dau to Maingate;
- Marquee Terminal caters to the East Bound Sector such as Angeles to Arayat, Magalang, Mawaque, Pandacaqui and SM Pampanga via Pandan;
- Nepo Mart Terminal caters to the West Bound Sector such as Angeles to Manibaug, Porac, Salu-Balubad;
- Essel Park Common Terminal, which caters to the south bound sector such as Angeles to Bulaun, San Fernando and friendship-telabastagan.

1263. A bus terminal is located at Marquee Mall, which is 0.40 km. from city hall. This serves only as dropoff point of provincial buses going to and coming from North Luzon.

Mabalacat

1264. Mabalacat has a total of 6 km of national roads, 7.8 km of provincial roads, 15.5 km of city/municipal roads, 132.07 km of barangay roads, and 3.4 km of alley roads. All roads are completely made of concrete except for two, the national roads in which 29% or 1.74 km are made of asphalt, and the barangay roads in which 1.5% or 2.03 km are made of asphalt and 53% or 70.02 km are made of earth.

1265. There are six bridges located in Mabalacat City: Quitangil Bridge, Sapang Balen Bridge, Lakandula-Dau Bridge, Morales Bridge, Bamban Bridge, Mabalacat Bridge. Made of concrete, all bridges are in good condition. The road capacity of all bridges is 14 tons except for Morales Bridge, which allows only 10 tons, and Mabalacat Bridge, 20 tons.

Bamban

1266. There are no reliable data available from the LGU on the condition of the roads and networks of Bamban. Data provided herein were taken by the MPDO from Satellite Imagery, Open Steet Map.

1267. The significant major arterial roads within the locality are the part of national roads SCTEX and MNR. The SCTEX is at the east side of the municipality that runs from the south through Barangay Malonzo and north through Barangays Bangcu, while the MNR runs along the urban areas of the municipality from the south though Barangays Lourdes, San Nicolas, San Roque, and north through Barangay Anupul. Bamban's main Bridge, Bamban Bridge, is connected to the south end of this major road.

1268. Bamban's major collector roads are the Rizal Street, Bonifacio Street, Sibal Street, Sibul Street and the Pandan-Dap-Dap Road. Rizal and Bonifacio Streets are almost parallel with MNR. Rizal Street is considered as major urban road because it extends from MNR south to MNR north running through the Poblacion. Bonifacio Streets, on the other hand, run parallel to Rizal Street. Both streets are connected and services with concrete drainage systems. Running through Rizal and Bonifacio is Sibal Street. It also connects these roads to MNR. Pandan-Dap-Dap is the road that connects the resettlement areas of Dap-dap and Mainang to MNR. This road also services various agro-industrial developments and serves as route to the dumpsite.

1269. Sibul Street is the nearest collector road to SCTES and the network that connects Bamban from MNR to Concepcion. This street also services several agro-industrial and light industrial developments in Barangays Dela Cruz, and VDR.

1270. There are six (6) bridges that connect road network continuity in the municipality. All are operational and in good condition.

1271. Bamban can be reached through public jeepneys (Tarlac-Bamban and Bamban-Angeles) and buses from the north and south along McArthur Highway. Though provincial buses now seldom pass by Bamban due to the opening of the SCTEX. Bamban's major transportation modes are the tricycle and jeepneys and terminals are makeshift in nature. There are no major transporation facility development and organized non-motorized mode of transportion in the municipality.

Capas

1272. Capas is very accessible through SCTEX and NLEX. The town is also directly traversed by one of the country's major arterial road, Manila North Road.

1273. Capas is also located in close proximity to the DMIA providing easy access to local and foreign tourists. The proposed Capas-Botolan Road will further improve the town's accessibility, particularly to North-Western Luzon. Public transportation requirements are sufficient. All barangays are also accessible through all-weather roads, except for Barangay Bueno, which involves traversing the Cabatuan Creek. A bridge would need to be constructed to ensure access during the monsoon season when the creek swells. The existing road network of Capas covers 18.89 hectares or 0.05% of the total land area. The total road length is 181.87 kilometers, with the following breakdown: 28.34 kilometers or 15.58% account for national roads; 17.60 kilometers or 9.68% for provincial roads; 1.40 kilometers or 0.77% for municipal roads; and 134.53 kilometers or 73.97% for barangay roads.

1274. The Manila North Road also serves as the main ingress and egress route of the LGU to the Municipalities of Concepcion and Bamban, and the City of Tarlac.

1275. No integrated public transport system or centralized public transport terminal is in place which is a necessary support service for a blooming tourism industry in Capas. Traffic congestion is also common along the Manila North Road, since this road serves as the primary route to travelers going to Tarlac City, Baguio City, and other prime destinations north of Manila, especially during the holidays.

1276. Table 3.4.41 presents the list of national roads that will be traversed/crossed by the proposed MCRP.

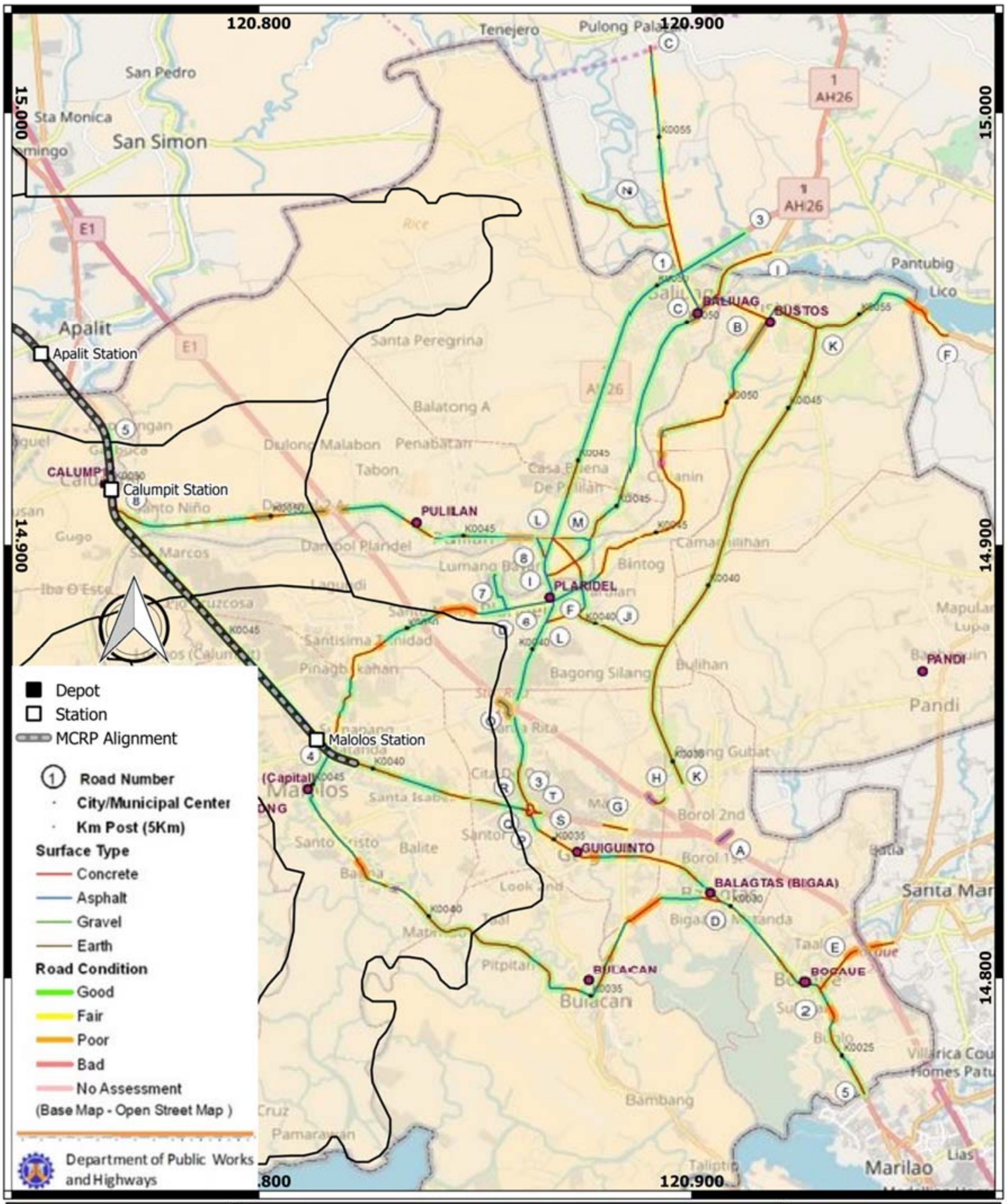
Table 3.4.41 Roads that will be traversed by the Proposed MCRP

Functional Classification / Road Name / Road number / Surface Type		Condition Rating					
		Good	Fair	Poor	Bad	No Assessment	Total (km)
Bulacan First District (Figure 3.4.3)							
	Primary Roads						
4-4	Malolos Flyover	-	-	-	-	0.28	0.28
	Asphalt	-	-	-	-	0.28	0.28
5-5	Manila North Rd	19.55	4.93	0.59	-	2.32	27.39

Functional Classification / Road Name / Road number / Surface Type		Condition Rating					
		Good	Fair	Poor	Bad	No Assessment	Total (km)
	Concrete	11.64	3.29	0.59	-	0.58	16.10
	Asphalt	7.91	1.63	-	-	1.74	11.28
	Secondary Roads						
8-8	Pulilan-Calumpit Road	6.18	2.74	1.77	-	0.26	10.95
	Concrete	2.05	1.11		-	0.07	3.24
	Asphalt	4.13	1.63	1.77	-	0.19	7.71
Pampanga First District (Source: 2017 DPWH ATLAS Figure 3.4.4)							
	Primary Road						
1-1	JASA/MNR Flyover	-	-	-	-	0.54	0.54
	Asphalt					0.54	0.54
2-2	Jose Abad Santos Ave. (JASA)	28.92	3.01	0.06	-	4.44	36.43
	Concrete	9.55	2.15	0.06	-	1.77	13.53
	Asphalt	19.37	0.86	-	-	2.67	22.90
3-3	Lazatin Flyover	0.13	-	-	-	0.20	0.33
	Asphalt	0.13	-	-	-	0.20	0.33
4-4	Manila North Road	26.38	2.56	0.20	-	0.83	29.96
	Concrete	4.99	-	-	-	0.65	5.64
	Asphalt	21.38	2.56	0.20	-	0.18	24.32
	Tertiary Road						
A	Apalit-Macabebe-Masantol Road	3.91	3.64	0.58	1.04	0.53	9.70
	Concrete	2.43	3.16	0.58	1.04	0.17	7.28
	Asphalt	1.48	0.48	-	-	0.46	2.41
G	Northwest Diversion Road	2.17	0.07	0.10	-	0.11	2.44
	Concrete	0.28	-	0.10	-	0.07	0.44
	Asphalt	1.89	0.07	-	-	0.04	2.00
J	San Fernando-Lubao Road	6.19	0.41	0.53	-	0.33	7.46
	Concrete	1.91	0.06	-	-	0.28	2.25
	Asphalt	4.28	0.35	0.53	-	0.05	5.21
N	Sto. Tomas-Minalin Road (Minalin-Macabebe Sect)	4.84	2.95	2.37	-	1.05	11.20
	Concrete	2.97	2.60	2.37	-	1.05	8.31
	Asphalt	1.87	0.35	-	-	0.37	2.36
	Gravel	-	-	-	-	0.53	0.53
Pampanga Third District (Source: 2017 DPWH ATLAS Figure 3.4.5)							
	Primary Road						
1-1	Manila North Road	-	-	-	-	16.17	16.17
	Concrete	-	-	-	-	4.13	4.13
	Asphalt	-	-	-	-	12.04	12.04
7-7	Old Manila North Road	3.69	0.18	-	-	0.05	3.93
	Asphalt	3.69	0.18	-	-	0.05	3.93
	Tertiary						
B	Camp Dau Road	0.48	0.21	-	-	0.06	0.75
	Asphalt	0.48	0.21	-	-	0.06	0.75

Notes: Source: 2017 DPWH ATLAS

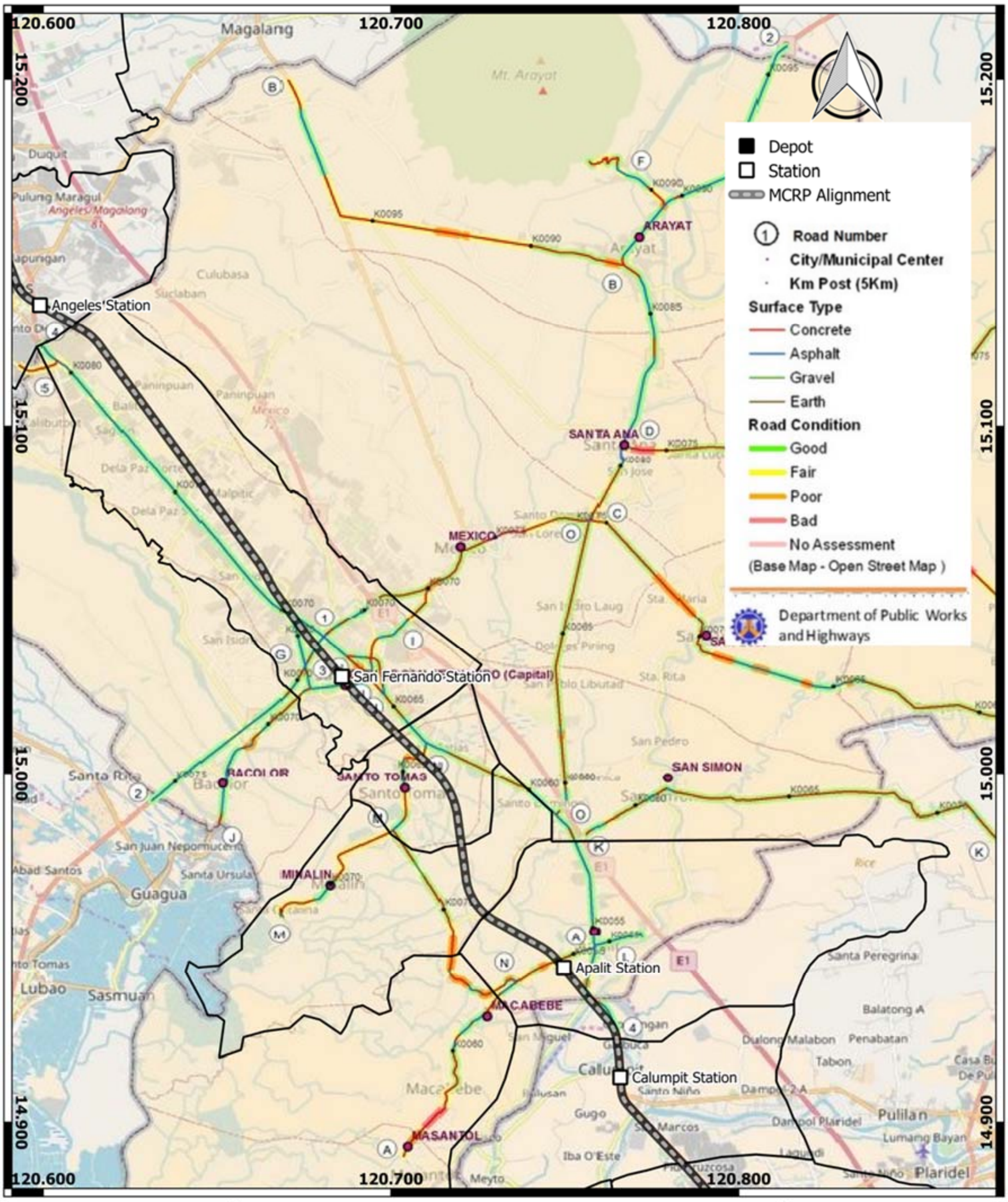
1.) Road data provided are as of 09 November 2017.
2.) The unit of measure for Road Data is kilometers.
3.) No Assessment refers to Road Sections that are either under construction and/or segments with length below the 50-meter gauging length.
4.) National Roads are classified into:
Primary Roads - roads that connect cities of > 100,000 population.
Secondary Roads - other roads which complement with the national arterial roads to provide access to main population and production centers of the country.
Tertiary Roads - other existing roads under DPWH which perform a local function. (In the map, these roads are represented only by letters.)



SOURCE: DPWH, 2017	ROAD NETWORK OF 1ST DISTRICT ENGINEERING OFFICE OF BULACAN	SCALE: 0 1 2 3 4 km

Source: 2017 DPWH ATLAS

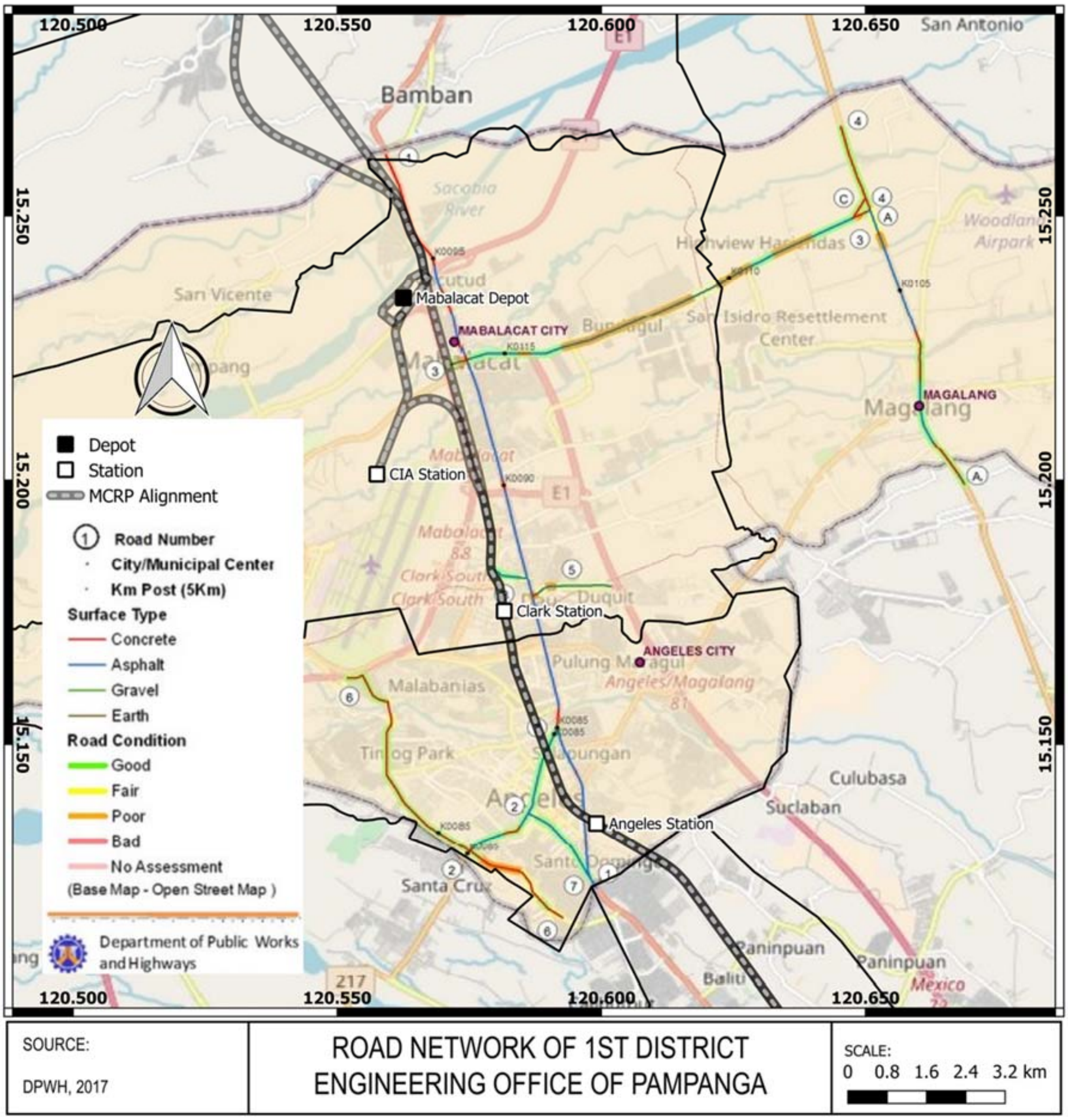
Figure 3.4.3 2017 Road Network Map of Bulacan 1st District



SOURCE: DPWH, 2017	ROAD NETWORK OF 1ST DISTRICT ENGINEERING OFFICE OF PAMPANGA	SCALE: 0 1.2 2.4 3.6 4.8 km

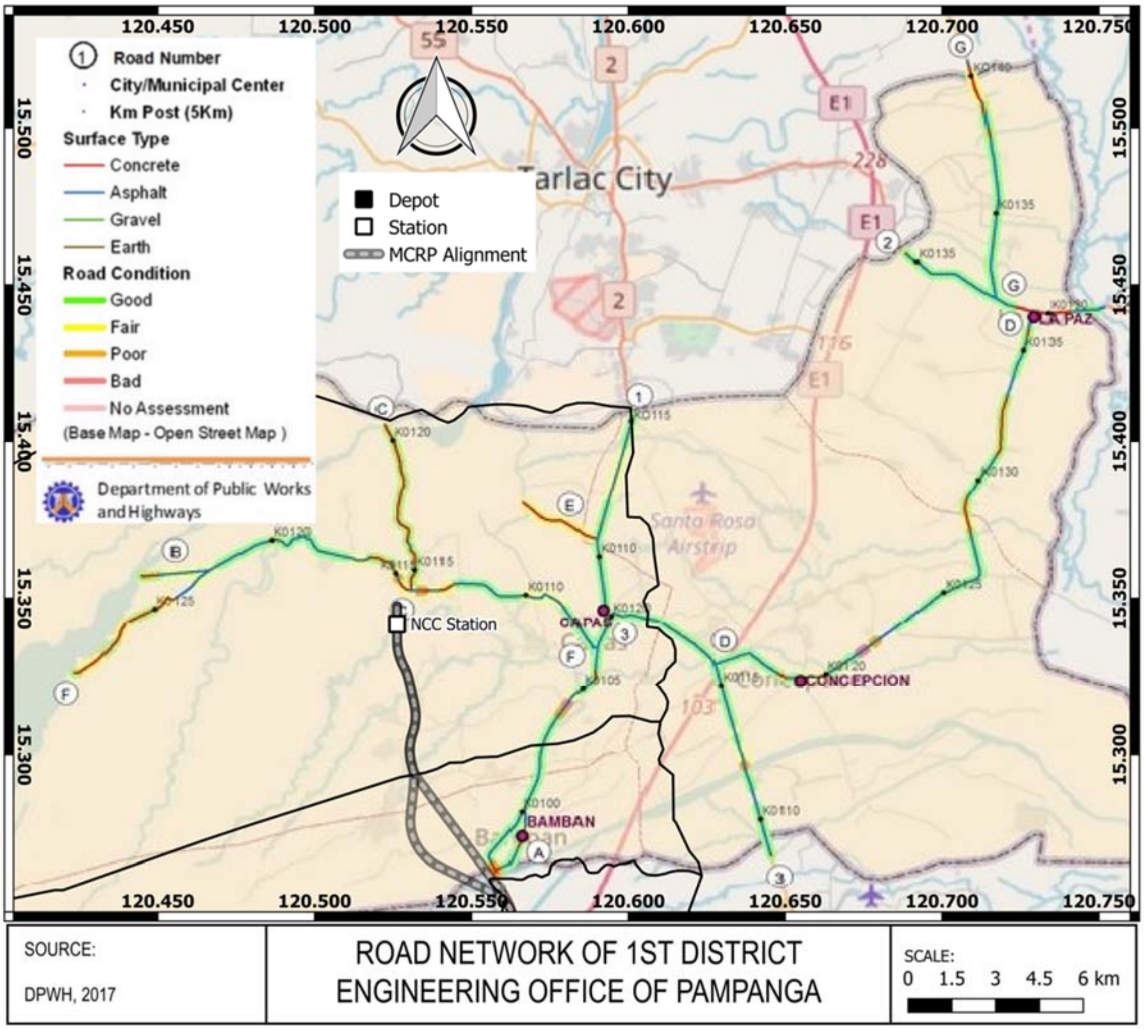
Source: 2017 DPWH ATLAS

Figure 3.4.4 2017 Road Network Map of Pampanga 1st District



Source: 2017 DPWH ATLAS

Figure 3.4.5 2017 Road Network Map of Pampanga 3rd District



Source: 2017 DPWH ATLAS

Figure 3.4.6 2017 Road Network Map of Tarlac 2nd District

1277. Based on 2017 DPWH ALTAS, there will be eleven (11) national bridges that will be traversed by the proposed MCRP, of which, nine (9) are located in Bulacan and two (2) are located in Pampanga (**Table 3.4.42**).

Table 3.4.42 Bridges that will be Traversed/Crossed by the Proposed MCRP

Bridge No.	Bridge ID	Bridge Name	Bridge Type		Overall Condition	Length (m)
Bulacan First District						
6	B00019LZ	Labangan Br. 1	Permanent	Concrete	Fair	101.10
8	B00148LZ	Labangan Br. 7	Permanent	Concrete	Good	127.20
46	B04341LZ	Bulihan Br.	Permanent	Concrete	Good	13.10
50	B04614LZ	Calumpit Br.	Permanent	Concrete	Good	180.42
55	B04708LZ	Labangan Br. 2	Permanent	Concrete	Good	17.42
56	B04709LZ	Labangan Br. 3	Permanent	Concrete	Good	27.09
57	B04710LZ	Labangan Br. 4	Permanent	Concrete	Good	16.92
58	B04711LZ	Labangan Br. 5	Permanent	Concrete	Good	26.60
59	B04712LZ	Labangan Br. 6	Permanent	Concrete	Good	27.01
Pampanga First District						
5	B01154LZ	San Fernando Flyover (East Bound)	Permanent	Steel	Good	208.00
23	B01470LZ	RR Crossing Br.	Permanent	Concrete	Good	23.35

Notes: Source: 2017 DPWH ATLAS

1.) Bridge data provided are as of 20 November 2017.

2.) The unit of measure for Bridge Data is linear meters.

3.) Further Assessment refers to Bridges that are either under the circumstances of on-going construction, under major maintenance work or washed-out.
4.) Permanent Bridges - are bridges that are composed of concrete and steel.

3.4.8.2 Access Points that may be blocked by the Proposed MCRP

1278. **Table 3.4.43** summarizes the access points which may be blocked by the proposed MCRP. Among the information indicated in Table 3.4.43, (a) G. Valdez Street and P. Villanueva Street and (b) Santo Entierro Street in Angeles need to be considered. The LGU of Angeles in particular cited that the 30m ROW should consider access either through G. Valdez Street or P. Villanueva Street near the proposed station location.

Table 3.4.43 Access Roads that intersect with the Proposed MCRP

No.	Station	LGU	Access Roads that may be Blocked
	Malolos[1]	Malolos	Access to Royal Estate Road (towards Royal Estate Subdivision)
			Unnamed road near Malang Creek (access to MacArthur Village)
1	Calumpit	Calumpit	Unnamed road near Green Plains Subdivision
			Private road near Pio Cruzcosa Purok 5 (77 Inn)
			Private road (Access to Calumpit Warehouse in Pio Cruzcosa)
			Unnamed road (Access to Villa de Calumpit Resort)
			Unnamed road (near San Marcos River)
			Unnamed road (near Irrigation Canal, access to Calumpit National High School)
			Unnamed road near United Pulp and Paper Co., Inc.
			Unnamed road near Galaxi Petroleum
			Unnamed road (after Bagbag River)
			Unnamed road (Access to Calumpit College)
			Gugo Iba O' Este Road
			Unnamed road (Road across Calumpit Public Market)
			Provincial Road
			Unnamed Road near Rio Grande River
			Unnamed road (Access to The Grove and Frances National High School)
2	Apalit	Apalit	Unnamed Road (near Apalit River)
			Macabebe-Calumpit –Apalit Road
			Unnamed road near proposed Apalit Station
			Apalit-Macabebe-Masantol Road
		Minalin	Unnamed road near Lourdes Creek
3	San Fernando	Santo Tomas	Municipal Road
			Balut Street (near Bondoc Ville Resettlement Site)
			San Pedro Road
			Access to Sampaguita Street
		San Fernando	Unnamed road near Ang Dating Daan Church
			Unnamed road near New Santa Lucia Parish
			Capitol Boulevard
			Unnamed road near Old PNR San Fernando Station
			Unnamed road
			Jose Abad Santos Avenue
			De Leon Street
			Santan Street
			Lazatin Boulevard
			Unnamed road near M.F. Reyes Realty
			Barangay San Agustin Road
			Unnamed road near Quebiawan Elementary School
			San Miguel Main Entry Road
			Unnamed road near DTI - Region 3 Office
			Sindalan Tourism Road
			Barangay del Rosario Road
			Road leading to Sindalan Barangay Hall
			Barrio road near Christian Church Fellowship
			Road near Fortuneville Phase 1 and 2
4	Angeles	Angeles	Pablo Torres Street
			Manila North Road (near House of Many Mansions)
			Road near Angeles Public School Teachers Credit
			Santo Entierro Street
			Kuliat Street

No.	Station	LGU	Access Roads that may be Blocked
			Evangelista Street
			Sta. Lucia Street
			P. Hizon Street
			L. Lajera Street
			Plaridel Street
			Glaciano Valdez Street (G. Valdez Street)
			Mesina Street
			F. Balagtas Street
			C. Dayrit Street
			P. Villanueva Street
			Rizal Street
			P. de Guzman Street
			Jake Gonzales Boulevard
			Arayat Road
			Westways Avenue
			Fields Avenue
5	Clark	Mabalacat	1st Street
6	CIA		
7	NCC	Bamban	
		Capas	

Source: JICA Study Team

3.4.9 Perception Survey

1279. The perception survey was conducted for the host and affected barangays of the proposed MCRP from February 6 to March 30, 2018. The survey covers the demographic characteristics, the source of income, health and the knowledge and attitude towards the proposed MCRP. The respondents of the survey were represented the barangay council, multi-sectoral representatives (women representatives, men group representative, senior citizen, church group representative) and other authority figures of the community.

3.4.9.1 Respondents' Profile

1280. More than half (52.19%) of the respondents are male while 47.81% are female (**Table 3.4.44**). Malolos and Calumpit have more male than female respondents, while Apalit, Minalin, San Fernando and Bamban have more female respondents. Angeles, Mabalacat, Sto. Tomas and Capas have equal male-female respondents ratio.

Table 3.4.44 Total Number of Respondents

Sex	Malolos		Calumpit		Apalit		Minalin		Sto. Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Male	26	38	41	31	21	72	38	55	38	55	79	57	28	48	35	61	55	71	45	56	406	52.19
Female	43	62	90	69	8	28	31	45	31	45	59	43	30	52	22	39	22	29	36	44	372	47.81
Total	69	100	131	100	29	100	69	100	69	100	138	100	58	100	57	100	77	100	81	100	778	100.00

1281. Majority of the respondents (66.07%) were born in the barangay where they currently reside, while a notable number of respondents came from other municipalities/cities and/or provinces (23.65%) (**Table 3.4.45**).

Table 3.4.45 Place of Birth of the Respondents

Place of Birth	Malolos		Calum-pit		Apalit		Minalin		Sto. Tomas		San Fernando		Angeles		Mabala-cat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
In this Barangay	42	61	80	61	24	83	52	75	45	65	87	63	43	74	42	74	52	68	47	58	514	66.07
Other Barangay	9	13	10	8	1	3	6	9	5	7	17	12	2	3	6	11	9	12	15	19	80	10.28
Other Municipality/City	11	16	23	18	1	3	6	9	14	20	14	10	3	5	1	2	8	10	10	12	91	11.70

Place of Birth	Malolos		Calum-pit		Apalit		Minalin		Sto. Tomas		San Fernando		Angeles		Mabala-cat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Other Province	7	10	18	14	3	10	5	7	5	7	20	14	10	17	8	14	8	10	9	11	93	11.95

1282. **Table 3.4.46** shows that 27.25% of the respondents were in the 41-50 years old, and respondents within working age bracket account for a little over 31.49% of the total.

Table 3.4.46 Age of the Respondents

Age	Malolos		Calumpit		Apalit		Minalin		Sto.Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
15-20	2	3	3	2	1	3	1	1	0	0	3	2	1	2	3	5	2	3	8	10	24	3.08
21-30	8	12	12	9	1	3	3	4	7	10	20	14	11	19	3	5	8	10	10	12	83	10.67
31-40	23	33	14	11	2	7	16	23	21	30	31	22	12	21	14	25	18	23	11	14	162	20.82
41-50	16	23	41	31	10	34	20	29	17	25	43	31	15	26	16	28	19	25	15	19	212	27.25
51-60	14	20	33	25	9	31	19	28	12	17	24	17	10	17	14	25	21	27	22	27	178	22.88
61-70	6	9	24	18	5	17	10	14	10	14	16	12	9	16	6	11	9	12	12	15	107	13.75
71<	0	0	4	3	1	3	0	0	2	3	1	1	0	0	1	2	0	0	3	4	12	1.54

1283. Most of the respondents (64.52%) areKapampangan (Table 3.4.47).

Table 3.4.47. Ethinicity of the Respondents

Ethnicity	Malolos		Calumpit		Apalit		Minalin		Sto.Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Tagalog	64	93	123	94	1	3	4	6	12	17	12	9	3	5	16	28	7	9	5	6	247	31.75
Ilokano	3	4	0	0	0	0	0	0	3	4	0	0	2	3	0	0	0	0	0	0	8	1.03
Kapangpangan	1	1	5	4	28	97	61	88	54	78	114	83	52	90	41	72	70	91	76	94	502	64.52
Others	1	1	3	2	0	0	4	6	0	0	12	9	1	2	0	0	0	0	0	0	21	2.70

1284. The respondents are mostly Roman Catholic, 91.90%, while only a few are either ProteNo.ant, Aglipayan or INC (**Table 3.4.48**).

Table 3.4.48 Religion of the Respondents

Religion	Malolos		Calumpit		Apalit		Minalin		Sto.Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO	%
Catholic	64	93	125	95	28	97	60	87	66	96	133	96	55	95	54	95	66	86	64	79	715	91.90
Protestant	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	0.39
Aglipayan	0	0	0	0	0	0	4	6	0	0	0	0	0	0	0	0	0	0	0	0	4	0.51
INC	0	0	0	0	0	0	0	0	1	1	3	2	1	2	0	0	7	9	11	14	23	2.96
Others	5	7	4	3	1	3	5	7	2	3	2	1	2	3	3	5	4	5	5	6	33	4.24

1285. Most of the respondents had formal education they acquired from community schools, and majority (38.17%) of them attended high school. This is higher than those who attended college with 37.92%. Comprising 14.14% of the total respondents, some were able to attend technical-vocational courses (**Table 3.4.49**).

Table 3.4.49 Respondents' Level of Education

HigheNo. Level of Education	Malolos		Calumpit		Apalit		Minalin		Sto.Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
None	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	2	0.26
Elementary	6	9	15	11	6	21	11	16	5	7	7	5	5	9	2	4	8	10	9	11	74	9.51
High School	23	33	50	38	11	38	24	35	26	38	72	52	22	38	14	25	32	42	23	28	297	38.17
Vocational	16	23	19	15	3	10	10	14	9	13	12	9	9	16	14	25	9	12	9	11	110	14.14
College	24	35	47	36	9	31	23	33	29	42	47	34	22	38	27	47	28	36	39	48	295	37.92
Total	69	100	131	100	29	100	69	100	69	100	138	100	58	100	57	100	77	100	81	100	778	100.00

1286. About 68.64% of the respondents confirmed that they are married, while 20.82% are single. The remaining percentage is shared by those who are widowed and separated. This only shows that marriage remains an important social institution in the municipalities surveyed (**Table 3.4.50**).

Table 3.4.50 Civil Status of the Respondents

Civil No.atus	Malolos		Calumpit		Apalit		Minalin		Sto Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Single	22	32	18	14	6	21	15	22	7	10	31	22	15	26	20	35	7	9	21	26	162	20.82
Married	39	57	89	68	15	52	43	62	55	80	102	74	38	66	34	60	64	83	55	68	534	68.64
Widow	4	6	19	15	5	17	8	12	4	6	3	2	3	5	1	2	3	4	4	5	54	6.94
Separated	4	6	5	4	3	10	3	4	3	4	2	1	2	3	2	4	3	4	1	1	28	3.60
Total	69	100	131	100	29	100	69	100	69	100	138	100	58	100	57	100	77	100	81	100	69	100

1287. **Table 3.4.51** below shows that majority (49.23%) of the respondents have 1 to 3 children.

Table 3.4.51 Number of Children of the Respondents

Number of Children	Malolos		Calumpit		Apalit		Minalin		Sto Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
None	22	32	24	18	7	24	21	30	10	14	29	21	9	16	21	37	9	12	23	28	175	22.49
1 to 3	38	55	73	56	14	48	27	39	38	55	66	48	34	59	19	33	40	52	34	42	383	49.23
4 to 6	9	13	28	21	7	24	17	25	19	28	40	29	9	16	15	26	24	31	21	26	189	24.29
7 to 10	0	0	6	5	1	3	3	4	1	1	3	2	1	2	2	4	3	4	3	4	23	2.96
10-above	0	0	0	0	0	0	1	1	1	1	0	0	5	9	0	0	1	1	0	0	8	1.03
Total	69	100	131	100	29	100	69	100	69	100	138	100	58	100	57	100	77	100	81	100	778	100.00

1288. **Table 3.4.52** shows that 19.82% of the respondents have been residents of their respective municipalities for 41 to 50 years.

Table 3.4.52 Years of Residency of the Respondents

Years of Residency	Malolos		Calumpit		Apalit		Minalin		Sto.Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
1-10	5	7	12	9	2	7	5	7	2	3	8	6	3	5	6	11	2	3	7	9	52	6.69
11-20	19	28	8	6	1	3	8	12	4	6	14	10	4	7	4	7	5	7	11	14	78	10.04
21-30	8	12	21	16	3	10	10	14	14	20	28	20	8	14	13	23	18	24	22	27	145	18.66
31-40	16	23	19	15	4	14	10	14	21	30	30	22	14	24	11	19	14	18	7	9	146	18.79
41-50	7	10	29	22	10	34	16	23	13	19	20	14	13	22	8	14	25	33	13	16	154	19.82
51-60	8	12	24	18	5	17	8	12	9	13	24	17	6	10	9	16	8	11	13	16	114	14.67
61-Above	6	9	18	14	4	14	12	17	6	9	14	10	10	17	6	11	4	5	8	10	88	11.33
Total	69	100	131	100	29	100	69	100	69	100	138	100	58	100	57	100	76	100	81	100	777	100.00

1289. **Table 3.4.53** shows that majority (52.95%) of the respondents belong to traditional families where husbands are the primary providers of income, which 54.21% are earning from their regular salaried jobs. Most of the respondents 31.75% earn P5,000 - 9,999 in a month, near to or lower than the minimum wage rate of approximately P11,300.

Table 3.4.53 Household Employment and Income

Particular	Malolos		Calumpit		Apalit		Minalin		Sto. Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Provider in the Family																						
Husband	37	54	82	51	21	57	39	45	40	52	83	58	40	45	36	57	61	59	55	52	494	52.95
Wife	16	23	33	20	8	22	18	21	18	23	26	18	21	24	14	22	34	33	27	25	215	23.04
Son	9	13	23	14	5	14	18	21	7	9	19	13	13	15	6	10	5	5	13	12	118	12.65
Daughter	7	10	23	14	3	8	11	13	12	16	14	10	14	16	7	11	4	4	11	10	106	11.36
Total	69	100	161	100	37	100	86	100	77	100	142	100	88	100	63	100	104	100	106	100	933	100.00
Source of Income																						

Particular	Malolos		Calumpit		Apalit		Minalin		Sto. Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Salary	38	55	57	44	26	90	39	57	46	67	76	55	35	51	46	81	26	31	42	52	431	54.21
Contractual Job	2	3	3	2	0	0	12	17	4	6	13	9	5	7	2	4	19	23	12	15	72	9.06
Farming	2	3	5	4	0	0	2	3	0	0	0	0	0	0	0	0	2	2	12	15	23	2.89
Selling	18	26	15	11	0	0	7	10	10	14	24	17	20	29	5	9	16	19	5	6	120	15.09
Others	9	13	51	39	3	10	9	13	9	13	25	18	8	12	4	7	21	25	10	12	149	18.74
Total	69	100	131	100	29	100	69	100	69	100	138	100	68	100	57	100	84	100	81	100	795	100.00
Earning in a month																						
Less than 1,000	5	7	10	8	0	0	4	6	1	1	5	4	8	14	0	0	6	8	5	6	44	5.66
P1,000 - 4,999	24	35	18	14	8	28	19	28	8	12	40	29	11	19	2	4	14	18	20	25	164	21.08
P5,000 - 9,999	17	25	48	37	6	21	19	28	22	32	58	42	17	29	20	35	27	35	13	16	247	31.75
P10,000 - 14,999	14	20	30	23	3	10	17	25	21	30	24	17	7	12	16	28	16	21	25	31	173	22.24
P15,000 - 20,000	7	10	17	13	3	10	3	4	7	10	7	5	12	21	13	23	8	10	8	10	85	10.93
More than 20,000	2	3	8	6	9	31	7	10	10	14	4	3	3	5	6	11	6	8	10	12	65	8.35
Total	69	100	131	100	29	100	69	100	69	100	138	100	58	100	57	100	77	100	81	100	778	100.00

1290. **Table 3.4.54** shows that with regards problems in the community, wastes (23.08%), poor public service (10.46%) are the most common concerns among respondents, while sentiment on traffic congestion and flood are next to the rank. While the possible solutions of the 26.25% of the respondents is to implement

Table 3.4.54 Existing Problems and Possible Solutions of the Respondents in their Community

Particular	Malolos		Calumpit		Apalit		Minalin		Sto. Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Problem in the Community																						
Traffic congestion	1	0	5	3	3	8	3	4	0	0	22	13	9	9	5	0	4	0	4	5	56	5.80
Drugs	1	1	6	4	10	28	6	8	1	1	7	4	6	6	16	28	18	17	1	1	72	7.45
Fire	0	0	0	0	0	0	0	0	10	13	3	2	0	0	0	0	13	13	0	0	26	2.69
WaNo.es	14	16	46	27	0	0	16	22	14	18	62	37	21	20	15	26	0	0	35	41	223	23.08
Flood	0	0	30	18	1	3	5	7	8	10	10	6	5	5	2	4	35	34	3	3	99	10.25
Lack of street lights	0	0	1	1	0	0	5	7	0	0	0	0	0	0	1	2	0	0	0	0	7	0.72
Public Service	29	34	26	15	0	0	8	11	5	0	0	0	25	24	0	0	8	8	0	0	101	10.46
Drainage	0	0	5	0	0	0	5	0	22	28	14	0	6	6	8	14	11	11	0	0	71	7.35
Lack of Livelihood	0	0	14	8	0	0	5	7	0	0	12	7	1	1	2	4	0	0	10	12	44	4.55
No permanent homes	0	0	0	0	0	0	0	0	4	5	2	1	6	6	0	0	0	0	0	0	12	1.24
Lack of housing program	19	22	7	4	0	0	1	1	3	4	0	0	10	10	2	4	0	0	3	3	45	4.66
Stubborn Citizens	7	8	11	7	13	36	7	9	8	10	28	17	6	6	1	2	0	0	6	7	87	9.01
Lack of education	1	1	0	0	0	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	6	0.62
Pollution	14	16	5	0	0	0	0	0	0	0	5	0	3	3	2	4	0	0	1	1	30	3.11
Poverty	0	0	13	8	9	25	13	18	5	6	4	2	2	2	3	5	15	15	23	27	87	9.01
Total	86	99	169	94	36	100	74	93	80	94	169	89	105	100	57	91	104	97	86	100	966	100.00
Possible solutions to the problem in the community																						
Smooth Traffic flow	5	6	5	3	3	8	4	6	4	5	18	10	33	33	2	0	17	18	1	1	92	9.78
road widening	1	1	0	0	0	0	2	3	7	9	6	0	8	8	13	23	31	33	3	4	71	7.55
"tokhang"	0	0	1	1	0	0	2	3	1	1	0	0	2	2	13	23	13	14	0	0	32	3.40
Daily collection of wastes/garbage	11	13	69	45	1	3	20	28	24	30	69	38	12	12	11	19	6	0	24	30	247	26.25
rehabilitation program	1	1	4	3	10	27	2	3	3	4	9	5	11	11	0	0	9	10	6	7	55	5.84
Street Lights	26	30	0	0	0	0	2	3	10	13	0	0	17	17	2	4	8	9	0	0	65	6.91
Housing Program	10	12	0	0	0	0	2	3	2	3	7	4	2	2	4	7	4	4	3	4	34	3.61
proper drainage system	14	16	32	21	1	3	6	8	13	16	21	12	0	0	5	9	3	3	0	0	95	10.10
Enhanced employement	1	0	10	6	9	24	13	18	7	9	10	6	2	0	1	2	2	2	29	36	84	8.93
Implement curfew hours	16	19	0	0	0	0	5	7	0	0	0	0	3	3	0	0	1	1	2	0	27	2.87

Particular	Malolos		Calumpit		Apalit		Minalin		Sto. Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Strict implementation of laws	1	1	31	20	13	35	7	10	3	4	31	17	9	9	4	7	0	0	9	11	108	11.48
Housing Program	0	0	0	0	0	0	0	0	3	4	0	0	0	0	2	4	0	0	2	2	7	0.74
Enhanced livelihood opportunities	0	0	3	2	0	0	6	0	3	0	10	0	0	0	0	0	0	0	2	2	24	2.55
Total	86	99	155	100	37	100	71	92	80	96	181	91	99	98	57	96	94	94	81	98	941	100.00

1291. **Table 3.4.55** shows that the majority either own (58.23%) or rents (15.94%) the property where they reside.

Table 3.4.55 Land Ownership of the Respondents

Land Ownership	Malolos		Calumpit		Apalit		Minalin		Sto. Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Owner	52	75	39	30	28	97	44	64	47	68	104	75	40	69	37	65	43	56	19	0	453	58.23
Tenant	7	10	30	23	0	0	11	16	1	1	5	4	2	3	14	25	1	1	53	65	124	15.94
Renting	6	9	42	32	0	0	11	16	13	19	11	8	7	12	2	4	3	4	0	0	95	12.21
Others	4	6	20	15	1	3	3	4	8	12	18	13	9	16	4	7	30	39	9	11	106	13.62
Total	69	100	131	100	29	100	69	100	69	100	138	100	58	100	57	100	77	100	81	77	778	100.00

1292. **Table 3.4.56** shows that the majority (47.56%) of the respondents do not cultivate crops, and the rest cultivates common crops such as vegetables and sweet potato. Rice is still cultivated but owing to the urban environment of the impact areas, the percentages are low.

Table 3.4.56 Cultivated Crops of the Respondents

Crops	Malolos		Calumpit		Apalit		Minalin		Sto.Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Rice Plant	3	4	40	26	1	3	2	2	5	7	2	1	4	7	0	0	11	9	0	0	68	7.72
Corn	2	3	21	14	0	0	0	0	2	3	0	0	0	0	13	21	13	10	22	25	73	8.29
Vegetables	11	16	7	5	1	3	17	20	9	13	3	2	1	2	0	0	11	9	1	1	61	6.92
Banana	1	1	28	18	0	0	7	8	5	7	3	2	3	5	0	0	13	10	22	25	82	9.31
Sweet potato	0	0	30	20	0	0	7	8	3	4	3	2	9	15	4	6	6	5	3	3	65	7.38
Others	7	10	0	0	0	0	11	13	9	13	7	5	6	10	39	62	30	24	4	5	113	12.83
None	45	65	26	17	27	93	40	48	36	52	126	88	36	61	7	11	41	33	35	40	419	47.56
Total	69	100	152	100	29	100	84	100	69	100	144	100	59	100	63	100	125	100	87	100	881	100.00

1293. Majority (42.69%) of the respondents have been ill at leaNo. one (1) time in the last year (**Table 3.4.57**).

Table 3.4.57 Frequency of Being Sick in the PaNo. Year

Frequency of Being Sick in the PaNo. Year	Malolos		Calumpit		Apalit		Minalin		Sto.Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
1	26	36	56	43	15	52	29	42	29	42	67	49	23	40	22	35	30	39	39	48	336	42.69
2	21	29	36	27	6	21	23	33	21	30	35	25	11	19	22	35	19	25	24	30	218	27.70
3	10	14	22	17	6	21	9	13	15	22	26	19	9	16	9	14	6	8	10	12	122	15.50
4	2	3	8	6	2	7	6	9	1	0	7	5	11	19	9	14	8	10	7	9	61	7.75
5	5	7	3	2	0	0	1	1	1	1	1	1	0	0	1	2	6	0	0	0	18	2.29
6 or more	8	160	6	5	0	0	1	1	2	3	2	1	4	7	0	0	8	10	1	1	32	4.07
Total	72	249	131	100	29	100	69	100	69	99	138	100	58	100	63	100	77	92	81	100	787	100.00

1294. **Table 3.4.58** shows that fever is the common (36.66%) cause of illness among the respondents, followed by upper respiratory diseases (26.28%). Among the PAFs, 31.72% of the respondents get medical treatment in the hospital, slightly more than those that get treatment at barangay health centers (28.30%). A significant percentage also opts for treatment at private clinics (28.30%), while a few No.ill gets treated by herbaliNo.s, or simply at home (self-treatment).

Table 3.4.58 Health Situation of the Respondents

Particular	Malolos		Calumpit		Apalit		Minalin		Sto. Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Kind of illness																						
Diarrhea	21	20	37	20	13	41	19	24	18	24	44	24	11	15	19	29	16	15	23	23	221	21.84
Upper Respiratory	34	33	43	23	4	13	24	30	20	26	49	26	23	31	11	17	31	28	27	28	266	26.28
Fever	43	42	72	38	8	25	24	30	24	32	55	30	27	36	28	42	48	44	42	43	371	36.66
Others	5	5	36	19	7	22	13	16	14	18	37	20	14	19	8	12	14	13	6	6	154	15.22
Total	103	100	188	100	32	100	80	100	76	100	185	100	75	100	66	100	109	100	98	100	1012	100.00
Place where they are treated																						
House	17	19	10	6	7	23	20	27	13	16	46	25	15	26	13	21	11	13	25	28	177	19.49
Health center	32	36	45	29	4	13	18	25	22	27	56	31	13	22	16	26	25	29	26	29	257	28.30
Barangay Health Worker	2	2	2	1	6	20	1	1	5	6	11	6	2	3	5	8	1	1	1	1	36	3.96
Private clinic	13	15	35	23	3	10	11	15	16	20	18	10	10	17	9	15	12	14	12	13	139	15.31
HerbaliNo.	0	0	6	4	0	0	0	0	1	1	0	0	0	0	1	2	2	2	1	1	11	1.21
Hospital	24	27	57	37	10	33	23	32	25	30	52	28	18	31	18	29	36	41	25	28	288	31.72
Total	88	100	155	100	30	100	73	100	82	100	183	100	58	100	62	100	87	100	90	100	908	100.00

1295. **Table 3.4.59** shows that most respondents rely on community water system for their drinking water supply (63.37%) and for their household chores like laundry and washing (63.24%).

Table 3.4.59 Sources of Water for Drinking and Household Chores

Particular	Malolos		Calumpit		Apalit		Minalin		Sto.Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Source of drinking water																						
Spring	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	8	10	1	1	13	1.67
Deep well	1	1	3	2	0	0	10	14	6	9	7	5	3	5	0	0	25	32	22	27	77	9.90
River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	2	0.26
Water system	56	81	93	71	25	86	44	64	48	70	72	52	51	88	53	93	28	36	23	28	493	63.37
Others	11	16	34	26	4	14	15	22	14	20	58	42	4	7	4	7	14	18	35	43	193	24.81
Total	69	100	131	100	29	100	69	100	69	100	138	100	58	100	57	100	77	100	81	100	778	100.00
Water source for household chores																						
Spring	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	9	12	0	0	11	1.41
Deep well	5	7	1	1	0	0	15	22	8	12	19	14	2	3	0	0	25	32	30	37	105	13.50
River	39	57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	5.01
Water system	15	22	106	81	29	100	45	65	48	70	76	55	49	84	51	89	41	53	32	40	492	63.24
Others	10	14	23	18	0	0	9	13	12	17	43	31	7	12	6	11	2	3	19	23	131	16.84
Total	69	100	131	100	29	100	69	100	69	100	138	100	58	100	57	100	77	100	81	100	778	100.00

1296. **Table 3.4.60** shows that respondents (50.77%) use either water-sealed sanitary toilet facilities, and 46.66 % use either flush, the rest are either utilizing hole on the ground.

Table 3.4.60 Toilet Facility of the Respondents

Toilet Facility	Malolos		Calumpit		Apalit		Minalin		Sto.Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
None	15	22	1	1	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	17	2.19
Flush	40	58	52	40	15	52	27	39	34	49	64	46	29	50	36	63	35	45	31	38	363	46.66
Water sealed	14	20	78	60	14	48	41	59	35	51	74	54	29	50	19	33	42	55	49	60	395	50.77
House hole on the ground	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0.13
Hole on the ground	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	1	1	2	0.26
Anywhere	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Total	69	100	131	100	29	100	69	100	69	100	138	100	58	100	57	100	77	100	81	100	778	100.00

3.4.9.2 Perception Survey Results

1297. Majority (85.07%) of the respondents are aware of the project through various means. About 60.80% of the respondents were made aware of the project through information disseminated in the barangays (**Table 3.4.61**). Majority (85.60%) of the respondents were in favor of the proposed project. Most respondents from Malolos, Calumpit and Apalit were in favor of the project.

Table 3.4.61 Awareness and Acceptance of the Respondents to the Proposed MCRP

Particulars	Malolos		Calumpit		Apalit		Minalin		Sto.Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Awareness on the Project																						
Yes	60	87	118	90	29	100	57	83	59	86	118	86	54	93	50	89	61	79	55	68	661	85.07
No	9	13	13	10	0	0	12	17	10	14	20	14	4	7	6	11	16	21	26	32	116	14.93
Total	69	100	131	100	29	100	69	100	69	100	138	100	58	100	56	100	77	100	81	100	777	100.00
Source of Information																						
Neighbor	1	1	10	8	0	0	16	23	11	16	13	9	3	5	0	0	4	5	0	0	58	7.46
Barangay	42	61	64	49	15	52	35	51	41	59	117	85	27	47	47	82	36	47	49	60	473	60.80
Other person	14	20	12	9	2	7	8	12	4	6	3	2	5	9	0	0	6	8	19	23	73	9.38
IEC/Public Scoping	12	17	45	34	12	41	10	14	13	19	5	4	23	40	10	18	31	40	13	16	174	22.37
Total	69	100	131	100	29	100	69	100	69	100	138	100	58	100	57	100	77	100	81	100	778	100.00
Acceptance of the Proposed Project																						
Yes	66	96	123	94	27	93	61	88	59	86	123	89	46	79	37	65	66	86	58	72	666	85.60
No	3	4	8	6	2	7	8	12	10	14	15	11	12	21	20	35	11	14	23	28	112	14.40
Total	69	100	131	100	29	100	69	100	69	100	138	100	58	100	57	100	77	100	81	100	778	100.00

1298. **Table 3.4.62** shows that 36.61% of the respondents were anticipating that the project will provide a much faster commute from Malolos to Clark, and 34.40% believes the project will result to less traffic congestion. About 44.27% of the respondents were concerned that the project will demolish the houses near the railway. The largest percentage came from Sto.Tomas with 67% of the respondents expressing concern over the impact of the project on the settlers near the railway.

Table 3.4.62 Possible Impacts of the Project Listed by the Respondents

Particulars	Malolos		Calumpit		Apalit		Minalin		Sto. Tomas		San Fernando		Angeles		Mabalacat		Bamban		Capas		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Benefits of the Project																						
Express transport from Malolos to Clark	45	41	81	32	25	35	41	43	38	40	86	37	43	43	21	30	53	31	47	41	480	36.61
Less traffic congestion	36	32	86	34	26	37	31	32	35	37	85	37	29	29	29	41	57	33	37	32	451	34.40
Less air pollution and noise from the vehicles	24	22	62	25	16	23	18	19	16	17	58	25	19	19	19	27	55	32	27	24	314	23.95
Others	6	5	21	8	4	6	6	6	5	5	1	0	10	10	2	3	8	5	3	3	66	5.03
Total	111	100	250	100	71	100	96	100	94	100	230	100	101	100	71	100	173	100	114	100	1311	100.00
Negative Impacts of the Project																						
Demolition of houses near the railway	49	49	91	42	26	39	36	44	54	67	95	48	37	42	28	44	51	34	47	41	514	44.27
Closure of the roads that traverse the railway	29	29	57	27	21	32	22	27	16	20	60	30	22	25	16	25	57	38	37	32	337	29.03
Noise during construction	23	23	44	20	18	27	19	23	9	11	43	22	25	28	14	22	34	23	27	24	256	22.05
Others	0	0	23	11	1	2	5	6	2	2	1	1	5	6	5	8	9	6	3	3	54	4.65
Total	101	100	215	100	66	100	82	100	81	100	199	100	89	100	63	100	151	100	114	100	1161	100.00

3.4.10 Impact Identification, Prediction, Assessment and mitigation

(1) Pre-Construction and Construction Phase

1) Displacement of Settlers

Displacement/Disturbance of Properties

1299. One of the significant impacts of the MCRP is the displacement/disturbance of properties. Based on the on going census, tagging and socio-economic survey conducted by the RAP Team from Malolos – Clark within the PNR ROW, a total of 1,329 households will be displaced. During the planning stage, one of the main factors considered in the proposed MCRP is the avoidance of residential, commercial and productive agricultural areas. DOTr will maximize the use of the existing PNR ROW from Malolos to a segment in Mabalacat. The segment in Mabalacat to Capas will be located outside the existing PNR ROW to avoid the heavily built-up areas along the existing PNR ROW maximizing the use of BCDA property. However, additional land will be acquired for the additional land requirement of the proposed stations, areas short of PNR ROW width, area with curved alignment, etc.

1300. Though the alignment will maximize the use of PNR ROW and BCDA property to minimize land acquisition, it has been however proliferated by ISFs disregarding the hazard of living along the PNR ROW. Moreover, with the acquisition of additional land for the project ROW for sections such as the proposed stations and curved alignment, displacement of households, businesses and commercial establishments, and displacement from the source of livelihood are unavoidable. Given that the alignment from CIA to NCC is being finalized, surveys for the said portion have not been conducted.

1301. Social Development Plan (SDP) Framework presented in Chapter 6 of this report will address, among others, the displacements involving resettlement of the PAFs. Specific details will be explained in the RAP for the MCRP, which is a separate document. RAP is being prepared to ensure that affected households and establishments will be provided with an acceptable relocation area and/or just compensation. The measures of compensation and assistance to all PAFs in the RAP will be based on the JICA Guidelines for Environmental and Social Considerations (2010) and Asian Development Bank (ADB) Safeguard Policy Statement (2009), the Republic Act No. 10752, and other applicable Philippine Laws and Regulations. Compensation will be paid in full prior to any displacement activity. Internal and external monitoring of RAP activities will be conducted in accordance with ADB and JICA guidelines.

1302. Relocation sites will be secured/developed prior to displacement in coordination with LGUs, NHA and other key shelter agencies with basic utilities such as power and water and health and educational facilities. A noted positive impact of the project is that the affected families (i.e. informal settler families) may eventually be provided with secure tenure through housing units with basic amenities.

1303. Livelihood of the local community from commercial establishments, small vendors, and farmers may experience temporary disturbance during construction. The project may also lead to a decline or eventual loss of business in affected areas. In consideration of affected groups, construction activities will be undertaken at the shortest possible time to restore normal business operations immediately. Alternative livelihood programs in coordination with the LGUs and other government agencies will also be taken in to consideration. For business establishments that will be permanently removed, compensation measures will be provided to ensure continued economic activity and/or the restoration and/or improvement of livelihood.

Impact on Privately-owned Land

1304. In the Project ROW outside the PNR ROW in certain segments of the alignment, some private landowners will be affected. One of the initially identified landowners is BCDA and owners of other private lands that will be traversed by the MCRP are yet being identified. Thus, DOTr will coordinate with the BCDA, LGUs, lot owners and other concerned stakeholders in acquiring the land and/or securing ROW.

1305. Land acquisition will also be addressed in the RAP, in accordance with ADB and JICA Guidelines and applicable Philippine Laws and Regulations. DOTr will coordinate with DPWH for the use of a portion of the BCDA for the alignment and depot that will be located within the bank protection wall.

1306. There will be provision for external and internal monitoring agencies to ensure that the displacement activities are conducted in compliance to the RAP. The agencies being referred to may include LGUs, concerned NGOs, academe, EMB DENR and other relevant government agencies. The internal and external monitoring indicators shall be as follows:

- For Internal Monitoring
    - Budget and timeframe
    - Delivery of Compensation and Entitlements
    - Public Participation and Consultation
    - Benefit monitoring
- For External Monitoring
    - Basic information on PAP households
    - Restoration of living standards
    - Restoration of Livelihoods
    - Levels of PAP Satisfaction
    - Effectiveness of Resettlement Planning
    - Other Impacts

Change/Conflict on Right of Way and Impact on Public Access

1307. Among the immediate impacts identified, is the blocking of access roads of the PAFs, as well as possible disruption of school activities of students (in case relocation would be conducted during the school year), pose major concerns during the construction phase.

1308. The project will study the current use of public access in local affected communities and mitigate the closure of existing access as much as possible. If any diversion will be required, the project affected communities and LGUs will be well informed on the project activities including constructions schedule and possible impact to the exiting public access (pedestrian, cyclist and vehicles). The RAP to be prepared will also include recommendations on coordination with the DepEd and the host LGUs for the schedule of construction activities to ensure that the transition and adjustment of PAFs would have minimal disruptions and would ensure that the PAFs' conditions would be maintained, if not improved.

1309. During the construction, diversion roads and alternative access routes will be provided with appropriate protection measures, which will minimize the disruption of dailylife of local communites. Traffic aides are also assigned on site to guide road users ensuring their safety and to monitor the site condition. Diversion access are likely to change as the construction progresses. The contractor will keep the public informed on any changes in diversion route through notices, posters, signage, consultations, etc.

Vulnerable Groups: People under poverty line, solo parents, women, children, elderly and persons with disabilities

1310. Under the RAP, Gender Impact Assessment has been conducted, with reports indicating a lack of awareness on the issue of gender and vulnerable groups among the infrastructure projects. The results likewise indicate that some gender and development (GAD) activities are not related to gender, thus not addressing the needs of the PAPs. Some identified issues among LGUs include: (1) lack of specialized gender-sensitive facilities and furnishings, (2) poor access of solo parents to employment and other livelihood opportunities, and (3) improved access to safe and potable water supply among indigenous communities, among others. In addition, the absence of a GAD database sets limitations on the capacity of LGUs to plan for their needs.

Vulnerable Persons such as solo parents elderly, persons with disabilities, and those living below the poverty line will also benefit from the Livelihood and Income Restoration Program (**LIRP**), which specific details will be explained in the RAP for the Project. The LIRP does not guarantee that there will be no adverse economic impact to PAFs. However, it was designed to (i) minimize the effects of displacement and (ii) help the PAFs immediately restore their living condition to pre-project condition. Some of the mechanisms that will be put in place to ensure that the PAFs will benefit, especially the vulnerable groups, are as follows:

1. Resettlement sites will be developed through people's plan approach. People's Plan is an alternative shelter planning approach that demonstrates the consultative and participatory principle of development planning enshrined in the Urban Development and Housing Act of 1992. It is an option that seeks to address the need for in-city, near-city (or off-city) relocation wherein PAFs, through community associations, are given the opportunity to identify, plan and manage the construction of their own relocation sites. This will hopefully fill the gaps of affordability, sustainability and other resettlement issues.
2. PAFs will be organized into community associations which will be assisted by mobilizers selected by the Social Housing Finance Corporation (SHFC). These mobilizers are non-government organizations (NGOs) that have experience in community organizing and shall assist each community associations in mobilizing, capacity building, planning and project implementation.
3. Aside from relocation sites and applicable compensation, the following additional assistance will be provided to vulnerable groups:
   a. Inconvenience allowance in the amount equivalent to Php 10,000 per household.
   b. For the families with persons who need special assistance and/or medical care, respective LGUs to provide nurses or social workers to help them before and during the resettlement activity.
   c. Rehabilitation assistance in the form of skills training and other development activities with the value of up to Php 15,000 will be provided in coordination with other government agencies.
   d. Support to access government welfare programs
   e. Inclusion in the Livelihood Restoration and Improvement Program as prescribed in the RAP
   f. Support case workers to assist transition process and monitor conditions
   g. The case workers will identify other assistance required for specific cases
4. For PAPs opting for self-relocation, DOTr will establish and keep records of all PAPs, issue the necessary certifications to facilitate access to national government programs through the partner agency regional field offices (DTI, DOLE, TESDA etc.), and carry out periodic monitoring and evaluation through DOTr regional field offices.
5. Institutional arrangements for the implementation of the RAP will be in place prior to the commencement of the process; this will include the provision of adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities.

1311. In addition, gender sensitive livelihood and skills training program will also be included in the Social Development Plan (SDP) Framework presented in Chapter 6 with due consideration to solo parents and women-headed families.

1312. The Project's design of train system will also account for the needs of the vulnerable groups through the provision of gender-sensitive facilities for women, allocation of trains for women (especially those pregnant), including allocation of security officers for each station. In addition, the station design will ensure that the PAPs are provided with sufficient lighting to ensure their safety and security.

2) In-Migration

1313. The impact of in-migration of workers during construction may not be significant for the DOTr and its contractors will employ qualified local residents for the MCRP. Encroachment of informal settlers during pre-construction stage is also possible taking advantage of the relocation package for affected ISFs of the Project. In order to avoid this impact, the time between the pre-construction and construction will be shortened as much as possible. Moreover, the project area will be fenced and guarded with security personnel to limit access or entry of unauthorized persons at the ROW.

1314. Qualified PAPs who own structures but do not own the land may also be relocated to existing resettlement sites or new construction sites near the proposed MCRP Alignment. DOTr will coordinate with the receiving LGUs for the development of sites and provision of basic services and facilities, as well as for ensuring the integration of the PAPs into the host community. This will be included in the SDP programs.

3) Cultural/Lifestyle Change

1315. The construction of the proposed MCRP will change the lifestyle of people living at the host barangays particularly the PAFs. The PAFs that will be relocated may experience inconvenience because they will be displaced from their home and/or source of livelihood.

1316. The proposed MCRP alignment will not traverse any Ancestral Domain area according to the letter from NCIP-Tarlac Provincial Office dated April 24, 2018. However, further investigation will be conducted for the site of the proposed Mabacat Depot due to its proximity to CADT 025-A. DOTr is currently coordinating with the NCIP for the conduct of FBI to determine whether or not the location of the proposed Mabalacat Depot overlaps with, or affects an Ancestral Domain area. In case the proposed Depot will encroach the Ancestral Domain, the culture and lifestyle of Aetas present in the area may be affected. The development within or near their community may cause changes in their cultural beliefs and heritage. The influx of construction workers who may not be familiar with the culture of Aetas may cause social conflicts and may influence the IP culture due to access on different resources.

1317. Some residents particulary the Aetas may increase the pace of their lifestyle to keep up the demand of employment and livelihood opportunities. Amenities including water, food supply, and temporary housing will be provided for them during construction so as not only to improve their living but also to change their perception on values of these conveniences.

1318. The living condition of the ISFs will be improved because they will be provided with secure tenure through housing units with basic amenities. With the coordination of the NCIP and LGUs, the affected IP community will be given opportunities during local hiring, particularly those who are qualified. Proper training will be provided as well. Should there be any issues raised by the Aeta community, NCIP will be consulted to resolve the complaint.

4) Impacts on Physical/Cultural Resources

Old PNR Structures

1319. The MCRP will affect the Old PNR structures, which are over 50 years old, such as the old PNR Bridge in Malolos, Calumpit Station, Apalit Station, Sto. Tomas Station and San Fernando Station. Aside from the old PNR structures, there are also Gov. Macario Arnedo Park, and Death March Marker in San Fernando, Pampanga and Grotto of Our Lady of Lourdes in Bamban, Tarlac. These old PNR structures may be preserved, demolished and/or relocated depending on the decision of the National Museum, NCCA, PNR, LGUs and DOTr.

1320. DOTr will conduct literature review and consult with the NCCA, National Museum, NHCP, concerned LGUs and PNR for the qualification of PNR structures. Moreover, DOTr will conduct measured survey of the identified historic structures including its foundation and building condition for the preparation and implementation of necessary protection measures during construction.

Artifacts and Archeological Remains

1321. Since the Project involves tunneling, possible unearthing of artifacts and archeological remains is inevitable. In the event that an archaeological asset is discovered during the course of construction period, the following procedure will be implemented:

1. DOTr must preserve the potential archaeological finds and report it immediately to the National Museum.
2. Closely coordinate with the National Museum on the appropriate course of action in protecting the archaeological finds.
3. Cease immediately all construction activities in the vicinity of the find/feature/site;
4. Hire an archaeologist, recognized by the National Museum, to ensure the following are carried out:

    - Delineate the discovered find/feature/site;
    - Record the coordinates of the find location, and all remains are to be left in place;
    - Secure the area to prevent any damage or loss of removable objects;
    - Assess, record and photograph the find/feature/site;
    - Undertake the inspection process in accordance with all project health and safety protocols under direction of the Health and Safety Officer;
    - Conduct all investigation of archaeological soils by hand;
    - Keep all finds, osteological remains and samples and submit to the National Museum as required;
    - In the event that any artefacts need to be conserved, secure approval from the National Museum;
    - Provide an on-site office and finds storage area to allow storage of any artefacts or other archaeological material recovered during the monitoring process;
    - In the case of human remains, in addition to the above, contact the National Museum and adhere to the guidelines for the treatment of human remains; and
    - If skeletal remains are identified, tap an osteo-archaeological to examine the remains.

5. Implement the following process for conservation:

    - In Hire a conservator, if required;
    - The consulting archaeologist completes a report on the findings and submits to the National Museum; and
    - National Museum reviews the report and informs when works can resume.

Outdoor Space

1322. The proposed MCRP will also affect the public open spaces such as the Lourdes Sur Day Care Center, People's Park, and Malabañas People's Park in Angeles, Pampanga. The relocation of such open spaces will be covered in the RAP.

5) Threats to Delivery of Basic Services/Increase in Demand for Resources

1323. Prior to construction of MCRP, the overhead high voltage cables, telephone and communication cables and underground water pipes exist inside and near the ROW need to be diverted/relocated to give way for the construction. DOTr will coordinate with the relevant utility agencies for the formulation and implementation of measures to minimize the impact of the divesion of such utilities.

1324. During construction, concreting works at the stations and depot will bring about increase in water consumption. The amount of water will depend on the size of the structure that will require concreting. These impacts, however, are rated as low and not significant and will persist only during the pre-construction and construction period. Mitigating measures include implementation of a water conservation program and regular monitoring of water consumption for domestic and construction purposes.

1325. The main issue will be solid waster management generated by the construction activities. Contractor will identify the final disposal sites for each LGUs. Solid wastes will be handled and disposed in accordance with RA 9003.

1326. On the other hand, increase in demand for resources such as power and water supply, additional schools, markets and community service facilities, etc. in the resettlement areas is expected. Provision of these resources will be included in the RAP.

1327. The proposed MCRP will also affect public open spaces in the area such as People's Park in Angeles, Pampanga and Malabanas People's Park in Angeles, Pampanga which utilising PNR ROW. Lourdes Sur Day Care Center in Angeles is converted the old PNR station buildings. DOTr will coordinate with the respective LGUs regarding the possible measures for the transfer or relocation of the parks and the nursery.

6) Threats to Public Health and Safety

1328. The potential air and water pollutants generated during pre-construction and construction phases of the proposed MCRP may have adverse impacts on the health and safety of the workers and residents of nearby communities, specifically those along the project boundary. Workers may be exposed to ergonomic stress and increased levels of noise, dust, and heat, as well as physical hazards associated with heavy lifting, moving heavy equipment, etc. The workers and local residents may also expose to or spread contagious/infectious diseases due to unsanitary condition at the project area.

1329. The following measures will be implemented to reduce risks of threats to human health and safety:

Pubic Health and Safety (Accidents involving Local Communities)

1330. For pre construction phase:

- Formulation and implementation of IEC Plan to inform the affected LGU and local communities and the general public about 1) the project, project activities, duration, possible project impacts and incorporate their comments and inputs in the design, 2) the potential impact of project activities to air quality, noise, vibration, and climate change and mitigation, and safety aspects like areas that are restricted for the public, and 3) the Grievance Redress Mechanism to handle complaint/s if any.

- Coordination with communities during consultation meetings for the schedule of construction.
- Plan for construction yard and access route in consideration to health and safety of local communities.
- Consideration of safety measures will also be considered in the design of the train such as emergency brake and exit.
- Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient.

1331. For construction phase

- Provision of safety officer to monitor the health and safety of the local community. If any coomplinas rises, immediately identify the causes and evaluate mitigate measures.
- Fencing of the construction site, provision of signage and posters, and guarding of the access point to ensure that the area is not accessible to the public.

<u>Occupational health and safety (Accidents and infectious disease)</u>

1332. Pre construction phase

- Prepare occupational Health and Safety Management Plan.
- Include medical certificate in the requirements for hiring of workers to ensure that they are fit to work.
- Ensure that the construction workers are provided with proper training on construction operating procedures, occupational health and safety procedures and emergency preparedness and response procedure.
- Prepare construction plan including storage of equipment and machinery, and access route of heavy vehicles considering health and safety of workers.
- Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient.

1333. Construction phase

- Provision of safe and clean water for drinking, appropriate sanitary facilities such as portable toilets and waste bins.
- Provision of appropriate PPE to all construction workers, particularly to the personnel working on heights, heavy and electrical equipment, and tunneling activities.
- Provision of medical/first aid kits at the construction area. Establishment of Health and Safety Desk or Medical Station at the active construction sites to safeguard the health of the workers and local residents and to provide immediate response during unexpectedincidents/emergencies.

7) Generation of Local Benefits

1334. The direct benefits resulting from the proposed MCRP during pre-construction and construction include the creation of temporary employment for both local and non-local manpower. During pre-construction of the proposed MCRP, DOTr will require about 200 workers while 12,000 workers will be required during construction. The exact number of workers and operators will depend on the construction duration and number of equipment that will be used. All manpower requirements during pre-construction phase will be hired directly by the DOTr. During construction, most of the technical personnel will be hired by the Japanese consulting company since Japanese technology will most likely be employed for the MCRP. For the construction works, manpower will be hired through the local construction company.

1335. DOTr is committed to provide equal opportunities for employment of everyone, in compliance with the Labor Codes of the Philippines, Republic Act No. 10911 known as the Anti-Age Discrimination in Employment Act, and RA 7277 known as the Magna Carta for Disabled Person. DOTr will provide equal opportunities for employment of men and women, on the basis of their abilities, knowledge, skills and qualifications rather than on age or disability. In compliance to RA 6685, DOTr will hire at least 50% of unskilled workers and 30% of the skilled labor requirement from the unemployed bona fide and actual residents of Bulacan, Pampanga and Tarlac with priority on the host barangays. The policy on hiring including the treatment of statutory benefits of the workers will be stipulated in the TORs and contracts with the local contractors to ensure compliance.

1336. To enhance the employment opportunities brought by the proposed MCRP, DOTr will regularly coordinate with the host LGUs and barangays regarding the hiring of temporary workers to ensure that the workers being considered are legitimate residents in the area. Moreover, by hiring local residents, some social conflicts associated with uncontrolled in-migration may be minimized. The priority of employment will be provided to project affected people and gender equality will be also well considered. Through livelihood and income generation program prepared under RAP, the skill training will be provided to those PAFs underprivileged in consideration so that they have sufficient skills to work at construction phase.

1337. The respective contractor will be responsible to provide accommodation for their workers and equipped with the necessary social infrastructure such as potable drinking water, portable toilets, waste bins, first aid kits, etc. Non-local skilled and non-skilled workers will stay in temporary accommodation inside the ROW. The temporary accommodation will also be provided with security guards for safety and security purpose. After construction activities, the contractor will ensure that workers leave the area to prevent the formation of informal settlements.

1338. Potential positive effects of the manpower influx will include demand for retail and other services. This may increase economic activities and benefits for some local businesses including food suppliers and other retailers that are not included in affected structures that will be displaced. It is expected also to increase business opportunities in terms of the project needs for construction materials, supplies, concrete aggregates, and social services.

8) Traffic Congestion

1339. An increase in vehicular traffic will be expected during pre-construction and construction of the proposed MCRP due to the movement of construction equipment; delivery of construction materials; and additional commuters – construction workforce.

1340. Because of the mobilization of heavy vehicles and equipment, construction activities and staging of works, restriction/blockage of some roadways/access roads will be unavoidable. This will lead to increased traffic congestion and changes in traffic patterns. Motorists, cyclists, and pedestrians might alter their trip routes to their inconvenience in order to avoid heavy traffic in the construction areas.

1341. Traffic Impact Assessment (TIA) will be prepared and base on its findings, a Traffic Management Plan (TMP) that details the activities to adequately manage traffic flow will be prepared and strictly implemented. The TMP will be properly coordinated with concered LGUs, transport operators and approved by the LGUs concerned. Some measures that will be included in the plan are rerouting of traffic, proper scheduling of transport of heavy structures during period when there are less vehicles on the road and posting of appropriate traffic sign and warning. Also, the general public, host barangays and LGUs are well informed on the potential impact of the project to the exiting access and provide mitigating measures.

(2) Operation Phase

1) Displacement of Settlers

1342. No displacement of households and business establishment is expected during operation of the proposed MCRP.

2) In-Migration

1343. Influx of migrant workers during operation of the proposed MCRP will intensify the competition for jobs of locals. Migrant workers may also bring in cultures and views not acceptable to the locals. Sometimes, the presence of migrants is associated with increased crime rate, sprouting of informal settlers and other social ills. Locals who are qualified will be given the opportunity and priority to seek employment from the proposed MCRP. DOTr will maximize the use of local labor as possible. Moreover, the project area will be fenced to prevent the settlement of ISFs along the ROW.

3) Cultural/Lifestyle Change

1344. With the operation of the proposed MCRP, it is anticipated that the host barangays, the surrounding barangays and the entire municipalities/cities will be undergoing transformation bringing about by the influx of new industries and expansion of existing industries, which will further increase opportunities for local employment, increase in-migration and the need of increasing goods, commodities and social services. Moreover, the shorter travel time from Manila to the host provinces will also give convenience to the commuters. Some residents, particularly the Aetas may increase the pace of their lifestyle to keep up with development in the area and the convenience of the mass transport may improve their living as well as their perception on values of these conveniences.

4) Impacts on Physical/Cultural Resources and Common Property Resources

1345. Old PNR Stations may be preserved, demolished and/or relocated depending on the decision of the National Museum, NCCA, PNR, LGUs and DOTr. Similarly, plans for areas currently used as parks will be coordinated with LGUs. Thus, preservation measures will ensure minimal impact on the structures. Measures will also be in place to ensure minimal disruption of nearby agricultural areas during operation phase.

1346. In addition, the proposed MCRP may enhance the access to tourist destinations in the host LGUs because of shorter time and the easy access.

5) Threat to Delivery of Basic Services/Increase in Demand for Resources

1347. The operation of the proposed MCRP is not expected to have significant impact on the basic services of the host municipalities and cities. The power, water, and other utilities requirement of the proposed MCRP will be integrated into the service areas of the existing public utilities and would not deprive the public access to such utilities.

6) Threat to Public Health and Safety

1348. There may be risk of accidents due to improper work ethics, which may be a threat health and safety of workers and passengers at the stations and depot. An Occupational Health and Safety Management Plan will be implemented by the DOTr, which is aligned with their policy of mandating the strict implementation of precautionary, safety and security measures to ensure safe, fast, efficient, and reliable transportation services. Appropriate PPE must be provided to all personnel undertaking maintenance work. Security guards will be deployed in all stations to direct passengers on the safe zone. An Emergency Preparedness and Response Plan will also be established in order to define actions in preventing the occurrence of accidents and response procedure in case of accidents, fire and natural hazards. Safety measures will also be considered in the design of the train such as emergency brake and exit.

1349. The health of employees working at the stations and depot may be affected from exposure to unsanitary conditions. Sanitary facilities or utilities to maintain sanitary and healthy conditions will be made available in all stations and depot.

7) Generation of Local Benefits

1350. Employment for skilled personnel to operate and maintain the railway system will be available during operation. It is estimated that the operation of the proposed MCRP will provide employment to approximately 1,400 employees for manning the stations, operations and maintenance of trains at the depot. All manpower requirements during operation phase will be hired directly by the DOTr. Moreover, DOTr is committed to provide equal opportunities for employment of everyone, in compliance with the Labor Code of the Philippines, Republic Act No. 10911 known as the Anti-Age Discrimination in Employment Act, and RA 7277 known as the Magna Carta for Disabled Person. DOTr will provide equal opportunities for employment of men and women, on the basis of their abilities, knowledge, skills and qualifications rather than on age or disability. Manpower will be sourced as much as possible from Bulacan, Pampanga and Laguna, while priority will be given to hiring employees from the host LGUs. The policy on hiring including the treatment of statutory benefits of the workers will be stipulated in the TORs and contracts with the local contractors to ensure compliance

1351. DOTr will regularly coordinate with the host LGUs, specifically at the barangay level regarding the hiring of regular workers to ensure that the workers being considered are legitimate residents in the area and gender equality.

1352. The proposed MCRP will boost regional economic activities along the route through provision of an efficient mass transit system and promotes urban and economic development by enhancing workforce mobility between the industrial zones. This fast and continuous means of transportation gives the labor force in Central Luzon more chances of getting available jobs without having to consider the distance between their home and their place of work. Shorter and more comfortable travel time will also bring workers better physical and psychological state resulting to work productivity. The presence of the stations will also attract future commercial development around the area.

8) Traffic Congestion

1353. The proposed MCRP will generally improve the traffic situation within the project area due to expected shift of commuters from road-based to rail-based transport system. The project will also result to a shorter travel time and convenience for commuters. This will relieve traffic congestion since people will not need to find residence in the metropolis where employment is mostly available.

1354. On the contrary, there may also be increased vehicular flow in areas adjacent to stations that may cause traffic congestion. This could be addressed by providing loading and unloading and or park and ride areas per station. DOTr will form a Transit Oriented Development (**TOD**) Committee, which will compose of the Traffic Management of LGUs, Planning Office, PNR, DPWH, and DOTr to plan TOD in consiereation to the loading and unloading area and the circulation of the traffic as well as the integration of transport facility within the station.

1355. While the structure of MCRP will consist mainly of viaducts, with the stations in Clark and CIA possibly underground, there will be likely no blockage of access roads. However, possible fencing of some sections of the ROW maybe considered for safety purposes.

Table 3.4.63 Summary of Impact Identification, Prediction, Assessment, and Mitigation for People

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
PRE-CONSTRUCTION / CONSTRUCTION				
Land acquisition for ROW and involuntary Resettlement for Project Affected Families (PAFs)	• Informal Settler Families (ISFs) • Vulnerable persons (Women-headed households, elderly, persons with disabilities and the poor)	• Displacement of ISFs • Disturbance of livelihood • Loss of income	A-	[Pre-Construction] • Design train system maximising the existing PNR ROW and minimising additional land acquisition. • Prepare and implement Resettlement Action Plan (RAP) to ensure that PAFs are provided with proper relocation area and/or justly compensated. The RAP will include the following: - Provision of relocation sites for ISFs - Livelihood and income restoration for head-of-household PAPs of ISFs and vulnerable persons. • Prior to displacement, secure and/or develop relocation sites in coordination with the concerned LGUs, Key Shelter Agencies, and other concerned stakeholders with conducive living condition and basic utilities, services and amenities. [Pre-Construction/ construction] • Conduct external and internal monitoring to ensure that displacement activities are conducted in compliance to the RAP. • If PAFs raise an issue, ensure prompt response and resolution per established Grievance Redress Mechanism (GRM)
	Legal PAFs	• Displacement/ Disturbance of Properties • Change/Conflict in Land Ownership • Impact on Livelihood and Income (i.e. farming, business)	A-	[Pre-Construction] • Prepare and implement RAP to ensure that PAFs are justly compensated for the loss of income by the project. • Payment of compensation prior to displacement. • Coordination with the LGUs, land owners and other concerned stakeholders in acquiring the land and/or securing ROW [Pre-Construction/ construction] • Prepare and implement livelihood and income restoration for PAF's whose present means of livelihood is no longer viable and will have to engage in new income activity. • Conduct Social Development Plan (SDP) including livelihood training for business owners, vendors, employers and agricultural landowners affected by project. • Conduct external and internal monitoring agencies to ensure that displacement activities are conducted in compliance to the RAP. • If PAFs raise an issue, ensure prompt response and resolution per established GRM
Employment and Livelihood	Gender and children	Generation of Livelihood Opportunities and improvement of Safety	C-	[Pre-Construction/ construction] • Prepare and implement RAP to ensure that gender equality and needs of vulnerable group are well addressed • Design and install train system in consideration to the following: - Strategic placement of security and lighting within the vicinity of the stations; - Adopt universal design • Employ workers in consideration to gender equality. • Include gender sensitive livelihood and skills training program in the SDP with due consideration to vulnerable group
• Clearing of the proposed project area • Resettlement	In Migration	In-migration to the project area	C-	[Pre-Construction / Construction] • Plan and implement construction schedule to shorten time between the pre-construction and construction as much as possible. • Install fencing and guarding of the proposed project to restrict the public from entering the ROW.
		Conflict between existing residents and		[Pre-Construction / Construction] • Prepare and Implement SDP in coordination with host LGU's to align projects/programs to their development plans

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
		new relocates		
In migration to new relocation site	Basic Services/ Resources	Increased demand on public infrastructure, Degradation on livelihood	C-	[Pre-Construction / Construction] • Prepare and implement RAP in consideration of relocation site to be sufficiently covered the expected demand of basic services and resource and social programs at relocation sites in coordination with LGUs. • Prepare and implement SDP in coordination with the host LGUs to align projects or programs to their development plans
		Loss of outdoor spaces		[Pre-Construction / Construction] • Coordinate with respective LGU's and PNR regarding the possible measures for the transfer/provision or relocation of public parks and other recreational facility.
• Construction of the proposed project	PAFs/IP	Cultural/Lifestyle Change	C-	[Pre-Construction] • Conduct Field-Based Investigation in accordance to the NCIP AO No. 3, 2012. If section of the project site is within an Ancestral Domain, additional measures will be implemented in close coordination with the NCIP and LGUs. • Ensure resolution of issues by the indigenous community (if any) in coordination with NCIP and LGU.
• Encroachment of the proposed MCRP to historical sites, tourist spots, etc. • Excavation activities • Construction of the proposed project	Historical Sites, artefacts and archaeological remains	Impacts on /Cultural Historical resources	B-	[Pre-Construction] • Conduct literature review and site validation of the potential historic structures in coordination with PNR and NHCP; • Perform measured survey of the identified historic structures including its foundation and building condition • Coordinate closely with the NCCA, National Museum, NHCP, concerned LGUs, and PNR for verifying the qualification of those structures and provide necessary protection measures. • Prepare and implement a protection plan for those identified PNR structures which will be maintained [Construction] • Close coordination with the National Museum on the appropriate course of action in case of any archaeological finds.
	Local conflicts of interest	Potential conflict with other government infrastructure projects	B-	[Pre-Construction] • Close coordination with BCDA, DPWH and other relevant agencies
Generation of solid waste, excavated soil and hazardous material	Basic Services/ Resources	Increased demand on waste disposal	B-	[Pre-Construction / Construction] • Identification of final disposal site for solid waste, excavated soil, hazardous waste at each LGUs. • Conduct regular monitoring of disposal status in compliance to RA 9003 and RA 6003.
• Mitigation /Generation of potential air and water pollutants • Heavy lifting and movement of heavy equipment • Construction of the proposed project	Public Health and Safety	• Degradation of public health • Increase in accident involving local communities	B-	[Pre-Construction / Construction] • Formulation and implementation of IEC Plan to inform the affected LGU and local communities and the general public about 1) the project, project activities, duration, possible project impacts and incorporate their comments and inputs in the design, 2) the potential impact of project activities to air quality, noise, vibration, and climate change, and corresponding health and safety mitigation measures, and 3) the Grievance Redress Mechanism to handle complaint/s if any. • Plan for construction sites/facilities/yard and access route in consideration to health and safety of local communities. [Construction] • Provide safety officers to monitor the health and safety of the local community. If any complains rises, immediately identify the causes and evaluate built-in measures. • Install fencing of the construction site, provision of signage and posters, and guarding of the access point to ensure that

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
				the area is not accessible to the public. • Plan and implement social development plan including health and safety of local community. • Implement Emergency Response Plan and Health and Safety Management Plan.
	Occupational Health and Safety	• Increase risk of accidents at construction sites • infectious disease of workers	B-	[Pre-Construction / Construction] • Prepare and implement occupational Health and Safety Management Plan • Include medical certificate in the requirements for hiring of workers to ensure that they are fit to work. Ensure that they are provided with proper training on construction, occupational health and safety, and emergency response procedure. • Provide safe and clean water for drinking, appropriate sanitary facilities such as portable toilets and waste bins. • Plan of construction including storage of equipment and machinery, and access route of heavy vehicle considering health and safety of workers • Provide appropriate personal protective equipment (PPE) to all construction workers, particularly to the personnel working on heights, heavy and electrical equipment. • Establish Health and Safety Desk or Medical Station at the active construction sites to monitor and safeguard the health of the workers and local residents and to provide immediate response during unexpected incidents/emergencies. • Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient.
Employment of workers	Local Economy	Generation of Local Employment	B+	[Pre-Construction /Construction] • Close coordination with the host LGUs (barangay level) regarding the hiring of temporary workers to ensure that the workers being considered are legitimate residents in the area. Those affected by the Project will be prioritized for employment. • Provide skill trainings to PAFs under livelihood and income generation program developed by RAP
Blocking of existing access roads	Public Access	• Impact on Public Access • Impact to School Access • Increase in accidents	B-	[Pre-Construction/ Construction] • Based on the study on public access at affected barangay, maintain the existing public access as much as possible. • In case of any temporary disclosure during construction, minimise the impact to the daily life of affected communities such as access to social infrastructure in coordination with the DepEd and host LGUs for the schedule of construction activities. • Disseminate information to the public, barangay, and LGUs on the potential impact to the existing public access and mitigation measure through the project activities. • Provision of diversion route with appropriate health and safety measures. In case of any changes, prompt update on the diverted routes to the concerned communities and LGUs, • Assignment of traffic guide to provide assistance to the road users.
• Movement of construction equipment; • Delivery of construction materials • Additional commuters due to construction	Traffic Management	Traffic Congestion	B-	[Pre-Construction/ Construction] • Conduct Traffic Impact Assessment (TIA) and based on the results of TIA, prepare and implement Traffic Management Plan (TMP), coordinate to the concerned LGUs and transport operator/s and get their inputs and approval • Schedule transport of heavy structures during period when there are fewer vehicles on the road and posting of appropriate traffic signage and warnings. • Disseminate information to the general public, host barangays, and LGUs on the potential impact of the project to the existing access and provide mitigating measures.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
workforce • Blocking of access roads				
OPERATION				
• Operation of train • Hiring of workers	Local Economy In Migration	• Generation of Local Benefits • Business opportunities • Influx of ISFs	C+	• Coordinate closely with the host LGUs, specifically at the barangay level regarding the hiring of regular workers to ensure that the workers being considered are legitimate residents in the area in consideration to gender equality. • Install fencing and provide guards to prevent the settlement of ISFs along the ROW
Operation of train	Physical/ Cultural resource	• Conservation of old PNR structure and parks • Improve access to tourist destination	C+	• Continuous conservation activities of old PNR structures in coordination with PNR and LGUs
• Operation of train and station • Maintenance work at Depot	Public Health and Safety	Increase risk of accidents	B-	• Provide security guards in all stations to direct passengers on the safe zone.
	Occupational Health and Safety	Increase risk of accidents and infectious disease of employee	B-	• Implement the Occupational Health and Safety Management Plan. • Provide appropriate PPE to all personnel undertaking maintenance work. • Implement the Emergency Response Plan • Provide sanitary facilities or utilities in all stations and depot.
• Operation of train	Traffic Management	Traffic Congestion in the areas adjacent to the proposed stations	B-	• Establish a TOD Committee, which compose of the Traffic Management of LGUs, Planning Office, PNR, DPWH, and DOTr to plan and implement TOD in consideration to the loading and unloading area and the circulation of the traffic as well as the integration of transport facility within the station.

Note:
A+/-: Significant positive/negative impact is expected.
B+/-: Moderate positive/negative impact is expected to some extent.
C+/-: Minor / Negligible positive/negative impact is expected to some extent.
D: Extent of impact is unknown.

4. ENVIRONMENTAL MANAGEMENT PLAN

1356. The DOTr is committed to minimize any adverse impacts, which could arise from the construction, operation and abandonment of the proposed MCRP. It will do so by formulating an Environmental Management Program (EMP) to manage the Project's impacts, adopt the best available proven control technologies and procedures, undergo a continuing process of review and positive action in the light of available monitoring results and continuing consultation with the local communities.

1357. Basically, the EMP will aim to achieve an exemplary environmental performance in the pre-construction, construction and operation of the proposed MCRP. In order to meet this goal, the following activities/measures/ programs will have to be implemented:

- Environmental Policy;
- Application of Mitigation/Management Measures;
- Environmental Monitoring Program;
- Social Development Program;
- Emergency and Contingency Plan;
- Information, Education and Communication Plan;
- Construction Contractor's Program; and
- Institutional Plan and Hiring of an Environmental/Safety Officer.

1358. **Table 4.1.1** presents the EMP for the proposed MCRP.

Table 4.1.1 EMP for the Proposed MCRP

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
GENERAL								
Pre-construction, Construction and Operation activities	Land, Water, Air and People			Comply with the relevant laws: • RA 6969: storage, transport, handling, treatment and disposal of hazardous waste - Secure hazardous waste generator's ID from DENR-EMB; - Provision of hazardous materials storage area; - Hazardous materials/ wastes will be stored in appropriate container properly sealed and labelled; - Hazardous waste will be hauled by an accredited transporter; - Hazardous waste will be treatment by a registered treater (TSD Facility). • RA 9003: management and disposal of solid wastes - Waste segregation, recycling, provision of waste color coded bins, etc.; - Provision of Material Recovery Facility (MRF); - Regular hauling of solid wastes through the LGU or private contractor. • RA 8749: comprehensive air pollution control policy - Secure permit to operate for all air pollution source installations (i.e genset); - Regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard; - Regular cleaning and clearing of construction access / sites surfaces of spoils and debris from construction equipment and vehicles and wetting of ground soil in the construction site when necessary; - Control vehicle movement maintaining the speed limit within the construction site to <10kph and provide cover to loaded trucks. • RA 9275: comprehensive water quality management and for other purpose - Secure discharge permit; - Provision of Wastewater Treatment Facility at the depot; - Provision of three-chambered septic tank at each station. • PD 442: Labor Code of the Philippines, as amended (including Occupational Safety and Health Standards) - Gender equality will be considered in hiring of workers; - Include medical certificate in the requirements for hiring of workers to ensure that they are fit to work. Ensure that they are provided with proper training on construction, occupational health and safety, and emergency response procedure.	• DOTr PMO • Contractors • Operator • LGUs • MMT	Included in the contractor and operator's service fee on health, safety and environmental management	EGF/ Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 4th Quarter of 2022

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
				- Provide appropriate personal protective equipment (PPE) to all construction workers, particularly to the personnel working on heights, heavy and electrical equipment. - Establish Health and Safety Desk or Medical Station at the active construction sites to monitor and safeguard the health of the workers and local residents and to provide immediate response during unexpected incidents/emergencies.; - Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient; • PD 856: Sanitation Code of the Philippines - Provide safe and clean water for drinking; - Provision of appropriate sanitary facilities such as portable toilets and waste bins. • Implementation of Emergency Response Plan and Health and Safety Management Plan to include but not limited to: - Distribution of manual/guideline for workers/employee on health and safety, environment management; - Orientation and continuous training of qualified workers/ employee/ operator on Environment Management, Basic and Construction Occupational Safety and Health, Scaffolding Safety, Fire Safety and Safe Use of Chemicals at Work; - Provision of earthquake, fire drills for workers; - Provision of appropriate PPE for workers; - Provision of security personnel. • Regular monitoring of site condition				
PRE-CONSTRUCTION / CONSTRUCTION								
LAND								
Land acquisition for the MCRP ROW	Land use and Classification	Incompatibility with the Existing Land Use	C-	[Pre-Construction] • Maximise the use of existing PNR ROW from Malolos to Clark and BCDA property from Clark to NCC • Information sharing to the affected LGU to align and ensure that proposed MCRP will be accommodated in their future land use plan • Identification of future land use of surrounding areas that will result to a significant increase of transportation-oriented developments in cooperation with urban planners of LGUs to adopt in the future developments.	• DOTr PMO • LGUs	N/A	N/A	3rd Quarter of 2018 to 2nd Quarter of 2019
Construction of the proposed MCRP at the	ECA	Incompatibility with Classification as an ECA	B-	[Pre-Construction] • Plan and design the site, structure foundation, and structure including construction activities in consideration to the ECAs.	• DOTr PMO • DED Consultant	To be included in the DED cost	EGF	3rd Quarter of 2018 to 2nd Quarter of 2019

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
following: • Areas with the existing old PNR structures • Areas with high risk to typhoon passage, high susceptibility to flooding • Prime agricultural areas in depot site				• Coordinate with relevant government agencies and stakeholders as required	• LGU			
Land acquisition for the MCRP ROW	Land Tenure	Involuntary resettlement of informal settlers who had encroached portion of the existing PNR ROW; settlements outside the existing PNR ROW	B-	[Pre-Construction] • Implement Resettlement Action Plan in coordination with KSAs/ NHA, LGUs, lot owners and other concerned stakeholders and agencies to address the issue on land acquisition and relocation of informal settlers.	• DOTr PMO • LGUs • NHA, KSAs	To be included in RAP Budget	RAP Budget to be adjusted after DED	3rd Quarter of 2018 to 2nd Quarter of 2019
		Potential conflict with other government infrastructure projects	B-	[Pre-Construction] • Coordinate with BCDA, DPWH (depot site), and other relevant agencies	• DOTr PMO	N/A	N/A	3rd Quarter of 2018 to 2nd Quarter of 2019
		Areas with CADT/CADC	B-	[Pre-Construction] • Coordinate with the NCIP for the conduct of FBI to determine the possible overlap with the CADT/CADC	• DOTr PMO	N/A	N/A	3rd Quarter of 2018 to 2nd Quarter of 2019
Construction activities	Visual aesthetic	Degradation of aesthetic view	B-	[Pre-Construction/ Construction] • Design and install facilities to harmonise with the surrounding environments (shape, colour, size, etc.) • Identify planting area within the ROW that will not be covered by development to act as buffer zone, green corridor and to lessen aesthetic sore brought by construction and railway structures, and plant trees [Construction] • Maintain the construction site/ yards tidy and clean and rehabilitate after construction. • Provision for temporary screens/ walls to minimise the visual clatter.	• DOTr PMO • DED Consultant • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
Generation and improper handling and disposal of	Land Value	Devaluation of land value as a result of improper solid waste	B-	[Pre-Construction] • Identify the final disposal site for solid waste, excavated soil and hazard waste at each LGUs.	• DOTr • Contractors • LGU	To be included in the contractor's	Bid Documents/ Contract	3rd Quarter of 2018 to 2nd Quarter of 2022

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
domestic and hazardous solid waste.		management		[Construction] • 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 monitoring on disposal/handling • Conduct Social Development Plan (SDP) including waste management to the communities	• MMT	Service Cost	Agreement	
Generation and improper handling and disposal of excavated soil, leftover concrete by excavation activities (Excavated Soil)	Land Value	Devaluation of land value as a result of improper handling of excavated soil	B-	[Pre-Construction/Construction] • Plan and implement recycling and reuse of excavated soil to be utilised for the project/ other project as much as possible. In case of excessive soil to be generated, identify the final spoil disposal site. [Construction] • Place excavated materials on appropriate dump sites or spoils area and with adequate containment. • Strictly implement construction plan, soil management plan, and proper disposal by contractor in accordance to RA 9003, minimization of waste, segregation.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
Construction of embankment	Topography	Permanent and major modification of the terrain and alteration of landform	C-	[Pre-Construction /Construction] • Formulate appropriate design measures for the protection on slopes and banks, soil improvement / ground reinforcement to minimise ground failure during construction based on the results of the geological survey and geotechnical investigations.	• DOTr • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
Earthworks, (excavation, backfilling, stockpiling, tunneling/ underground) and natural hazards	Geology/ Geomorphology	Ground Subsidence Liquefaction Landslide, Mud/ Debris Flow, etc.	B-	[Pre-Construction/Construction] • Design and implement appropriate foundation and structures based on combination of geotechnical, geodetic and hydrologic study, and seismicity studies, and in compliance with the National Building Code and the Structural Code of the Philippines and internationally accepted guideline. • Design and install emergency escape route, early warning (alarm) system, emergency power supplies in the design of the structure particularly in the viaduct. • Plan and implement appropriate construction method, schedule, and activities based on combination of geotechnical and geological investigations, and seismicity studies in coordination with the PHIVOLCS. [Construction] • Install sufficient protection measure 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	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
				construction schedule. Conduct earthquake drills for workers.				
Clearing and removal of vegetation, stripping of soil cover, excavation of underlying rock, grading or construction of embankments.	Pedology	Soil erosion/loss of top soil	B-	[Pre-Construction/ Construction] • Design and install of appropriate mitigating measures to prevent or minimize slope failure during construction based on the results of the geohazard assessment and geotechnical investigations. [Construction] • Minimise the removal of vegetation cover as much as possible, provision of slope stabilization measure/s, when necessary. • Install surface water runoff drainages system, protection of slope and bank as required. • Implement appropriate materials handling program or a site protection and rehabilitation program including but not limited to the following; - Scheduling of clearing and excavation activities in speedy manner during dry season if possible. - Installation of temporary erosion ponds or silt traps around the major work areas. - Placement of excavated materials on appropriate staging site or spoils area and with adequate containment. Limit stock pile height up to 2 m high only. - Installation of fence at the stockpiles of sand and gravel to reduce sediment transport during heavy rains including reduction of storage time in the work areas. • Utilize heavy equipment for transporting, hauling and excavating material from one area to another so as to avoid spills into drainage system	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
• Accidental spills of fuels /lubricants from construction vehicles & machineries/ hazardous chemicals. • Generation and improper handling/ disposal of construction/ domestic /hazardous wastes.	Pedology	Degradation of soil quality (soil contamination)	B-	[Construction] • Proper inspection and maintenance of machines and equipment. • 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.	• DOTr • Contractor	Construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2019 to 2nd Quarter of 2022
Drilling and	Pedology	Exposure to	C	[Pre-Construction]	• DOTr PMO	DED cost /	EGF/Bid	3rd Quarter of

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
excavation at previously contaminated site (e.g. Old Calumpit Dump Site)		contaminated soil		• Identify a potential contaminated site and conduct of soil sampling survey at potential contained site, if necessary. • Conduct Environmental Site Assessment if there is suspected contamination on the proposed location of facilities (e.g. depot). In case that toxic substances are found within the project area and/or adjacent sites, prepare contaminated soil management plan and implement necessary remediation measures. • Storage, handling, transport, treatment and disposal of contaminated soil will be in accordance with RA 6969 [Construction] • Conduct continuous monitoring of toxic level to ensure that contaminants will not pose hazards. In case traces are detected, construction activities on affected site will be paused until a soil management plan is developed and implemented in consultation to the DENR – EMB.	• DED consultants • Contractors • LGUs • MMT	construction cost to be finalized during the DED	Documents/ Contract Agreement	2018 to 2nd Quarter of 2022
Removal of vegetation along the proposed MCRP particularly the planted trees at other areas along the ROW	Terrestrial Ecology (Flora)	• Loss of Habitat • Threat to Existence and/or Loss of Important Local Species • Threat to Abundance, Frequency and Distribution of Important Species • Hindrance to Wildlife Access	B-	[Pre-Construction] • Design, plan and implement the project that will minimise vegetation clearing, alteration of landform, generation of noise, vibration, illumination, and vehicular movement particularly in areas adjacent to flora of higher conservation significance (i.e. Antipolo, Is-is, Narra) and in the vicinity of ecological significant areas.. • Conduct 100% inventory of the affected trees along the alignment to determine the total counts, category, and characteristics of affected trees and minimise removal particularly in areas adjacent to vegetation of higher conservation significance as much as possible. Native/endemic/ indigenous species of trees, shrubs and grasses will be specified. • Wildlings of the endangered and threatened species, if any, will be collected before construction, placed in the nursery, and give priority during nursery operation to be used for rehabilitation of areas that will be affected by project • For tree replanting, areas not part of the development within the ROW, around the stations and depot will be prioritized for replanting activity to create buffer zone and to improve habitat for wildlife. For those that cannot be replanted within the project area, coordination with the DENR and LGUs on the identification of area for the potential trees that will be relocated. • Earthballing of trees (if there are any) will be coordinated with the DENR and LGUs including the site where the earthballed trees will be transplanted • Secure tree cutting permit in compliance with DENR Memorandum Order No. 2012-02. [Construction] • Prior to any clearing activity, clearly mark the ROW to avoid the unnecessary clearance of tree cutting. • Conduct tree planting activities to compensate site clearing activities. Conduct	• DOTr PMO • Contractors • LGUs	Construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
				regular monitoring on survival of replanted trees and replant if necessary.				
• Earthworks and vehicle movement. • Generation of dust and noise, vibration, and illumination pollution.	Terrestrial Ecology (Fauna)	• Loss of Habitat • Threat to Existence and/or Loss of Important Local Species • Threat to Abundance, Frequency and Distribution of Important Species • Hindrance to Wildlife Access	B-	[Pre-Construction/ Construction] • Design, plan and implement the project that will minimise vegetation clearing, alteration of landform, generation of noise, vibration, illumination, and vehicular movement particularly in areas adjacent to flora of higher conservation significance (i.e. Antipolo, Is-is, Narra) and in the vicinity of ecological significant areas. • Prepare and implement a tree and vegetation management plan as part of the construction plan considering the significance to fauna (local bird species) such as installing buffer zone, minimising the use of herbicide and machinery as much as possible. • Coordinate with BMB-DENR and SCPW for the conservation of migratory birds if required.	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
WATER								
• Site preparation, land clearing, removal of vegetation • Excavation • Construction activities	Hydrology	Flooding and inundation by sediment run off, siltation, drainage overflow, clogging	B-	[Pre-Construction/ Construction] • Design and install sufficient drainage system including temporary drainage system during construction to accommodate the surface water runoff from the project and avoid any flooding in the area caused by the project, in consideration to the existing drainage system and flood storage capacity. • Based on the hydrological, geological study and local climate change data from PAGASA, design and install train system in robust to flood and related extreme events including temporary construction drainage, train structure to be above the flood level, installation of drainage pumping system, etc. • Based on the result of hydrological study, design and install viaduct piers • Coordinate with DPWH and LGUs on the integration of proposed drainage plan to the project area. [Construction] • Minimise the removal of vegetation and alteration of topography as much as possible. • Install soil erosion control such as protection of slope and bank silt traps to minimize siltation of waterways as required. • Strictly implement construction plan, operating instructions and solid waste / soil management plan, which include minimization of waste/soil generation, segregation, and proper disposal by contractor in accordance to RA 9003 • Regular inspection and prompt maintenance of the drainage system, all installed structures and facilities and improve/ enhance capacity when possible.	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
	Hydrogeology	Depletion of water resource/ competition in water use	C-	[Construction] • Utilize surface water from the local water service provider/s • Conduct regular monitoring of water consumption	• DOTr PMO • Contractors • LGU	To be included in the contractor's	Bid Documents/ Contract	3rd Quarter of 2019 to 2nd Quarter of 2022

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
				• Implement water conservation program such as use of rain harvested/ recycled water at construction yard/ camp.	• MMT	Service Cost	Agreement	
Earthworks, (excavation, backfilling, stockpiling, tunneling/underground)	Water Quality	Degradation of groundwater quality	C-	[Pre-Construction/ Construction] • Plan and Implement appropriate construction methods (i.e. excavation, backfilling, stockpiling) based on geological and geotechnical investigations. • Install sedimentation/filtration pond at tunnel construction area [Construction] • Comply with environmental permitting requirements for the storage, transport, handling, treatment, and disposal of hazardous material/ wastes and contaminated soil in accordance with RA 6969, and solid waste / soil management plan, in accordance to RA 9003.	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
Earthworks, (excavation, backfilling, stockpiling)	Water Quality	• Disturbance on bottom sediment and degradation of surface water • Siltation • Induce of turbidity	B-	[Pre-Construction] • Based on the hydrological and geodetic surveys, design bridge piers that will minimise installation within the rivers and select appropriate construction materials to be used. • Minimize the removal of vegetation cover, alternation of topography as much as possible. • Plan and implement construction activities in consideration to the water course, embankment, and dry season. • Coordinate with NWRB, DPWH and LGUs for necessary permit [Construction] Install protection measures for soil erosion and bottom sediment around the bridge piers if necessary. • Place excavated material in temporary staging area with provision for silt traps/ siltation pond to avoid silt draining to waterways, degradation of surface water quality and clogging of waterways, if necessary. • Conduct regular surface water quality monitoring.	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-					
• Discharge of wastewater, from construction sites/ yards • Accidental spills of fuels and lubricants from construction vehicles and machineries, as well as other hazardous	Water Quality	Degradation of surface water quality	B-	[Pre-Construction/ Construction] • Design and implement the temporary drainage of waste water from construction yard/ facilities/ camp, surface water runoff drainage systems to minimise discharge. • Design and install sewage treatment facility and separate non-sewage wastewater for stations and Depot in compliance to the Sanitation Code of the Philippines. In addition, depot will have interceptor tank to remove oil and fuel from surface water. • Compliance with RA 9275, secure discharge permit. [Construction] • Install wastewater treatment, portable sanitary facilities at construction sites/yards	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-					

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
chemicals like paints and solvents. • Generation and improper handling and disposal of construction, domestic and hazardous wastes.				• Conduct proper inspection and regular maintenance of construction machineries, equipment, vehicles and wastewater treatment equipment and facilities with appropriate measure to collect any leakage • Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969 and solid waste / soil management plan, which include minimization of waste/soil generation, segregation, and proper disposal including the temporary storage by contractor in accordance with RA 9003 • Implement material handling program or a site protection program. • Conduct of effluent quality monitoring at discharge point				
AIR								
• Operation of construction machinery, equipment and vehicles • Removal of trees and other vegetation	Climate Change	Exhaust emissions from movement of equipment and vehicles, excavated soil carried by vehicles and other heavy loaders.	C-	[Pre-Construction] • Plan and design structures that will minimise the removal of vegetation and alteration of topography if possible. [Construction] • Conduct proper inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard • Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation if possible	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
Climate Risk	Meteorology/ climatology	Restrictions/ disruption of construction due to soil erosion/landslides/ and flooding.	A-	[Pre-Construction] • Take account of change in local micro climate such as rainfall, temperature pattern for 2020 and 2050 in project design criteria and schedule of construction works. • Based on the hydrological and geodetic study, design and install train system which is robust to climate change and related extreme events including drainage, passenger facilities and structures (viaduct and embankment) i.e. train facilities to be above the flood level, installation of drainage pumping system. [Construction] • Adjust construction activities in consideration to local climate / extreme events such as extreme heat to avoid overheating of construction equipment and service vehicles and cause heat stress to workers. • Implement Emergency Response Plan.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	EGF/ Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
		Slower drainage, soil erosion, disruption in construction by increased rainfall	B-					
		Overheating of construction equipment, vehicles / heat stress by high temperature and heat waves	C-					
• Earthworks including excavation activities • Site clearance including	Air Quality	Degradation of air quality due to dust generation from transportation of excessive soil / spoil to fill area construction	B-	[Construction] • Minimise alteration of topography and removal of vegetation. • Adjust construction activities in consideration to weather system, identifying periods of high winds and drought that aggravated dust transport. • Conduct prompt inspection and regular maintenance of heavy equipment,	• DOTr PMO • Contractors	construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2019 to 2nd Quarter of 2022

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
removal of topsoil at the depot site		activities		machineries and service vehicles to meet the DENR Emission Standards • Control vehicle movement maintaining the speed limit within the construction site to <10kph and minimise vehicle transport by maximising the use of site generated materials • Conduct regular cleaning and clearing of construction access / sites surfaces of spoils and debris from construction equipment and vehicles and wetting of ground soil in the construction site when necessary. Stock pile and trucks loaded with spoils will be covered. • Implement materials handling program or a site protection and rehabilitation program. • Monitor air quality at identified nearby sensitive receptors regularly and evaluate effectiveness of the air pollution reduction measures provided.				
• Operation of construction machinery, equipment and vehicles	Air Quality	Degradation of air quality due to gaseous emissions from machineries and service vehicles	C-					
• Operation of construction machinery, equipment and vehicles • Earthworks	Acoustic Noise	• Increase in ambient noise level • Threat to existence and/or loss of important local species and habitat • Threat to abundance, frequency and distribution of species	B-	[Pre-Construction /Construction] • Select sites (i.e. construction yard, temporary facilities, access route) in consideration to sensitive receptors including ecologically significant areas (if any) likely to be affected. • Design and install effective noise barriers and absorbers along the alignment especially in areas with sensitive facilities. • Design and adopt long rails and ballast-less track with elastic and absorbent sleeper support to minimize noise generation from train operation [Construction] • Implement construction activities in consideration to time, duration, and scale to optimize the use construction equipment, machineries, and vehicles in accordance to the noise emission standard. • Minimise alteration of topography and removal of vegetation • Install noise control devices such as mufflers and noise suppressors to all construction equipment and machineries. Use of electric instead of diesel powered equipment, hydraulic tools instead of pneumatic tools. • Conduct regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard • Provide appropriate PPE to construction workers • Monitor noise levels at identified nearby sensitive receptors (residential, school and hospital areas) including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provided.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
• Conduct of geotechnical investigation • Operation of construction	Ground vibration	• Increase in ambient vibration level and threat to the health and safety of sensitive receptors	C-	[Pre-Construction / Construction] • Select sites in consideration to sensitive receptors including ecologically significant areas (if any) likely to be affected. • Conduct building condition survey of old PNR structures and buildings adjacent to the alignment to provide proper protection provision measures and	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022

<table>
<tr><th>Environmental Aspect</th><th>Environmental Component</th><th>Potential Impact</th><th>Level of significance</th><th>Prevention/Mitigation/ Enhancement Measures</th><th>Responsible Institution</th><th>Estimated Cost (PhP)</th><th>Guarantee/ Financial Arrangement</th><th>Implementation Schedule</th></tr>
<tr><td>machinery, equipment and vehicles
• Pile driving for piers</td><td></td><td>• Threat to existence and/or loss of important local species and habitat
• Threat to abundance, frequency and distribution of species</td><td></td><td>continuous monitoring from the impact of vibration.
[Construction]
• Implement construction activities in consideration of time, duration, and scale of construction to optimize the use construction equipment, machineries, and vehicles with minimal vibration generation.
• Select construction equipment and machineries matching the scale of the construction and with minimal vibration generation if possible
• Provide training on vibration mitigation and provide appropriate PPE to construction workers;
• Monitor vibration levels including identified nearby sensitive receptors, old PNR structures including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provided.</td><td>• LGUs</td><td></td><td></td><td></td></tr>
<tr><td colspan="8">PEOPLE</td><td></td></tr>
<tr><td>Land acquisition for ROW and involuntary Resettlement for Project Affected Families (PAFs)</td><td>• Informal Settler Families (ISFs)
• Vulnerable persons (Women-headed households, elderly, persons with disabilities and the poor)</td><td>• Displacement of ISFs
• Disturbance of livelihood
• Loss of income</td><td>A-</td><td>[Pre-Construction]
• Design train system maximising the existing PNR ROW and minimising additional land acquisition.
• Prepare and implement Resettlement Action Plan (RAP) to ensure that PAFs are provided with proper relocation area and/or justly compensated. The RAP will include the following:
- Provision of relocation sites for ISFs
- Livelihood and income restoration for head-of-household PAPs of ISFs and vulnerable persons.
• Prior to displacement, secure and/or develop relocation sites in coordination with the concerned LGUs, Key Shelter Agencies, and other concerned stakeholders with conducive living condition and basic utilities, services and amenities.
[Pre-Construction/ construction]
• Conduct external and internal monitoring to ensure that displacement activities are conducted in compliance to the RAP.
• If PAFs raise an issue, ensure prompt response and resolution per established Grievance Redress Mechanism (GRM)</td><td>• DOTr PMO
• DED consultants
• LGUs
• NHA, KSAs</td><td>DED cost / To be included in RAP Budget</td><td>RAP Budget to be adjusted after DED</td><td>3rd Quarter of 2018 to 2nd Quarter of 2022</td></tr>
<tr><td></td><td>Legal PAFs</td><td>• Displacement/ Disturbance of Properties
• Change/Conflict in Land Ownership
• Impact on Livelihood and Income (i.e.</td><td>A-</td><td>[Pre-Construction]
• Prepare and implement RAP to ensure that PAFs are justly compensated for the loss of income by the project.
• Payment of compensation prior to displacement.
• Coordination with the LGUs, land owners and other concerned stakeholders in acquiring the land and/or securing ROW
[Pre-Construction/ construction]</td><td>• DOTr PMO
• LGUs
• KSAs</td><td>To be included in RAP Budget</td><td>RAP Budget to be adjusted after DED</td><td>3rd Quarter of 2018 to 2nd Quarter of 2022</td></tr>
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Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
		farming, business)		• Prepare and implement livelihood and income restoration for PAF's whose present means of livelihood is no longer viable and will have to engage in new income activity. • Conduct Social Development Plan (SDP) including livelihood training for business owners, vendors, employers and agricultural landowners affected by project. • Conduct external and internal monitoring agencies to ensure that displacement activities are conducted in compliance to the RAP. • If PAFs raise an issue, ensure prompt response and resolution per established GRM				
Employment and Livelihood	Gender and children	Generation of Livelihood Opportunities and improvement of Safety	C-	[Pre-Construction/ construction] • Prepare and implement RAP to ensure that gender equality and needs of vulnerable group are well addressed • Design and install train system in consideration to the following: - Strategic placement of security and lighting within the vicinity of the stations; - Adopt universal design • Employ workers in consideration to gender equality. • Include gender sensitive livelihood and skills training program in the SDP with due consideration to vulnerable group	• DOTr • DED consultants • Contractors • LGUs	DED cost / To be included in the Construction Cost	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
• Clearing of the proposed project area • Resettlement	In Migration	In-migration to the project area	C-	[Pre-Construction / Construction] • Plan and implement construction schedule to shorten time between the pre-construction and construction as much as possible. • Install fencing and guarding of the proposed project to restrict the public from entering the ROW.	• DOTr PMO • Contractors • LGUs	To be included in the contractor's Service Cost	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
		Conflict between existing residents and new relocatees	C-	[Pre-Construction / Construction] • Prepare and Implement SDP in coordination with host LGU's to align projects/programs to their development plans.				
In migration to new relocation site	Basic Services/ Resources	Increased demand on public infrastructure, Degradation on livelihood	C-	[Pre-Construction / Construction] • Prepare and implement RAP in consideration of relocation site to be sufficiently covered the expected demand of basic services and resource and social programs at relocation sites in coordination with LGUs. • Prepare and implement SDP in coordination with the host LGUs to align projects or programs to their development plans	• DOTr PMO • LGUs • NHA, KSAs	To be included in RAP Budget / the DOTr's service fee on	RAP Budget to be adjusted after DED	3rd Quarter of 2018 to 2nd Quarter of 2022
		Loss of outdoor spaces	C-	[Pre-Construction / Construction] • Coordinate with respective LGU's and PNR regarding the possible measures for the transfer/provision or relocation of public parks and other recreational facility.				
• Construction of the proposed	PAFs/IP	Cultural/Lifestyle Change	C-	[Pre-Construction] • Conduct Field-Based Investigation in accordance to the NCIP AO No. 3, 2012. If	• DOTr PMO • DED	DED cost / construction	Bid Documents/	3rd Quarter of 2018 to 2nd

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
project				section of the project site is within an Ancestral Domain, additional measures will be implemented in close coordination with the NCIP and LGUs. • Ensure resolution of issues by the indigenous community (if any) in coordination with NCIP and LGU.	consultants • Contractors • LGUs	cost to be finalized during the DED	Contract Agreement	Quarter of 2019
• Encroachment of the proposed MCRP to historical sites, tourist spots, etc. • Excavation activities • Construction of the proposed project	Historical Sites, artefacts and archaeological remains	Impacts on /Cultural Historical resources	B-	[Pre-Construction] • Conduct literature review and site validation of the potential historic structures in coordination with PNR and NHCP; • Perform measured survey of the identified historic structures including its foundation and building condition • Coordinate closely with the NCCA, National Museum, NHCP, concerned LGUs, and PNR for verifying the qualification of those structures and provide necessary protection measures. • Prepare and implement a protection plan for those identified PNR structures which will be maintained [Construction] • Close coordination with the National Museum on the appropriate course of action in case of any archaeological finds.	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
	Local conflicts of interest	Potential conflict with other government infrastructure projects	B-	[Pre-Construction] • Close coordination with BCDA, DPWH and other relevant agencies	• DOTr PMO			
Generation of solid waste, excavated soil and hazardous material	Basic Services/ Resources	Increased demand on waste disposal	B-	[Pre-Construction / Construction] • Identification of final disposal site for solid waste, excavated soil, hazardous waste at each LGUs. • Conduct regular monitoring of disposal status in compliance to RA 9003 and RA 6003.	• DOTr PMO • Contractor • LGUs	To be included in the construction cost	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
• Mitigation /Generation of potential air and water pollutants • Heavy lifting and movement of heavy equipment • Construction of the proposed project	Public Health and Safety	• Degradation of public health • Increase in accident involving local communities	B-	[Pre-Construction / Construction] • Formulation and implementation of IEC Plan to inform the affected LGU and local communities and the general public about 1) the project, project activities, duration, possible project impacts and incorporate their comments and inputs in the design, 2) the potential impact of project activities to air quality, noise, vibration, and climate change, and corresponding health and safety mitigation measures, and 3) the Grievance Redress Mechanism to handle complaint/s if any. • Plan for construction sites/facilities/yard and access route in consideration to health and safety of local communities. [Construction] • Provide safety officers to monitor the health and safety of the local community. If any complains rises, immediately identify the causes and evaluate built-in measures. • Install fencing of the construction site, provision of signage and posters, and	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
				guarding of the access point to ensure that the area is not accessible to the public. • Plan and implement social development plan including health and safety of local community. • Implement Emergency Response Plan and Health and Safety Management Plan.				
	Occupational Health and Safety	• Increase risk of accidents at construction sites • infectious disease of workers	B-	[Pre-Construction / Construction] • Prepare and implement occupational Health and Safety Management Plan • Include medical certificate in the requirements for hiring of workers to ensure that they are fit to work. Ensure that they are provided with proper training on construction, occupational health and safety, and emergency response procedure. • Provide safe and clean water for drinking, appropriate sanitary facilities such as portable toilets and waste bins. • Plan of construction including storage of equipment and machinery, and access route of heavy vehicle considering health and safety of workers • Provide appropriate personal protective equipment (PPE) to all construction workers, particularly to the personnel working on heights, heavy and electrical equipment. • Establish Health and Safety Desk or Medical Station at the active construction sites to monitor and safeguard the health of the workers and local residents and to provide immediate response during unexpected incidents/emergencies. • Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient.	• DOTr PMO • Contractors • LGUs	Included in the contractor's service fee on health, safety and environmental management	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
Employment of workers	Local Economy	Generation of Local Employment	B+	[Pre-Construction /Construction] • Close coordination with the host LGUs (barangay level) regarding the hiring of temporary workers to ensure that the workers being considered are legitimate residents in the area. Those affected by the Project will be prioritized for employment. • Provide skill trainings to PAFs under livelihood and income generation program developed by RAP	• DOTr PMO • Contractors • LGUs	RAP cost/ To be included in the Construction Cost	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
Blocking of existing access roads	Public Access	• Impact on Public Access • Impact to School Access • Increase in accidents	B-	[Pre-Construction/ Construction] • Based on the study on public access at affected barangay, maintain the existing public access as much as possible. • In case of any temporary disclosure during construction, minimise the impact to the daily life of affected communities such as access to social infrastructure in coordination with the DepEd and host LGUs for the schedule of construction activities. • Disseminate information to the public, barangay, and LGUs on the potential	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost/ To be included in the Construction Cost	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
				impact to the existing public access and mitigation measure through the project activities. • Provision of diversion route with appropriate health and safety measures. In case of any changes, prompt update on the diverted routes to the concerned communities and LGUs, • Assignment of traffic guide to provide assistance to the road users.				
• Movement of construction equipment; • Delivery of construction materials • Additional commuters due to construction workforce • Blocking of access roads	Traffic Management	Traffic Congestion	B-	[Pre-Construction/ Construction] • Conduct Traffic Impact Assessment (TIA) and based on the results of TIA, prepare and implement Traffic Management Plan (TMP), coordinate to the concerned LGUs and transport operator/s and get their inputs and approval • Schedule transport of heavy structures during period when there are fewer vehicles on the road and posting of appropriate traffic signage and warnings. • Disseminate information to the general public, host barangays, and LGUs on the potential impact of the project to the existing access and provide mitigating measures.	• DOTr PMO • Contractors • LGUs	To be included in the Construction Cost	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2022
OPERATION								
LAND								
Operation and maintenance of the proposed MCRP	ECA	Incompatibility with the area that will be hardly hit by natural calamities.	B-	• Coordinate with PAGASA / PHIVOLCS and adjustment of train schedules. • Implement proper inspection and prompt maintenance of drainage systems.	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost	EGF	From 3rd Quarter of 2022
Presence of the proposed MCRP structures (railway, passenger facilities, depot etc.)	Visual aesthetics	Impairment of visual aesthetic	C-	• Maintain tree planting to minimise the visual impact by the project and harmonise to the surrounding environments in open areas within the ROW, depot and around the stations, to create green corridor.	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost	EGF	From 3rd Quarter of 2022
Generation and improper handling of domestic and hazardous wastes including accidental oil and lubricant spills from passenger facilities (station), depot.	Land value	• Degradation of land value • Change in soil quality	C-	• Conduct proper inspection and prompt maintenance of machines and equipment, and facilities • Strictly implement solid waste management plan in accordance to RA 9003, and treatment of hazardous chemicals and contaminated soil in accordance with RA 6969 including monitoring. • Conduct of soil quality monitoring when necessary.	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost	EGF	From 3rd Quarter of 2022

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
• Occurrence of landslides, volcanic hazards, ground shaking and liquefaction • Likely seismic events around MCRP line	Subsidence, Liquefaction, Landslide, Mud/Debris Flow, etc	• Damage to tracks • Risk to the life of passengers and workers • Damage to passenger facilities.	B-	• Conduct inspection in the event of natural hazard occurrence to assess damage of structures • Regular Coordination with the PHIVOLCS for earthquake and volcanic events to adjust the train schedule as necessary. • Conduct earthquake drills for train users are also advised • Conduct proper inspection and prompt maintenance checks to every single installed structure and facility and improve/ enhance capacity when possible • Upgrades or install new technological advances when available are also encouraged for the continued operation of MCRP	• DOTr PMO • Operator	Included in the operation and maintenance cost	EGF	From 3rd Quarter of 2022
Operation of the proposed MCRP and passenger facility, Depot, service vehicle, Passenger movement	Terrestrial Ecology	• Loss of Habitat • Threat to Existence and/or Loss of Important Local Species • Hindrance to Wildlife Access	C-	• Minimised noise, vibration, illumination, and vehicular movement in significant fauna area • Continuous planting of replacement tress if any. • Conduct monitoring on survival of replanted trees and replant if required. • Implement vegetation management plan considering significant fauna (local bird species) to minimise the use of herbicide and machinery as much as possible.	• DOTr PMO • Operator	Included in the operation and maintenance cost	EGF	From 3rd Quarter of 2022
WATER								
Operation of train	Hydrology	Increase of flood occurrence and worse the impact	C-	Conduct proper inspection and prompt maintenance of the installed drainage system, and improve/ enhance capacity when possible	• DOTr • Operator • LGUs	Included in the operation and maintenance cost	EGF/ Contract agreement	From 3rd Quarter of 2022
Operation of passenger facilities, depot.	Water Quality	Degradation of groundwater quality	C-	• Comply with environmental permitting requirements for the storage, transport, handling, and treatment and disposal of hazardous material/ wastes and contaminated soil in accordance with RA 6969. • Conduct proper inspection and prompt maintenance of the installed wastewater treatment facilities. • Compliance to RA 9275 including but not limited to securing of discharge permit. • Conduct proper inspection and regular maintenance of drainage system and treatment facility. • Conduct of regular effluent quality monitoring	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost	EGF/ Contract agreement	From 3rd Quarter of 2022
• Discharge of waste water, from passenger facilities, depot. • Accidental spills of fuels and lubricants from service vehicles and machineries, at depot • Generation and improper handling and disposal of		Degradation of surface water quality	B-					
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-					

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
domestic and hazardous wastes.								
AIR								
Climate Change	Meteorology/ Climatology	Restrictions/ disruption of railway operation due to soil erosion/landslides/ and flooding.	A-	• Regular inspection and preventive maintenance of railway structures and facilities to ensure optimum working condition; • When necessary, install improvement of railway system to make it more resilient to temperature and rainfall increase ; • Planting of vegetation as much as possible in open areas at the depot, around the stations and along the railway track; • Implementation of an Emergency Response Plan;	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost	EGF/ Contract agreement	From 3rd Quarter of 2022
		Slower drainage, soil erosion, disruption in construction by increased rainfall	B-					
		Overheating of construction equipment and vehicles and overheating of track buckling and signalling problems	C-					
Operation of trains, depot, passenger facilities (stations), service vehicles, etc.	Meteorology/ Climatology	Reduction of Greenhouse Gases	B+	• Provide incentives and information dissemination activities to encourage commuters to use rail transit and its benefits over other modes of transport (Modal Shift) • Plant and manage vegetation as much as possible to open areas at the depot, around the stations and along the railway track • Conduct energy/water conservation program such as use energy efficient products (i.e. LED lights) and monitor carbon footprint monitoring • Conduct regular inspection and proper maintenance of railway systems and facilities, and equipment and machinery	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost	Contract agreement	From 3rd Quarter of 2022
	Air Quality	• Degradation of air quality in the vicinity of the station and in depot area • Increase in Vehicle Exhaust emission and entrained dust due of increased movement of people	C-	• Select appropriate operation and maintenance equipment that are fuel efficient to reduce emission. • Conduct regular inspection and maintenance of heavy equipment, machineries, facilities and service vehicles and facilities such as generator etc. to meet the DENR Emission Standard • Regular cleaning and clearing of road from spoils and debris and wetting of ground in the periphery of the depot when necessary. • Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969 at depot area, and provide appropriate PPE for the concerned personnel	• DOTr • Operator • LGUs	Included in the operation and maintenance cost	EGF/ Contract agreement	From 3rd Quarter of 2022

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
				• Control service vehicle movement by maintaining the speed limit to <10kph within the construction site. Minimise vehicle transport by maximising the use of site generated materials. • Monitor air quality at the identified sampling stations				
Operation of trains	Acoustic Noise	Reduction of noise due to decrease in traffic volumes	B+	• Provide incentives to and information dissemination activities to encourage commuters to use rail transit over other modes of transport	• DOTr • Operator • LGUs	Included in the operation and maintenance cost	N/A	
Operation of trains, depot, passenger facilities (stations), service vehicles, etc.	Acoustic Noise	Increase in ambient noise level	C-	• Optimize the number of train operation at night time to reduce generated noise • Provision of effective height of noise barriers on each side of the track especially on areas with sensitive receptors such as school, hospital, residential area • Provision of noise control device such as muffler to all stationary sources (i.e. generator set) • Regular inspection and proper maintenance of trains and tracks to ensure its optimal operation and functionality • Monitor noise levels including identified nearby sensitive receptors including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provided.			EGF/ Contract agreement	From 3rd Quarter of 2022
	Ground Vibration	Increase in ground vibration level	C-	• Monitor vibration levels including identified nearby sensitive receptors, old PNR structures, historical heritages including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provided. • .Regular inspection, proper maintenance and reconditioning of trains and tracks such as rail grinding, slip-slide detectors and maintenance or replacement of suspension system, brakes and wheels	• DOTr • Operator • LGUs	Included in the operation and maintenance cost	EGF/ Contract agreement	From 3rd Quarter of 2022
PEOPLE								
• Operation of train • Hiring of workers	Local Economy In Migration	• Generation of Local Benefits • Business opportunities • Influx of ISFs	C+	• Coordinate closely with the host LGUs, specifically at the barangay level regarding the hiring of regular workers to ensure that the workers being considered are legitimate residents in the area in consideration to gender equality. • Install fencing and provide guards to prevent the settlement of ISFs along the ROW	• DOTr • Operator • LGUs	Included in the maintenance cost	Contract agreement	From 3rd Quarter of 2022
Operation of train	Physical/ Cultural resource	• Conservation of old PNR structure and parks • Improve access to tourist destination	C+	• Continuous conservation activities of old PNR structures in coordination with PNR and LGUs	• DOTr • Operator • LGUs	Included in the budget of proponent	EGF/ Contract agreement	From 3rd Quarter of 2022
• Operation of	Public Health and Safety	Increase risk of accidents	B-	• Provide security guards in all stations to direct passengers on the safe zone.	• DOTr	Included in the health and	EGF/ Contract	From 3rd Quarter of 2022

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Implementation Schedule
train and station • Maintenance work at Depot	Occupational Health and Safety	Increase risk of accidents and infectious disease of employee	B-	• Implement the Occupational Health and Safety Management Plan. • Provide appropriate PPE to all personnel undertaking maintenance work. • Implement the Emergency Response Plan • Provide sanitary facilities or utilities in all stations and depot.	• Operator • LGUs	safety and environmental management plan of proponent budget	agreement	From 3rd Quarter of 2022
• Operation of train	Traffic Management	Traffic Congestion in the areas adjacent to the proposed stations	B-	• Establish a TOD Committee, which compose of the Traffic Management of LGUs, Planning Office, PNR, DPWH, and DOTr to plan and implement TOD in consideration to the loading and unloading area and the circulation of the traffic as well as the integration of transport facility within the station.	• DOTr • Operator • LGUs	Included in the operation and maintenance cost	EGF/ Contract agreement	From 3rd Quarter of 2022

Note:
A+/-: Significant positive/negative impact is expected.
B+/-: Moderate positive/negative impact is expected to some extent.
C+/-: Minor / Negligible positive/negative impact is expected to some extent.
D: Extent of impact is unknown.

5. ENVIRONMENTAL RISK ASSESSMENT

5.1 OBJECTIVES

1359. The primary objective of the Environmental Risk Assessment (ERA) is to identify the risks to the environment, health and safety risks associated with MCRP activities. ERA aims to manage unforeseen events and potential hazards that may have adverse impacts to the environment and the people. It aims to provide information for making informed decisions and mechanisms to communicate forecasted risks such that stakeholders and the public are informed of the implications of identified risks.

5.2 METHODOLOGY

1360. The risk characterization and assessments can be done using either a qualitative or quantitative approach. Descriptive assessments and systematic characterization form the basis of the qualitative assessment. This is best applied to accidents or events with little or no data pertaining to frequencies of occurrence or ecosystem and health impacts. There are limited data available for the Philippines that can be used for statistical analysis

1361. The assessment method is generally defined as an engineering reliability method known as Failure Modes and Effects Analysis (FMEA). This approach is a systematic characterization and evaluation of sources of risks to the environment. It can be considered as a qualitative approach based on expert opinions. The primary objective of this approach is to identify the risks, prioritize those risks, identify risk tradeoffs, and identify means and methods to reduce the risks. Four questions must generally be answered to fully satisfy the process:

- What can go wrong?
- What is the range of severity of the adverse consequences?
- How likely are those adverse consequences to occur?
- What can be done to reduce risks that are unacceptable?

1362. The assessment is conducted through following steps:

- Hazard identification: Identification of materials to be stored and used within the site
- Environmental Pathway Identification: Cataloguing pathways and migration routes for transport of chemical or biological agents, and the spread of physical stressors
- Accident Scenario: Identification of scenario that allow the introduction of materials to the environment, focusing on the scenarios of “what can go wrong” that have the potential to adversely affect the environment and human health so that the full range of potential consequences must be considered at this stage
- Risk Characterization and Assessment: Estimation of the incidence and severity of the effects likelihood to occur in an environmental compartment due to actual or predicted exposure to a hazard

5.3 HAZARD IDENTIFICATION

1363. Hazards associated with the project were identified during construction and operation phases under the 11 categories below. It should be noted that hazards caused by noise and vibration are not included in this section as these are already discussed in the previous sections. Hazards identified below are focused more on the health and safety impacts to the people.

- Rail system failure
- Structural failure

- Construction related accidents
- Exposure to the toxic chemicals / hazardous substances at contaminated site during construction and operation
- A breach or release of toxic chemicals / hazardous substances at maintenance depot
- A breach or release of toxic chemicals / hazardous substances during transport
- Fire
- Natural Disasters (Earthquake, Flood etc.)
- Terrorism attacks
- Security and violent incidents
- Transmission of infectious diseases

1364. Additional information relative to the specific hazards and risks associated with those hazards is presented below:

(1) Railway System Failure

1365. This includes failure of rail equipment particularly rail track, signaling/ communication systems and rolling stock. Failure of these devices due to natural hazards (flood, earthquake, volcanic eruption and the like), natural wear and tear of rail parts, terrorist attacks or other forms of accidents may result to derailment.

(2) Structural Failure

1366. Structural failure as a hazard is related to buildings at the Depot and stations as well as all infrastructures where the rail tracks are laid. Failure of these structures due to natural or man-made hazards may result to damage of property and/or loss of human life

1367. DOTr and the Contractor will comply with the necessary codes and standards (i.e. the Philippine National Structural Code and National Building Code) in order to obtain the required permits. This will serve as an assurance that the facilities are structurally sound.

(3) Exposure to the Toxic Chemicals / Hazardous Substances at Previous Contaminated Site

1368. In case contaminated sites exist in the project area, exposure to the toxic substance may occur during the detoxification process, excavation of the site during the construction, and also to the neighboring communities. DOTr and the Contractor will ensure that site remediation and/or clean-up, if appropriate, follows national government regulations and procedures on health, safety and environment.

(4) A Breach or Release of Toxic Chemicals / Hazardous Substances at Maintenance Depot

1369. The chemicals used for maintenance activities at depot are not harmful when handled properly. However, if accidental spills during their usage or a breach in containment unit occur, these chemicals may cause hazard to air and surface water. Even on storage, breach in containment unit may accidentally happen allowing the chemicals to diffuse into the air or be spilled on soil and surface/groundwater.

1370. The fuel / chemical containers will be properly designed to ensure its safety and durability during storage. Personnel who will be assigned at the depot will be trained on occupational safety and health standards to ensure safety during handling of chemicals and other hazardous substances for maintenance activities.

(5) A Breach or Release of Toxic Chemicals / Hazardous Substances during Transport

1371. This can be due to accidental spills or breach in containment unit of toxic chemicals and hazardous substances while in transport.

1372. Freight service will be introduced into the rail system or when the system has been developed to warrant the introduction of this service. However, since this Project is a transportation facility, some passengers may opt to carry with them “dangerous” goods that they need to transport. These goods may be accidentally spilled or released from its containers during transport and may cause fire, damage to property and / or loss of human life.

1373. The design of rail facilities to handle storage of toxic chemicals / hazardous substances during freight service will be in accordance with applicable local and international codes and standards. Inspection of containment units of toxic chemicals / hazardous substances for transport will be handled by qualified DOTr personnel and/or the railway operator.

(6) Fire

1374. Fire may occur due to excessive heat, failure of equipment and other accidents. Fire may result to damage of property and/or loss of human life.

1375. DOTr will comply with the Bureau of Fire Protection requirements as part of its application for building permits. Firefighting equipment (fire hydrants, fire extinguishers) will be placed at strategic locations within the project site. The emergency response plans will ensure timely and proper response to emergency situations caused by fire.

(7) Natural Disaster (Earthquake, Flood, landslides, cyclones etc.)

1376. Some part of project area is prone to the natural disaster such as Flood and earthquake. The railway structures are designed taking into account those events, however there might be extreme cases beyond prediction which will cause damage to railway facilities and system, human injuries and accidents.

1377. The DOTr/Contractor will ensure adequate coordination with Disaster and Risk Reduction Management agencies, (Philippine National Red Cross etc.) on appropriate protocols to address such incidents including the response mechanism.

(8) Terrorism Attack

1378. Terrorism attacks are prevalent in mass transport systems these days. Tight security measures (including coordination with law enforcement agencies) will be implemented during construction and operation phases to avoid occurrence of this risk.

(9) Security and Violent Incidents

1379. The structural environment of railway systems may present opportunities for security incidents, crime and violence to occur. These include numerous unobserved niches and empty spaces, poorly lit stations, constricted platforms and crowded facilities.

(10) Transmission of Infectious Diseases

1380. Transmission of infectious diseases through close person-to-person contact or indirect contact is a potential health hazard related to subways, where spaces could be confined. Rodents may also be a problem in subway systems. Hence, it is important to consider diseases that maybe spread by these rodents and their health awareness measures.

(11) Construction Related Accident

1381. During construction, all personnel assigned at the project site may be subject to accidents if health and safety management plans are not properly carried out. Similar to other construction activities, risk may occur due to construction related accidents such as:

- Collapse of scaffolding;
- Falling of construction materials while being lifted by a crane boom;
- Fire or electrocution from welding and use of other electrical equipment;
- Personnel being run over by heavy equipment;
- Accidental fall of workers while in elevated location; and
- Injury from construction debris and materials.

1382. Health and safety management plans required for the Works will be set up by the Prime Contractor. As a matter of policy, Occupational Safety and Health regulations should be followed by all personnel.

5.4 ENVIRONMENTAL PATHWAYS

1383. Ground can be considered as an environmental pathway when liquid substances travel through it by seepage or surface runoff.

1384. Water is one of the fastest and the most short-term pathway for potential pollutant impact. In many cases, this pathway is also a combination of surface water runoff and groundwater. The physical and chemical processes that affect migration of contaminants with both surface water and groundwater pathways are similar. Additionally, topographic and geomorphologic conditions also influence this pathway.

1385. Air can only become an environmental pathway when substances are in gaseous state. Vapors from hazardous chemicals and other substances are volatile. If these substances are released, they may diffuse into the air.

1386. To avoid deleterious effects of the various potential contaminants/pollutants on humans via the enumerated pathways all possible mitigating measures will be made available by the Proponent/Contractor.

5.5 FAILURE MODE AND EFFECT ANALYSIS

1387. Based on the previous discussions of hazard identification, environmental pathways and accident scenarios, FMEA was performed. This is primarily a qualitative assessment approach but does provide a systematic characterization and evaluation of the risks. The analyses combine subjective ratings or categories of likelihood and consequences of various events, which are identified in **Table 5.5.1** and **Table 5.5.2** .

(1) Likelihood and Consequence Rating

1388. The identified hazards will be assessed in terms of the relationship between the level of likelihood to exposure and the severity of effect/consequence of losses to the people, financial, public and environment. The table below shows the relationship of exposure and severity of effects.

Ratings or categories of livelihood and consequences of various events, which are identified in the following tables.

Table 5.5.1 Likelihood Categories for Risk Assessment

Subjective Category	Likelihood Occurrence	Likelihood Occurrence
Negligible	<10-6	Less than 1:1,000,000
Very low	10-6 to 10-4	1:1,000,000 to 1:10,000
Low	10-4 to 10-2	1:10,000 to 1:100
Moderate	10-2 to 10-1	1:100 to 1:10
Significant	>10-1	Greater than 1:10

Source: JICA Study Team

Table 5.5.2 Environmental and Health Consequence Categories for Risk Assessment

Subjective Category	Environmental and Health Consequences
Safe	Negligible effect on environment and human health
Marginal	Failure will cause some environmental degradation but no major or long term damage. Minor injury or illness.
Moderate	Failure will cause significant environmental degradation but no long term damage. Major injury or illness.
Critical	Failure will degrade environment, and if not mitigated will cause significant and permanent damage. Permanent disability.
Severe	Failure will cause major and irrevocable environmental damage. Fatalities

Source: JICA Study Team

(2) Risk Assessment Conclusion

1389. As indicated in the FMEA analysis, a number of individual events would need to occur in near simultaneous fashion to result in potential occurrence of these risks. Individually, each event has a low probability of occurrence. When taken as a joint occurrence the probabilities are even lower. As such, only a catastrophic event would present a potential environmental hazard.

1390. A summary of these analyses using these categories as applied to the eleven (11) accident scenarios is presented in **Table 5.5.3**.

Table 5.5.3 Summary of Failure Modes and Effects Analysis

	Description of Failure Mode	Project Phase	Effects	Consequences		Likelihood		Preventive measure
				Category	Confidence	Category	Confidence	
1	Failure of rail component may result to derailment	Operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Design of rail system should conform with known standards
2	Structural failure of encapsulation facility by seismic events	Construction and operational phase	Possible damage to property and injury/loss of human life	Minimal to marginal (environmental degradation)	High	Very low	High	Structural design follows or exceeds Code requirements
3	Exposure to the toxic chemicals and hazardous substances at previous contaminated site	Construction phase	Possible damage to property and injury/loss to human life	Minimal to marginal (environmental degradation)	High	Very Low	High	Adherence and training on Occupational Safety and Health Environmental guidelines/procedures
4	Release of toxic chemicals and hazardous substances during maintenance activities	Operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Safety training for depot personnel and proper design of depot facilities
5	Release of toxic chemicals and hazardous substances during transport of dangerous goods	Operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Inspection of goods for transport by qualified personnel and design of rail facility to handle transport of dangerous goods
6	Fire	Construction and operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Installation of firefighting facilities
7	Natural Disaster	Construction and Operational Phase	Possible damage to property and injury/loss to human life	Minimal to moderate (Environmental degradation)	High	Very low	High	Design of rail structure/system should conform to international standards. Adequate response mechanism
8	Terrorist attacks	Construction and operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Tight security measures within the project site
9	Construction related accidents	Construction phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Follow Occupational Safety and Health regulations
10	Security and violent incidents	Operational phase	Possible damage to property and injury/loss to human life	Minimal to marginal (environmental degradation)	High	Very low	High	Tight security measures at the Railway facilities (Station, Sub-station, Depot)
11	Transmission of infectious diseases	Construction and operational phase	Possible injury/loss to human life	Minimal to marginal (Health consequences)	High	Low	High	Health awareness measures and sanitary practices.

Source: JICA Study Team

5.6 EMERGENCY RESPONSE POLICY AND GENERIC GUIDELINES

5.6.1 Objectives

1391. During the DED, the DOTr will organize a Project Management Office which will develop an Emergency Preparedness and Response Plan (EPRP) in order to define actions in preventing the occurrence of accidents and response procedure in case of accidents, fire and natural hazards. For the construction phase, the contractor will be required to prepare the EP RP.

1392. During the operation phase, the DOTr and PMO operator of the proposed MCRP will also prepare a specific ERP for its operations.

1393. The EPRP will be aligned with the policy of the DOTr on the strict implementation of precautionary, safety and security measures to ensure safe, fast, efficient and reliable transportation services.

5.6.2 Concept

1394. Possible causes of emergency situations due to man-made and natural hazards should be considered in the DED to reduce the chance of their occurrence. There are a number of design standards and codes that DOTr PMO will have to comply with and incorporate in its performance specifications. These standards are part of the requirements of the local agencies concerned in order to grant permits and licenses to DOTr.

1395. Procedures for each of several emergency categories will be established. The procedures will specify necessary actions to be performed by appropriate personnel within a time or event sequence. The emergency response plan will as a minimum address, but not limited to the following categories:

- Construction-related accidents (including spills during excavation works)
- Fire
- Bomb Threat
- Total Power Failure
- Structure Failure
- Train Derailment or Collision
- Transport of Dangerous Goods
- Suicide/Railway Injuries or Fatalities
- Criminal Acts
- Natural disasters (High Winds, Flood, Earthquake, etc.)

1396. The plan will establish what constitutes an emergency and the procedure will be developed for the following:

- Emergency Reporting
- Notification of Emergency Response Personnel
- Dispatching of Emergency Response Personnel and Equipment to the Site
- Coordination of all Emergency Response activities
- Protection of passengers/personnel, and equipment at the emergency site
- Evacuation of passengers/personnel
- Communication to all passengers, employees, emergency response personnel
- Restoration of normal operations
- Containment procedures for hazardous chemicals and dangerous goods

1397. Training of contractors, employees and emergency response team will also be undertaken. Education of the riding public with regard to emergency procedures and equipment as well as required passenger emergency response will also be included. Facilities, equipment and vehicles needed to cope effectively with emergency situations will also be required.

5.6.3 Emergency Response Program

1398. The proponent through its vision will adopt an active program of pursuing a healthy, safe and environment-friendly operation. DOTr/Operator guidelines on health and safety will be made clear to contractors and all employees during construction and operations. An orientation briefing for contractors and training for employees will be implemented.

(1) Construction Phase

1399. Emergency situations that may occur during construction are construction-related accidents and fire. The Prime Contractor will set up safety measures required for the Works as follows:

- Upon issuance of Notice of Award, prepare, as part of the Contractor's Environmental Management Plan (CEMMAP), an Emergency Response and Contingency Plan, as well as an Occupational Safety and Health Management Plan that illustrate measures to be undertaken during emergency cases including spills, fire, structural failure, and other construction-related accidents. As previously mentioned, approval of the CEMMAP (including plans mentioned above) will be a prerequisite for issuance of Notice to Proceed.
- Provide and enforce wearing of Personal Protective Equipment (PPE) such as: efficient helmets, and where necessary, eye goggles, ear protection, safety harnesses, and other personal protection equipment for all the personnel.
- Submit for the approval of DOTr detailed proposals for safety regulations and emergency procedures.
- Approved copies of above plans, regulations and emergency procedures will be produced by the Prime Contractor and distributed and displayed at each place of work, together with any other documents, posters, notices boards, or the like which are required by law. The Prime Contractor will revise, replace, maintain, or remove the notices, regulations and the like as required by legislation.
- Provide adequate warning signs, barricades, and warning lights at all times during construction.
- Ensure that all equipment is in good working condition.
- Provide at designated stations within the site emergency telephones, suitable accommodation, and transport and first aid equipment including stretchers.
- Provide adequate service for the protection against fire at the site in accordance with the local fire regulations.
-

(2) Operation Phase

1400. For the operation stage, emergency situations that could occur are as presented in **Table 5.6.1**.

Table 5.6.1 Preventive Maintenance during Emergency Situations

Emergency Situation	Preventive Measures
Derailment	• Railway Operator will procure emergency re-railing and rescue equipment. These should be part of the depot equipment. • Railway Operator will inspect, maintain adjust and replace defective, excessively worn or broken running rails, cross ties, special track work components, ballast, direct fixation fasteners, and other track materials, related

Emergency Situation	Preventive Measures
	hardware and support equipment. • Railway Operator will also inspect and adjust the smoothness of the alignment and levels of the track geometry. There will be inspections for: - Track geometry and ride quality - Turnouts (which may be combined with regular lubrication and cleaning) - Ultra-sonic testing of rail joints and turnout components. These tests will be based on an annual test in each of the first two years and then scheduled as necessary according to the initial results.
Fire	The Fire Safety Enforcement Manual of the Bureau of Fire Protection Philippine Standards will be principally used as the design criteria of this project as imposed by the laws of the Philippines to be complied with.
Typhoon	Regulations to follow for each typhoon signal no.: 1 – speed restriction for trains (60 kph max) 2 – speed restriction for trains (30 kph max) 3 – speed restriction for trains (30 kph max) 4 – suspend operation
Flood	The bridge design will be carried out for a 50 and/or 100 yr return period high water level with a minimum safety margin clearance of 1 m and/or 0.5 m, respectively whichever is the greater. In addition, all drainage will be replaced, and in most cases by a better system. Railway Operator will conduct periodic maintenance or when necessary for its drainage and water systems.
Earthquake, Ground Setting and Liquefaction	[Guideway Structures] • Railway Operator will perform regular inspections by routine patrol of all subway and depot structures and perform maintenance and repairs. A detailed structure inspection will be performed at least once per year. • The general condition of the structure as viewed from the track will be included in the item list of all route patrols, which are carried out on a regular basis. • All structures will be catalogued and numbered in a register of structures that records the conditions, inspection requirements, results and any corrective actions. • Main structures will be the subject to periodic structural inspections. These inspections will be designed and performed according to general practice according to the structure types, materials (steel or concrete), foundations, and any specific examination of components such as bearing and expansion joints. • Stations and Depot buildings will also be inspected using route patrolling and general route inspections. The inspections will be supplemented with fault reports made by the operational staff. • Should periodic inspection detect signs of ground movement, services will be suspended or be run at reduced speed. If services are allowed to continue, detailed monitoring of the site would be instigated. If services will be suspended, passengers would be de-trained at the next available station stop. Detailed investigation into the improvements required would be undertaken before services are recommenced or speed restrictions be lifted and such works would be put in hand as soon as reasonably. [Tracks] • Railway Operator will inspect, maintain adjust and replace defective, excessively worn or broken running rails, cross ties, special track work components, ballast, direct fixation fasteners, and other track materials, related hardware and support equipment. • Railway Operator will also inspect and adjust the smoothness of the alignment and levels of the track geometry. • In addition to the patrols described above, there will be inspections for: - Track geometry and ride quality - Turnouts (which may be combined with regular lubrication and cleaning) - Ultra-sonic testing of rail joints and turnout components. These tests will be based on an annual test in each of the first two years and then scheduled as necessary according to the initial results. • Should periodic inspection detect signs of ground movement, services will be suspended or be run at reduced speed. If services are allowed to continue, detailed monitoring of the site would be instigated. If services will be suspended, passengers would be de-trained at the next available station stop. Detailed investigation into the improvements required would be undertaken before services are recommenced or speed restrictions be lifted and such works would be put in hand as soon as reasonably.
Failure of Structure	DOTr PMO will comply with international and national standards to ensure that the structures are designed and built in accordance with these safety standards.
Transport of Dangerous Goods	DOTr PMO has no immediate plans for the transport of dangerous goods. However, DOTr PMO and Railway Operator train crew and emergency re-rail and rescue crews would receive specific training on emergency procedures associated with the specific types of goods carried.
Medical attention required by passengers	For every station, security guards will be equipped with first aid kits. During extreme emergency cases, medical services including ambulance would be summoned to the nearest station by the central supervising station.
Criminal Acts	Railway Operator will provide security services to ensure the safety of passengers, crew and office workers.

1401. DOTr PMO will produce an emergency procedural plan, which will include, but not limited to, the following:

- Policy, purpose, scope and definitions

- List of participating agencies and names of executives responsible for each agency
- Safety procedures during emergency situations
- Purpose and operation of Centralized Train Control (CTC) System and alternate CTC
- Purpose and operation of command post and auxiliary command post
- Communication facilities available for use during emergency cases
- Operating manuals of all specialized rescue equipment
- Maps and plans of complex areas of the system
- Any additional information and data that the particular agencies require to have in the plan.

1402. LGUs and other participating agencies within the locality will be coordinated with by DOTr PMO to cooperate and assist depending on the nature of an emergency, which will include the following:

- Medical services
- Building department
- Fire department
- Police department
- Utility companies
- Other transportation agencies

1403. Training for emergency response crew for the operation stage will be programmed to include the following:

- Sponsored by equipment suppliers for the rescue equipment, firefighting equipment and the like
- Courses being offered by some government agencies and entities such as DSWD, Bureau of Fire Protection Special Rescue Unit (BFP-SRU), Philippine National Red Cross, DENR-EMB, Disaster and Risk Reduction Management offices etc.
- Evacuation of passengers from train, to a point of safety along the guideway
- Evacuation of passengers from stations (surface and underground)

1404. Emergency procedures to be controlled from the CTC within the Depot control center, including coordination of participating agencies such as fire service, police, ambulance, public works and utility companies, etc.

6. SOCIAL DEVELOPMENT PLAN/FRAMEWORK AND IEC FRAMEWORK

6.1 SOCIAL DEVELOPMENT PLAN/FRAMEWORK

(1) Objective

1405. The Social Development Plan/Framework (SDP) is formulated in coordination with the City and Municipal Planning and Development Officers of the cities and municipalities where MCRP will pass through, in order to derive from the respective local SDPs of the LGUs, their programs and projects for people's livelihood, health and environment. This would enable them to enhance their self-reliance in the context of the proposed MCRP.

(2) Responsible parties

1406. The LGU will implement SDP for potential projects as stated in **Table 6.2.1**. The formulation of the SDP will involve also those government agencies with mandates to deliver services in social development such as DOH, DENR, Department of Education (DepEd), Department of Social Welfare and Development (DSWD), Department of Trade and Industry (DTI), Philippine National Police (PNP), etc. It should also include civil society such as NGOs and People Organizations (PO).

(3) Social Development Framework

1407. SDP for the proposed MCRP will be prepared based on the data/information collected from CLUP of the host LGUs and based on the discussions during the Pre-IEC, Public Scoping. The information collected from perception survey will also form part of the SDP that mainly addresses the perceived fears of environmental degradation due to pollution on land, water, air and health risks. **Table 6.2.1** presents the indicative SDP for the proposed MCRP.

1408. Further, it is necessary that re-assessment of SDP be regularly done to identify and monitor the following:

- High investments which may have savings and income for the LGU/s and proponent;
- More social development projects for direct and indirect affected communities; and
- Need for a unified grievance mechanism to address complaints effectively and timely.

1409. The cost estimates will be prepared once the specific projects have been identified and processed in consultation with the LGUs and sectors concerned.

6.2 IEC FRAMEWORK

1410. The IEC Plan/Framework will be undertaken to encourage the participation and cooperation not only of the affected households but a broader sector of stakeholders and facilitate the establishment of support linkages throughout the implementation and operation of the project.

1411. The IEC will also inform the stakeholders about the progress of the project and provide feedback to the proponent regarding the concerns and issues raised by the stakeholders as the project progress.

1412. **Table** 6.2.2 presents the IEC Framework for the proposed MCRP.

(1) Target Sector

1413. The IEC will be provided targeting project affected barangay and public as well as general public who will be indirectly affected.

1414. During the detailed design and engineering works, which will be undertaken post ECC, the proponent will consider consultations as maybe necessary and feasible with independent professionals, individuals, members of the academe, concerned governmental entities (e.g. the DOST PAGASA/PHIVOLCS) and of the civil societies concerning the application of technical/scientific/engineering knowledge and methodologies to address various perceived and real concerns on natural risks and hazards at the project site environs.

(2) IEC Scheme/ Strategy Methods and Information Medium

1415. The IEC methods will include individual methods (key informant interviews), group methods (focus group discussions), community open forum, and multi-media (print and social media). The IEC will provide information about the project details such as benefits and risks that will result from its implementation and should also inculcate value formation by making members of the community aware of their responsibilities as stakeholders.

1416. The IEC program will be implemented in close coordination with concerned LGUs, NGOs, and stakeholders. DOTr will also engage the services of local teachers and community organizers in planning, implementing and conducting the IEC.

(3) Timeframes / Frequency and Funding Support

1417. Presented in **Table 6.2.1** and
1418. **Table** 6.2.2 the SDP and IEC Frameworks, respectively. Schedule of activities varies per target sector. Included in the matrix is the source of fund for each activity for the proposed SDP activities. IEC activities on the other hand will be funded by DOTr.

Table 6.2.1. SDP Framework for the Proposed MCRP

Concern		Responsible Community Member/ Beneficiary	Government Agency/ Non-Government Agency and Services	Proponent	Indicative Timeline	Source of Fund
1	Livelihood					
	1-A Preparation of Resettlement Action Plan (RAP)	• Barangay Chairman; and • Presidents of Homeowners Association	• DOTr • NHA • LGU	DOTr – PMO	DED Stage (i.e. After conduct of Parcellary Survey)	Part of DED Consultancy budget
	1-B Relocation of informal settlers	• Barangay Chairman; and • Presidents of Homeowners Association	• DOTr • NHA • LGU Housing Office • DSWD • DPWH	DOTr – PMO	Pre-Construction Stage	• DOTr • Site development cost and other basic facilities can be included in DED budget
	1-C Gender Responsive Livelihood Training Program (for women) • Skills training for construction work • Skills training for handicraft making • Skills training for food preparation, etc.	• Barangay Chairman; • Barangay Kagawad for Livelihood; • Presidents of Homeowners Association • Officers of Women's organizations	• LGU Livelihood Office • DSWD • TESDA	DOTr – PMO	After ECC Issuance	• LGU Livelihood Office • TESDA • DOTr PMO/Contractor CSR
	1-D Formation of/ Support to Vendors Organizations	• Barangay Chairman; and • Leaders of Vendors Organizations	• DOTr • DTI • LGU	DOTr – PMO	Prior to RAP Implementation	• LGU Livelihood Office • DOTr PMO/Contractor CSR
2	Health and Safety • Environmental Health Risk from the construction of the Project • Problems of potable water and sanitation • Lack of health facilities and development program	• Barangay Chairman; and • Barangay Kagawad for Health and Safety	• City/Municipal Health Office; • DSWD • Barangay Health Centres	DOTr – PMO	Pre-Construction, Construction, Operation Stage	• LGU Health Office • DOTr PMO/Contractor CSR
3	Education • Scholarship of qualified students • Alternative education for adults who lack literacy and numeracy skills	• Barangay Chairman; • Barangay Kagawad for Education • Teacher and/or Principal; and • Qualified Students of Barangays	• Department of Education • Barangay		Pre-Construction, Construction, Operation Stage	• LGU • DOTr PMO/Contractor CSR
4	Sports • Enhancement of culture and sports activities	• Barangay Chairman; and • Barangay Kagawad for Sports	• City/municipal Sports Commission • Barangays		Pre-Construction, Construction, Operation Stage	• LGU • DOTr PMO/Contractor CSR
5	Environment and Sanitation • Indiscriminate disposal of garbage • No proper toilets and sewage system	• Barangay Chairman; and • Barangay Kagawad for Environment and Sanitation	• LGU and CENRO; and • DENR Region 3	DOTr – PMO	Pre-Construction, Construction, Operation Stage	• LGU CENRO • DOTr PMO/Contractor CSR

Concern		Responsible Community Member/ Beneficiary	Government Agency/ Non-Government Agency and Services	Proponent	Indicative Timeline	Source of Fund
6	Peace and Order • Maintenance of peace and order	• Barangay Chairman; • Barangay Kagawad for Peace and Order; • Homeowners Association Sergeant-at-Arms	• LGU • PNP	DOTr – PMO	Pre-Construction, Construction, Operation Stage	• LGU and PNP • DOTr PMO/Contractor CSR
7	Spiritual	• Barangay Chairman; • Parish Pastoral Council; • President Homeowners Association; • Leaders of other religious groups	• Parish Priests • LGU	DOTr – PMO	Pre-Construction, Construction, Operation Stage	• LGU • DOTr PMO/Contractor CSR

Table 6.2.2 IEC Framework for the Proposed MCRP

Target Sector	Major Topic/s of Concern in Relation to Project	IEC Scheme/ Strategy/ Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
LGUs along Railway Alignment	Project Status	Group Meeting	Slide Presentation FGD	• Once on Pre-construction (DED Stage) • Quarterly during Construction Phase • As required during Operation Phase	P20,000.00 per meeting
	Work Progress	Group Meeting	Slide Presentation FGD	• Monthly during Construction Phase	P20,000.00 per meeting
Concerned Government Agencies (e.g. DPWH, BCDA)	DED issues	Group Meeting	FGD	• As needed on Pre-construction (DED Stage) • As required during Construction and Operation Phases	P15,000.00 per meeting
Professional society and Individuals	Continuing consultation	Group Meeting	Multi-sectoral Cluster Meeting FGD	• Once on Pre-construction (DED Stage) • As required during Construction and Operation Phases	P15,000.00 per meeting
Barangay Chairman of Project-affected barangays	• Project Status • Socio-Economic impacts and benefits to existing establishments, health and safety • Resettlement Action Plan	Group Meeting	• Audio-Visual Presentation • Slide Presentation • Authority figures and Key Informant Interviews	• Once on Pre-construction (DED Stage) • Monthly during the entire period of ROW Acquisition • As required during Construction and Operation Phases	P30,000.00 per meeting
Local Inter-Agency Committees (LIACs)	• Presentation of Project Status; and • Presentation of valuation methodology and next steps for ROW Acquisition	Group Meeting	• Slide Presentation • Multi-sectoral Cluster meetings	• Once on Pre-construction (DED Stage) • Monthly during the entire period of ROW Acquisition • As required during Construction and Operation Phases	P30,000.00 per meeting
Land and Structure Owners	• Project Status • Valuation methodology and next steps for ROW Acquisition	Group Methods	• Slide Presentation • FGD • Printed Materials	• Before construction Phase • As necessary until completion of ROW Acquisition	P30,000.00 per meeting
Senior Citizen	• Project Status • Health and Safety	Group Methods	• Slide Presentation • Printed Materials	• Before construction Phase • As necessary until completion of ROW Acquisition	Will be determined during DED
Female residents	• Project Status • Health and Safety	Group Methods	• Slide Presentation • Printed Materials • FGD	• Before construction Phase • As necessary until completion of ROW Acquisition	Will be determined during DED
Vendors	• Project Status	Group Methods	• Slide Presentation	• Before construction Phase	Will be

Target Sector	Major Topic/s of Concern in Relation to Project	IEC Scheme/ Strategy/ Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
	• Health and Safety		• Multi-sectoral Cluster meetings	• As necessary until completion of ROW Acquisition	determined during DED
Informal Settlers	• Project Status • Relocation site • Health and Safety	Group Meeting	• Slide Presentation • Multi-sectoral Cluster meetings	• Before construction Phase • As necessary until completion of ROW Acquisition	Will be determined during DED
General Public (Indirect)	• General project information and updates	Multi-media	• Media releases • Slide Presentation • Printed Materials	• Before construction Phase up to the completion of the project.	Will be determined prior to construction
MMT Members	• Project Details • Status of Implementation • Impact Management and Monitoring Plans • Quality Management	Group Method	• Slide Presentation • Printed Materials	• Upon formation of MMT composition	P15,000.00

7. GRIEVANCE REDRESS MECHANISM

7.1 OBJECTIVES OF GRIEVANCE REDRESS MECHANISM

1419. The Grievance Redress Mechanism (GRM) is an effective tool for early identification, assessment, and resolution of compliants on projects. GRM will serve as a venue for receiving aggrieved stakehoders' concerns and acting on the concerns but it does not hinder them from their right to judicial action if the decision is unacceptable. The DOTr will establish a GRM for following objectives:

- Receive and facilitate the resolution of project 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

1420. During the Feasibility Study Stage, MCR–PMO will set-up a helpdesk to initially handle complaints. GRM will be established during the DED Stage. MCR–PMO 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 MCR–PMO (hotlines, email, etc.)

7.3 LEVELS OF GRIEVANCE REDRESS MECHANISM

The GRM is composed of four (4) levels (**Table 7.3.1**). The Grievance officer of DOTr Railay Office will be the contact point for receiving the grievances/complaints from the stakeholders.

Table 7.3.1 Levels Of Grievance Redress Mechanism

	Environment Issue	Health and Safety Issue	Timeline
Contact Point	Greivance Officer of DOTr Railway Offices		Same day
1st Level	HSEO of PMO		3 days
2nd Level	HSEC		10 days
3rd Level	Multipartite Monitoring Team (MMT)	DOTr Management Level	15 days
4th Level	DENR EMB	Court of Justice	

1421. 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.

1422. The DENR and the Court of Justice will be the final decision maker for the complaint and grievance. All cases elevated to the 4^{th} level will be outside the jurisdiction and control of this GRM.

7.4 ROLES AND RESPONSIBILITIES

7.4.1 The Grievance Officer of DOTr Railway Offices

1423. The Grievance Officer will be appointed as a complaint contact point of DOTr Railway Offices to receive all MCRP-related complaints. The DOTr will prepare a procedural manual / operation manual on the GRM to include, but not limited to, the nature of complaints which should be handled by the HSEO of the PMO, HSEC, MMT, DOTr Management Level. The manual will also include a GRM Frequently Asked Questions Sheet to be circulated to all DOTr Offices. The Grievance Officers will be provided with sufficient training prior to deployment.

1424. The following are the roles and responsibilities of the Grievance Officer of DOTr Railway Offices:

- Screening of complaint if it is project-related or not. If the complaint is project-related (health, safety, environment issue), forward the complain to the HSEO, HSEC or MMT. If the complaint is not project-related, assist the aggrieved stakeholder by forwarding 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 grievance registry of the DOTr-Record Management System) of the complaint and provide copy of the complaint including contact details where the complaint will be forwarded and who will act on it within the day of receipt;
- Constant communication with the aggrieved stakeholder to the whereabout and status of his/her concerns;
- Following up with the HSEO, HSEC, and MMT on their action on the complaint;
- Providing feedback to the PMO on the status of complaint and subsequent action/decision of the HSEO, HSEC, and MMT; and
- Maintaining a database for all complaints and the corresponding actions and decisions on the complaints received. Prepare Quarterly Report on Grievance Redress to include accomplishments and status of unresolved grievance to the higher level and JICA/ ADB.

7.4.2 1st Level: Health, Safety and Environment Officer

1425. The HSEO of MCR-PMO will be responsible to receive, assess/evaluate and provide findings/recommendation on all complaints forwarded by the Grievance Officer of DOTr Railway Office. The following are the roles and responsibilities of the HSEO:

- Act and decide within three (3) working days on the complaint forwarded by the Grievance Officer of DOTr Railway Office; and
- Provide feedback to the aggrieved stakeholder on the status and/or the decision on the complaint through the Grievance Officer of DOTr Railway Office.

7.4.3 2nd Level: Health, Safety and Environment Committee

1426. The HSEC, which will compose of HSEO, General Contractor and Contractor, will be responsible to receive all complaints forwarded by the Grievance Officer. The following are the roles and responsibilities of the HSEC:

- Discuss forwarded grievances on the regular weekly meeting;
- Act and decide within 10 working days on the complaint received from the Grievance Officer; and
- Provide feedback to the aggrieved stakeholder on the status and/or the decision on the complaint through the Grievance Officer.
- Hold public consultation within the area of complaint to consult the community.

7.4.4 3rd Level: MMT / DOTr PMO Board level

1427. The MCR–PMO will initiate the formation of MMT compliant to Section 18 of DAO No. 2017-15. MMT will be responsible for handling environmental issues whereas health and safety related issues will be handled by the DOTr Management Level. Its roles and responsibilities relative to grievances are the following:

- 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; and
- Inform the aggrieved stakeholder and MMT/ DOTr Management Level of the actions and decisions regarding the filed complaints through the Grievance Officer of DOTr Railway Office.
- Conduct monthly meetings to discuss complaints and grievances; and
- Update the status of the MCRP in the FAQ sheet to be disseminated to Grievance Officers

7.4.5 4th Level: DENR

1428. Issues related to environment, not addressed in the third level will be elevated to EMB-DENR.

7.5 GRIEVANCE REDRESS MECHANISM PROCEDURES

1429. Grievances from the aggrieved stakeholders related to environment issues with regard to the project will be handled, free of monetary charge, through a process of negotiations aimed at arriving at a consensus decision. The procedures are described below:

Table 7.5.1 Grievance Procedure

<table>
<tr><th>Steps</th><th>By</th><th colspan="2">Actions</th></tr>
<tr><td>1</td><td>Aggrieved Stakeholder</td><td colspan="2">Any aggrieved stakeholder will lodge his/her grievance in writing, verbally or electronically transmitted to the DOTr Railway Office for immediate action.</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">The Grievance Officer (DOTr Railway Office)</td><td colspan="2">• 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 grievance registry of the DOTr-Record Management System) of the complaint, provide copy and give contact details of where the complaint will be forwarded and who is responsible for acting on complaint.
• Review the complaint to determine whether it is project related or not.</td></tr>
<tr><td>a) If the complaint is project-related, the DOTr Railway Office will forward the complaint to the HSEO within the day from receipt of complaint.</td><td>b) If it is not project-related, the DOTr Railway Office will assist the PAP by referring the complaint to the appropriate agency or LGU who may be able to act on the complaint.</td></tr>
<tr><td>3</td><td>Aggrieved Stakeholder</td><td></td><td>If the aggrieved stakeholder is not satisfied with the decision of the Grievance Officer of DOTr Railway Office that the complaint is not project-related, the aggrieved stakeholder may elevate his/her complaint to the HSEO.</td></tr>
<tr><td>4</td><td>The Grievance officer (DOTr Railway Office)</td><td></td><td>• Receive request from the aggrieved stakeholder to elevate his/her complaint to HSEO of the Contractor
• Record the status of the aggrieved stakeholder complaint.</td></tr>
<tr><td>5</td><td>1st Level PMO HSEO</td><td colspan="2">• Receives complaint forwarded by the Grievance officer.
• Act and decide on the complaint within three (3) working days reckoning from the day it is received from Grievance Officer and inform the decision to the aggrieved stakeholder on the decision accordingly.
• Inform the Grievance Officer the action and/or decision on the aggrieved stakeholder's complaint.</td></tr>
<tr><td>6</td><td>The Grievance Officer (DOTr Railway Office)</td><td colspan="2">• Receive and record decision of 1st level decision maker
• Inform to the aggrieved stakeholder.</td></tr>
<tr><td>9</td><td>Aggrieved Stakeholder</td><td colspan="2">• Receives action of the 1st level through the Grievance Officer
• If satisfied, the complaint is resolved and recorded accordingly.</td></tr>
</table>

Steps	By	Actions
		• If not satisfied with the decision of the 1st level or if his/her complaint has not been acted upon within a period of three (3) working days and has not received any response from the 1st level decision maker, the aggrieved stakeholder can forward the complaint, or file an appeal, to the HSEC.
	Grievance officer (DOTr Railway Office)	• Receive request from the aggrieved stakeholder to elevate his/her complaint to the HSEC • Record the status of the aggrieved stakeholder complaint. • Forward the complaint to the 2nd Level within the day from receipt of complaint.
7	2nd Level HSEC	• Receives complaint from the Grievance Officer. • Act and decide on the complaint within 10 working days and inform the decision to the aggrieved stakeholder on the decision accordingly. • Inform the Grievance Officer the action and/or decision on the aggrieved stakeholder's complaint.
8	Grievance Officer (DOTr Railway Office)	• Receive and record decision of HSEC • Inform to the aggrieved stakeholder.
9	Aggrieved Stakeholder	• Receives action of the 2nd Level through the Grievance Officer • If satisfied, the complaint is resolved and recorded accordingly. • If not satisfied with the decision of the 2nd Level or if his/her complaint has not been acted upon within a period of 10 working day and has not received any response from the 2nd Level, the aggrieved stakeholder can forward the complaint, or file an appeal, to the 3rd Level.
10	Grievance Officer (DOTr Railway Office)	• Receive request from the aggrieved stakeholder to elevate his/her complaint to the 3rd Level. • Record the status of the aggrieved stakeholder complaint. • Forward the complaint to the 3rd level within the day from receipt of complaint.
11	3rd Level MMT / PMO Board	• Receives complaint from the Grievance Officer. • Act and decide on the complaint within 15 working days and inform the decision to the aggrieved stakeholder on the decision accordingly. • Inform the Grievance Officer the action and/or decision on the aggrieved stakeholder's complaint.
12	Grievance Officer (DOTr Railway Office)	• Receive and record decision of the 3rd Level • Inform to the aggrieved stakeholder.
13	Aggrieved Stakeholder	• Receives action of the 3rd Level through the Grievance Officer • If satisfied, the complaint is resolved and recorded accordingly. • If not satisfied with the decision of the MMT or if his/her complaint has not been acted upon within a period of 15 working day and has not received any response from the 3rd Level, the aggrieved stakeholder can forward the complaint, or file an appeal, to the DENR
14	4th Level DENR	• Receives complaint from aggrieved stakeholder. • Once the complaint is filed in the DENR, technical conference will follow.

7.6 GRIEVANCE REDRESS MECHANISM GUIDELINES

1430. The guidelines for GRM are as follows:

- All complaints received in writing, verbally or transmitted electronically will be documented and filed. Upon receiving a complaint from the aggrieved stakeholder, the Grievance officer will accomplish the Grievance Action Form (GAF).
- Aggrieved stakeholder will not be charged of any fees (administrative and legal fees) in filing of their grievance.
- The GAF will be stamped with a "Received" mark with corresponding control number, date of receipt and signature of the persons who received the said letter.
- Actions and decisions made with the received complaints/grievances/appeals by the HSEC, MMT and EMB-DENR will be reported and discussed by the Grievance Officer during weekly meetings.
- If the grievance indicated in the letter cannot be readily addressed, the aggrieved stakeholder will be referred to the appropriate authority. The following will be indicated in the GAF: name of the authority to look for, date when the aggrieved stakeholder can meet with the said authority, and the venue for the meeting.
- In addition, the Grievance Officer of DOTr Railway Office will publicize the grievance redress process in the form of handouts such as pamphlets, brochures or leaflets that are written in Filipino. All concerned institutions, including Barangays, LGUs, and the MCR – PMO, will use the same handouts in explaining the grievance redress procedures to the

aggrieved stakeholder who will come to them to raise their issue or concern. The handout will be disseminated through LGUs and Barangays as well as DOTr, also the mechanism to be publicized at the website of DOTr and LGUs.

7.7 GRIEVANCE ACTION FORM

1431. The GAF presented in **Figure 7.8.1** will be adopted. At all levels, a grievance registry will be maintained to keep track and document the number and type of complaints and grievances that will be raised, as well as their status and action/s taken. The GAF will, as a minimum, contain the following:

- Basic information of the aggrieved stakeholder (Name, Address, Contact Number);
- Date of last disclosure meeting;
- Category of grievance filed (environment related issue or not); and
- Type of action taken (resolved at the HSEC level or referred to higher authorities).

7.8 MONITORING REPORTS ON GRIEVANCE REDRESS

1432. The MCR-PMO will prepare Quarterly Reports on Grievance Redress which include the accomplishments and status of unresolved grievance of each agency to the higher level and JICA/ADB. This report will be a part of internal and external monitoring.

Grievance Action Form

<table>
<tr><td colspan="2">Note: Shaded portions to be filled up by the Grievance Officer only</td><td>Control No.</td></tr>
<tr><td>PROJECT INFORMATION
Name of Project:</td><td colspan="2">Date Received:</td></tr>
<tr><td>Implementing Officer:</td><td colspan="2">Received by:
Designation:

Signature over printed name</td></tr>
<tr><td colspan="3">PAP's PERSONAL INFORMATION</td></tr>
<tr><td colspan="3">Name ______ Date of Birth (MM-DD-YYYY) ______
Spouse ______ Date of Birth (MM-DD-YYYY) ______
Address ______
Occupation ______
Contact Number ______</td></tr>
<tr><td colspan="3">DETAILS ON GRIEVANCE FILED</td></tr>
<tr><td>CATEGORY (Encircle appropriate letter)

A Environmental Related
B Health and Safety Related
C RAP Related
D Not Environment/RAP Related</td><td>TYPE OF ACTION (Encircle appropriate letter)
Environmental
A Resolved at HSE Officer Level
B Resolved at HSEC Level
C Resolved at MMT Level
D Referred to DENR – EMB</td><td>RAP
A Resolved at LIAC / DOTr per PMO
B Resolved at RIC
C Referred to Court</td></tr>
<tr><td>DETAILS OF GRIEVANCE
Date: ______

Details: ______</td><td colspan="2">REFERRAL DETAILS

Name of Authority ______
Office ______
Position ______
Date of Meeting ______
Venue ______</td></tr>
<tr><td colspan="3">Referred by: ______
(Printed Name and Signature of Grievance Officer)

Concurred: ______
(Printed Name and Signature of PAP)

Date: ______</td></tr>
</table>

Figure 7.8.1 Grievance Action Form (draft)

8. ENVIRONMENTAL COMPLIANCE MONITORING

1433. The Environmental Compliance Monitoring presents the DOTr's commitment to conduct a self-monitoring activity wherein various measures are proposed in order to ensure that the impacts which will be caused by the proposed project are minimized and properly managed. This Environmental Compliance Monitoring takes reference to the provision of DAO 2017-15, which requires the establishment of the MMT for Environmentally Critical Projects (ECPs), the Environmental Monitoring Fund (EMF) and the Environmental Guarantee Fund (EGF).

8.1 SELF-MONITORING PLAN

1434. DOTr will conduct a self-monitoring activity of its environmental operations, and will regularly submit its Self-Monitoring Report (SMR) to the DENR. The initial Environmental Monitoring Plan (EMoP) will follow Annex 2-20 of the DAO 2003-30. The plan is largely indicative and will be refined during project implementation.

1435. Environmental monitoring will involve all project phases; namely, construction, commissioning, operations and abandonment to determine and find explanation on any changes in the baseline data. This includes inventory of opened up areas, removal of structures and vegetation, volume of spoils, spaces opened up, built up structures, influx of workers, water consumption, jetty operations, waste generation, disposal of hazardous wastes, operating and maintenance of equipment, fuel and chemical storage and dismantling and removal of facilities and removal and disposal of demolition wastes. An initial EMoP is presented in **Table 8.1.1**.

Table 8.1.1 Environment Monitoring Plan for the Proposed MCRP

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
PRE-CONSTRUCTION PHASE													
LAND													
Terrestrial Flora: Clearing existing vegetation along the ROW	Removal/ Transfer of trees and other vegetation	• Number of trees cut/ transplanted • Number of trees replaced	Inventory	Monthly until ROW is cleared prior to construction	Project ROW/ nurseries	• DOTr PMO Contractor	Part of pre-construction cost	Post ECC Agreement between DOTr, contractor, and DENR – EMB			85-90% survival rate of the trees/ vegetation planted/ transplanted Obtain tree-cutting/ balling permit prior to removal of any trees		
PEOPLE													
Land Acquisition	Displacement of residents and few commercial establishments along the proposed alignment	Compensation for affected land, structures and improvements	Consultation Meeting and Survey with PAPs	Monthly until ROW is fully acquired	Affected barangays	DOTr-PMO	Included in the RAP cost	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	100% compensation prior to displacement
Involuntary Resettlement for PAPs	Improvement of living Conditions through Relocation	Resettlement of PAPs to the relocation sites	Consultation Meeting and/or Survey with the PAPs	Monthly until ISFs are all relocated	Affected barangays	• DOTr- PMO • NHA • LIAC	Included in the RAP cost	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM Improvement of living conditions through Relocation	100% Resettlement of PAPs to the relocation sites
		Livelihood program No. of Participants	• Consultation Meeting and/or Survey with the PAPs • Livelihood Trainings and Seminars	Quarterly until the end of livelihood restoration program	Affected barangays	• DOTr- PMO • LGUs	Included in the RAP cost	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Livelihood trainings and program will consider gender equality
CONSTRUCTION PHASE													
LAND													
Earthworks including excavation activities	Generation of excavated soil	• Volume • Disposal method • Management of soil against soil management plan	• Ocular inspection, • Regular reporting, meeting	Daily visual inspection, Monthly reporting and meeting, Immediately in case of spill	Area of construction	• DOTr PMO • Contractor	Included in the engineering cost	Post ECC Agreement between DOTr, contractor, and DENR – EMB			Post ECC Agreement between DOTr, contractor, and DENR – EMB		
Overall construction activities: Generation of solid waste	Soil pollution and aesthetic view	• Volume • Disposal method • Management of against solid waste management plan	Ocular inspection, Regular reporting, meeting	Daily visual inspection, Monthly reporting and meeting,	Area of construction and temporary facilities and disposal site	• DOTr PMO • Contractor	Included in the engineering cost	Post ECC Agreement between DOTr, contractor, and DENR – EMB			Post ECC Agreement between DOTr, contractor, and DENR – EMB		
		Soil fertility level (if necessary)	Soil sampling and analyses for fertility	As required		• DOTr PMO • Contractor		Post ECC Agreement between DOTr, contractor, and DENR – EMB			Post ECC Agreement between DOTr, contractor, and DENR – EMB		
Operation and Maintenance of construction machineries, equipment and vehicles	Generation and accidental spills of hazardous wastes (i.e. oil, grease, etc.)	• Quantity • Occurrence of accidental spills • Condition of equipment and machinery	• Ocular inspection, • Regular reporting and documentation • Meeting	Daily visual inspection, Monthly reporting and meeting,	Area of construction and temporary facilities	DOTr Contractor	Included in the engineering cost	Incidence of spillage	Initiate clean-up	Compliance with RA 6969	Complaints	Resolve complaints based on GRM	Compliance with RA 6969
		• Substances that may spill (e.g. oil, diesel, grease)	• Check against RA 6969 • Soil sampling	As needed		DOTr PMO DOTr Contractor Third Party sampling firm	Included in the EMF	Compliance to RA 6969 for the treatment, storage and disposal of contaminated materials			Dutch Standards: parameter to be monitored is dependent on the spilled substance (e.g. oil and grease)		
Earthwork activities	Ground subsidence	Level of ground subsidence	Visual observation/ Measurement of level	Monthly or as needed	Area of construction and temporary facilities	• DOTr PMO • Contractor	Included in the Construction cost	N/A	N/A	N/A	Visually observed subsidence	Implement corrective actions as necessary	If the observed subsidence will pose hazard to the workers and community
• Clearing and removal of vegetation • Earthwork activities	Soil Erosion	Occurrence of erosion	Ocular inspection	Daily	Area of construction and temporary facilities	• DOTr PMO • Contractor	Included in the Construction cost	N/A	N/A	N/A	Visually observed erosion	Implement corrective actions as necessary	If the observed erosion will pose hazard to the workers and community
Clearing existing	Loss of Flora	• Number of trees	Ocular survey	Semi-annually	Designated tree planting	• DOTr PMO	Included in the	To be determined		POST-ECC	Terrestrial Flora:	Transfer of trees and	• Number of trees

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
vegetation		Replaced • Provision of corresponding number of tree seedling • Survival rate of the species introduced			Site/receiving area, buffer area/nurseries	• Contractor	Construction cost	during the MMT meeting which will be agreed upon by Proponent, DENR and MMT members only after establishing the baseline during dry and wet seasons.		Agreement between DOTr, Contractor and EMB	Clearing of existing vegetation	other vegetation 85-90% survival rate of the trees/ vegetation planted/ transplanted	transplanted/ replaced • Survival rate of the species introduced • Provision of corresponding number of tree seedling
WATER													
Increase demand on the drainage	Flooding (during rainy season)	Occurrence of flooding	Ocular inspection and observation Check PAGASA bulletin	Daily during rainy season	Area of construction and temporary facilities	• DOTr PMO • Contractor	Included in engineering cost	N/A	N/A	N/A	N/A	N/A	N/A
• Excavation, piling work • Construction of piers in rivers	Increase in suspended sediments in receiving water	• DO, • TSS, • pH • turbidity	Ocular inspection Water sampling in accordance to	Daily inspection Quarterly sampling	Surface water established sampling stations	• DOTr PMO • Contractor • Third party sampling firm • MMT	Included in the EMF	Post ECC Agreement between DOTr, contractor, and DENR – EMB		DO: 5ppm TSS: 30 ppm pH: 6.5-8.5	Post ECC Agreement between DOTr, contractor, and DENR – EMB		
• Wastewater generation • Fuel and oil leaks from construction equipment	Degradation of Surface Water Quality;	• Color (TCU) • TSS • pH • Temp (°C) • DO (mg/L) • BOD5 (mg/L) • Fecal Coliform (MPN/100mL) • Total Coliform (MPN/100mL) • Conductivity • Chloride (mg/L) • Nitrate as N (mg/L) • Phosphate as P (mg/L) • Copper (mg/L) • Arsenic (mg/L) • Cadmium (mg/L) • Chromium (mg/L) • Lead (mg/L) • Mercury (mg/L) • Cyanide (mg/L) • O&G (mg/L) • Organo-phosphates (µg/L) • Phenols (mg/L) • Surfactants (mg/L)	Grab sampling (In situ for pH and T Using pH meter and temperature probe) In accordance to DAO 2016-08 Approved methods	Quarterly	Surface water established sampling stations near active construction sites; temporary facility and depot discharge points	• DOTr PMO • Contractor • Third Party Sampling Firm • MMT	Included in the EMF	Post ECC Agreement between DOTr, contractor, and DENR – EMB		Class C: Color: 75 TSS: 80 ph: 6.5-9 Temp: 25-31 DO: 5 BOD 5: 7 Fecal Coliform: 200 Total Coliform: 100 (Japan Standard) Conductivity: Chloride: 350 Nitrate as N: 7 Phosphate as P: 0.5 Copper: 0.02 Arsenic: 0.02 Cadmium:0.005 Chromium: 0.01 Lead: 0.05 Mercury: 0.002 Cyanide: 0.1 O&G: 2 Organo-phosphates: 3 Phenols: 0.05 Surfactants: 1.5	Post ECC Agreement between DOTr, contractor, and DENR – EMB		
	Quality of effluent discharge	• pH • Temp • DO, mg/L(min) • Color, TCU • BOD5, mg/L(max) • Fecal Coliform, MPN/100mL • O&G, mg/L								Class C: Ph: 6-9.5 Temp: 3°C DO Color: 150 BOD5: 3 Fecal Coliform:400 O&G: 5	Post ECC Agreement between DOTr, contractor, and DENR – EMB		
AIR													
Air Quality: Construction works; Movement of vehicles	Degradation of Air Quality; Generation of dust;	Dust level	• Ocular observation • Interview to residents of affected barangay	Daily observation Monthly interview	In and around construction sites Affected Barangay	• DOTr PMO • Contractor	Included in the Construction cost	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
and equipment	Exhaust emissions from equipment	• TSP (µg/NCM) • PM_{10} (µg/NCM) • $PM_{2.5}$ (µg/NCM) • SO_2 (µg/NCM) • NO_2 (µg/NCM) • Pb (µg/NCM) • CO (mg/NCM) • O3 (µg/NCM)	• TSP, PM_{10}: High Volume; Gravimetric method • $PM_{2.5}$: e-sampler, gravimetric • SO_2, NO_2, CO, O_3: grab sampling; absorbing solution	Quarterly (24-hr Sampling except for CO and O_3 which is 1-hr sampling) Immediately based on complaints	Established monitoring stations near active construction sites	• DOTr PMO • Contractor • MMT • Third Party Sampling Firm	Included in the EMF	Post ECC Agreement between DOTr, contractor, and DENR – EMB		TSP: 230 ug/NCM; PM_{10}: 150 ug/NCM; $PM_{2.5}$: 50 ug/NCM; SO_2: 180 ug/NCM; NO_2: 150 ug/NCM; Pb: 1.5 ug/NCM; CO: 35 ug/NCM; O_3: 140 ug/NCM		Post ECC Agreement between DOTr, contractor, and DENR – EMB	
Earthmoving, Operation of equipment and machinery	Increase in Noise Levels	Noise Level	• Ocular observation • Interview to residents of affected barangay • Direct reading/Sound level Meter	Daily observation Monthly interview	In and around construction sites Affected Barangay	• DOTr PMO • Contractor	Included in the Construction cost	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
	Increase in Noise Levels	Noise Level (dBA)	Direct Reading/ Sound Level Meter(24 hours sampling)	Monthly (morning, daytime, evening and nighttime when applicable) Immediately based on complaints	Established monitoring stations including sensitive receptor (within 50 m from alignment)	• DOTr PMO • Contractor • MMT • Third Party Sampling Firm	Included in the EMF	Post ECC Agreement between DOTr, contractor, and DENR – EMB		Environmental Quality Standards for Noise in General Areas (NPCC Memorandum Circular No. 1980-02)		Post ECC Agreement between DOTr, contractor, and DENR – EMB	
Earthmoving, Operation of equipment and machinery	Increase in Vibration Levels	Vibration Level	• Ocular observation • Interview to residents of affected barangay	Daily observation Monthly interview	In and around construction sites • Affected Barangay	• DOTr PMO • Contractor • MMT	Included in the Construction cost	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
		Vibration Level (dBA)	Vibrometer	Monthly	• Established monitoring stations including sensitive receptor (within 50 m from alignment) • Old PNR structure / NHCP accredited cultural/historical structures (within 50m from alignment)	• DOTr PMO • Contractor • MMT • Third Party Sampling Firm	Included in the EMF	Post ECC Agreement between DOTr, contractor, and DENR – EMB			Post ECC Agreement between DOTr, contractor, and DENR – EMB		
PEOPLE													
• Construction activities • Vehicle access around constructionists	Threat to Health and safety of the community	• Number of accident involving communities • Degradation of livelihood of local communities	• Survey occurrence of accidents with local communities • Interview to affected communities	• Regular monitoring throughout construction phase • In case of accidents, immediately	Affected Barangay	DOTr Contractor	Included in the Construction cost	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
Construction Activities	Occupational health	Working Environment Measurement (WEM)	• BWC-OSHC/NIOSH method	Quarterly Throughout construction phase	Project Site	• Third party sampling firm • DOTr • Contractor	Part of construction cost	Exceeding: • Philippine OSH Standard • NIOSH Standard	Strictly adhere to Occupational Safety and Health Standard	• Philippine OSH Standard • NIOSH Standard	• Complaints on workers' health and safety • Complaints on workers' health and safety	Investigate on workers' health and safety issue and conduct measurement if necessary	• Philippine OSH Standard • Regular check-up
		• Infectious disease • Degradation of health condition of workers	• Survey trend of epidemic disease • Health Check-up of workers	Monthly throughout construction phase	Construction yard	• DOTr PMO • Contractor	Included in the Construction cost	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
		Number of Accident	• Occurrence of accidents related construction work • Monitoring • Documentation • Help Desk	Weekly, In case of accidents, immediately	Project Site	• DOTr PMO • Contractor	Included in the Construction cost	N/A	N/A	N/A	Occurrence of accident	• Provide appropriate PPE • Conduct supplementary training on safety as necessary	Coordinate with the nearest medical facility
Employment of PAFs and locals		Number of PAFs, locals, females hired	Survey status of employment	Quarterly	Project Sites	• DOTr • Contractor	Included in the Construction cost	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
Resettlement, Construction activities	Social conflicts Degradation of livelihood	SDP implementation Record IEC implementation Record Participants list	Interview with residents of affected barangay, relocatees	Quarterly	Affected Barangay Barangay with relocated sites	• DOTr PMO • Contractor	Included in the Construction cost	N/A	N/A	N/A	Complaints	• Resolve complaints based on GRM • Coordinate with LGUs	Implement corrective actions as necessary
• Block of access, • Increase in construction vehicles	Increase in traffic volume	• Traffic congestion • Traffic volume	• Survey traffic volume • Actual traffic observation and documentation • Help Desk	Weekly monitoring of traffic condition	Main intersection near construction area	• DOTr PMO • Contractor	Included in the Construction cost	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
OPERATIONAL PHASE													
LAND													
Train operation	Ground subsidence	Level of ground subsidence	• Visual observation • Documentation • Level measurement	• Visual observation: daily • Measurement: monthly		• DOTr PMO • Operator	Included in the Operation & Maintenance cost	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
Train operation • Depot • Passenger facilities	Generation of domestic / Solid wastes by passengers and personnel	• Volume • Disposal method • Management of against solid waste management plan	• Ocular inspection, • Regular reporting	• Daily visual inspection, • Monthly reporting	• Passenger facility • depot	• DOTr PMO • Operator	Included in the Operation & Maintenance cost	Complaints	Resolve complaints based on GRM	Compliance with RA 9003	Complaints	Resolve complaints based on GRM	• Compliance with RA 9003 • Coordinate with the host LGU/s
		• Soil fertility level	Soil sampling and analyses	As necessary	• Depot	• DOTr PMO • Operator • Third Party Sampling Firm	Included in the EMF	Post ECC Agreement between DOTr, contractor, and DENR – EMB			Post ECC Agreement between DOTr, contractor, and DENR – EMB		
Maintenance works • Depot facility	Spill of oil and other similar substances	Substance/s that spill (e.g. Oil, diesel and Grease)	• Ocular inspection • Regular reporting and documentation • Check against RA6969	Weekly ocular inspection In case of spill, immediate action is required	• Depot	• DOTr PMO • Operator •	Included in the Operation & Maintenance cost	NA	NA	NA	Incidence of spillage	Initiate clean-up	Compliance with RA 6969
			Soil sampling	As needed		• DOTr PMO • Operator • Third Party Sampling Firm	Included in the EMF	Compliance to RA 6969 for the treatment, storage and disposal of contaminated materials			Dutch Standards: parameter to be monitored is dependent on the spilled substance (e.g. oil and grease)		
Survival of transplanted trees/ vegetation	Survival rate of transplanted trees/ vegetation	Number of trees surviving	Ocular inspection	Semi-annually	Transplanted areas	• DOTr PMO • Operator	Included in the Operation & Maintenance cost	50% survival rate	Replacement of non-surviving tree/s	85-90% survival rate of the trees/ vegetation planted/ transplanted	70% survival rate	Replacement of non-surviving tree/s	85-90% survival rate of the trees/ vegetation planted/ transplanted
WATER													
Increase demand on the drainage	Flooding (during rainy season)	Occurrence of flooding	Ocular inspection and observation	Daily during rainy season	Project alignment, train stations and depot facility	• DOTr PMO • Operator	Included in the Operation & Maintenance cost	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
• Wastewater generation • Fuel and oil leaks from construction equipment	• Degradation, Quality of effluent discharge	• ph • Temp • DO, mg/L (min) • Color, TCU • BOD5, mg/L (max) • Fecal Coliform, MPN/100mL • O&G, mg/L	Grab sampling (In situ for pH and T Using pH meter and temperature probe) In accordance to DAO 2016-08 Approved methods	Quarterly	discharge points	• DOTr PMO • Operator • Third party sampling firm • MMT	Included in the EMF	Post ECC Agreement between DOTr, contractor, and DENR – EMB		Class C: pH: 6-9.5 Temp: 3C change DO:DO: 5.0 (min) Color: 150 BOD5: 3 Fecal Coliform: 400 O&G: 5	Post ECC Agreement between DOTr, contractor, and DENR – EMB		
AIR													
Train operation, Depot, passenger facilities, service vehicles	Degradation of Air Quality; Generation of dust; Exhaust emissions from equipment	TSP (ug/NCM) PM_{10} (ug/NCM) $PM_{2.5}$ (ug/NCM) SO_2 (ug/NCM) NO_2 (ug/NCM) Pb (ug/NCM) CO (mg/NCM)	• TSP, PM_{10}: High Volume; Gravimetric method • $PM_{2.5}$: e-sampler, gravimetric • SO_2, NO_2: grab sampling; absorbing solution	• Annually (24-hr Sampling except for CO and O3 which is 1-hr sampling) • Immediately based	Station and Depot	• DOTr PMO • Operator • MMT	Included in the EMF	Post ECC Agreement between DOTr, contractor, and DENR – EMB		TSP: 230 PM_{10}: 150 $PM_{2.5}$: 50 SO_2: 180 NO_2: 150 Pb: 1.5 CO: 35	Post ECC Agreement between DOTr, contractor, and DENR – EMB		

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
		O3 (ug/NCM		on the complaints						O3: 140			
	Increase in Noise levels	Noise levels	Direct Reading/ Sound Level Meter	• Semi Annually (daytime and night time) • Immediately based on the complaints	Established monitoring stations at sensitive receptor (within 50m from alignment)	• DOTr PMO • Operator • Third party sampling firm	Included in the EMF	Post ECC Agreement between DOTr, contractor, and DENR – EMB		Class AA: Daytime 50 dBA; Nighttime: 40 dBA		Post ECC Agreement between DOTr, contractor, and DENR – EMB	
	Increase in Vibration Levels	Vibration Level (dBA)	Vibrometer	• Semi Annually • Immediately based on the complaints	• Established sampling stations at sensitive receptor (within 50m from alignment) • Old PNR structure / NHCP accredited cultural/historical structures (within 50m from alignment)	• DOTr PMO • Operator • Third party sampling firm	Included in the EMF	Post ECC Agreement between DOTr, contractor, and DENR – EMB		Vibration Level: 55 dBA		Post ECC Agreement between DOTr, contractor, and DENR – EMB	
PEOPLE													
Operation of train	Health and safety issues of the community	• Increase in accident involving communities • Degradation of livelihood of local communities	Monitoring and documentation	• Regular monitoring • In case of accidents, immediately	Area with stations and Depot	• DOTr PMO • Operator	Included in the Construction cost	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary	Complaints	• Resolve complaints based on GRM • Coordinate with LGUs	• Implement corrective actions as necessary • Coordinate with the nearest medical facility
Operation of train	Safety Issues on employee	Occurrence of accident/s	• Monitoring of work environments • Regular Meeting	Monthly	Project Sites	• DOTr PMO • Operator	Part of Operation & Maintenance cost	Complaints on workers safety	Investigate on workers safety issue and conduct measurement if necessary	Philippine OSH Standard NIOSH Standard	Exceeding: Philippine OSH Standard NIOSH Standard	Strictly adhere to Occupational Safety and Health Standard	Philippine OSH Standard
	Increase in accident	Number of Accident	Help desk	• Regular monitoring • In case of accidents, immediately	Project Sites	• DOTr • Operator	Part of Operation & Maintenance cost	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
Traffic management	Increase in traffic volume	Traffic congestion	Help desk	Throughout operation phase	Project Site	DOTr Contractor	Included in the Construction cost	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary	Complaints	• Resolve complaints based on GRM • Provision for traffic signage and personnel	Implement corrective actions as necessary

8.2 MULTI-PARTITE MONITORING TEAM

1436. Pursuant to DAO 2017-15, the law mandates that after issuance of the ECC, a Multi-Partite Monitoring Team (MMT) will be formed for ECPs. The MMT is tasked to monitor the compliance of the project as stated in the ECC conditions, Environmental Management Plan and other related policy. Furthermore, the MMT will gather information and data relating to complaints and impacts of the project to environment and society. Other tasks of the members of the MMT are the following:

- Prepares and submit quarterly report
- Assimilate all monitoring reports
- Disseminate information to the affected individual
- Submit recommendations to EMB-DENR

1437. The EMB-DENR will provide oversight guidance to the MMT and consider its reports and recommendations in its impact and compliance evaluation.

1438. The composition of the MMT will be representative of relevant stakeholders groups. The following are recommended members of the MMT:

- Representative from the LGUs along the MCRP alignment
    - Malolos
    - Calumpit
    - Apalit
    - Minalin
    - Sto. Tomas
    - San Fernando
    - Angeles
    - Mabalacat
    - Bamban
    - Capas
- Representatives from accredited local NGOs and POs with mission/s specifically related to environmental management.
- Representatives from DepEd and Religious Groups
- Representative from locally recognized community leaders who can represent vulnerable sectors such as women and senior citizen
- Concerned Government Agencies
    - Department of Public Works and Highways
    - PHIVOLCS
    - MGB
    - NCIP
- The members of MMT will elect among themselves the Chairman and Vice Chairman.

8.3 ENVIRONMENTAL MONITORING AND GUARANTEE FUND COMMITMENT

(1) The Purpose of EMF and EGF

1439. The DOTr commits to establish an EMF and EGF. The EMF will be exclusively utilized to cover all costs attendant to the operation of the MMT. Whereas, the EGF will be used exclusively for the following purposes:

- Immediate rehabilitation of areas affected by damages to the environment and the resulting deterioration of environmental quality as a direct consequence of the proposed MCRP construction, operation and abandonment;
- Just compensation of parties and communities affected by the negative impacts of the proposed MCRP;
- Conduct of scientific or research studies related to the proposed MCRP that will aid in the prevention or rehabilitation of accidents and/or environmental damages; and
- For contingency and clean-up activities, environmental enhancement measures, damage prevention programs and social equity measures including the necessary IEC and capability building activities related to the Project.

(2) Basis of the Cost

1440. The EGF Trust Fund and EGF Cash Fund will be replenished to its original amount annually or whenever the amount goes below 50% of the original amount. The EGF Trust Fund will be renewed upon every expiration. The amount of EMF, EGF Trust Fund and EGF Cash Fund presented in **Table 8.3.1** are only estimates and will be finalized in the Memorandum of Agreement on the Creation of MMT, EMF and EGF.

Table 8.3.1 Estimated EMF, EGF Trust Fund and EGF Cash Fund for the Proposed MCRP

Type of Fund	Amount (PhP)
EMF (PhP)	400,000.00
EGF Trust Fund (PhP)	5,000,000.00
EGF Cash Fund (PhP)	3,000,000.00

1441. At the end of the project life, a sufficient amount will be reserved from the EGF to ensure that rehabilitation, restoration, decommissioning, or abandonment will be adequately financed. Such amount may be increased during the project life span to ensure that the balance will be sufficient for the abandonment phase. In such case, the EGF Committee may require an adjustment of such amount to cover inflation and other factors. The required submission to the EMB-DENR of the Abandonment/ Decommissioning Plan for the proposed MCRP will have a corresponding fund commitment subject to the approval of the DENR or the lead government agency with direct approving authority on the Abandonment/Decommissioning Plan.

9. DECOMMISSIONING/ABANDONMENT/ REHABILITATION POLICY

9.1 POLICY

1442. In the unlikely event that the proposed MCRP becomes uneconomically viable or if by *force majeure* or acts of God, it will have to be terminated and/or decommissioned. A detailed abandonment/decommissioning plan will be developed prior to the closure of the facilities and within the timeframe that will be specified in the ECC. The Abandonment and Decommissioning Plan will be prepared in accordance to DENR requirements and will address the following:

- Proposed abandonment/decommissioning measures for the Project facilities;
- Removal of any existing hazardous and non-hazardous waste;
- Site restoration where appropriate;
- Cost associated with the proposed abandonment/decommissioning activities and source of funds for the implementation of the activities; and
- Conformance to the requirements of the PNR (as owner of the ROW), the local government, the DENR and other relevant agencies.

9.2 PROCEDURE AND RESPONSIBLE PARTIES

(1) Pre-Abandonment/Decommissioning Activities

1443. The DOTr-PMO will further develop the appropriate protocols to address the Abandonment/Decommissioning Plan. The plan will be submitted to the DENR for review and approval prior to the commencement of abandonment/decommissioning activities. DOTr concerned Staff/Workers will be informed six (6) months prior to abandonment/decommissioning of the proposed MCRP. All affected communities and stakeholders will also be properly informed of the abandonment/decommissioning activities.

(2) Abandonment/Decommissioning Activities

1444. The DOTr-PMO will oversee the performance of the Contractor on the implementation of decommissioning activities as prescribed in the Abandonment/Decommissioning Plan. Appropriate documentation will be conducted during the decommissioning activities including photographs of the work areas/decommissioning areas. This documentation will be made available to the proper agencies, upon request and for monitoring purposes.

(3) Post-Abandonment/Decommissioning Activities

1445. DOTr will submit a report to EMB-DENR about the completion of decommissioning activities. Upon review of the submitted report, EMB-DENR will notify the DOTr of its findings and may conduct site inspections together with the MMT.

1446. Should irreversible damages to the environment be discovered during site inspection, the extent of such damage will be investigated and the results will be reported to the EMB-DENR. If the findings show that said damages were caused by construction-related activities, the Contractor's All Risk Insurance (CARI) will be tapped for compensation of damages. In the event that the damages were caused by train maintenance and operations procedures, the EGF will be tapped.

10. INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

1447. The Institutional Plan is the inception of a body that will implement the proposed EMP whose main thrust is to ensure that environmental, socio-economic, political and public health issues are properly address in a timely manner. It provides necessary mechanism that will strengthen the organizational relationship of the proponent with the host community, concerned government agencies and other stakeholders.

1448. The proposed MCRP will be primarily implemented by the DOTr.

10.1 DEPARTMENT OF TRANSPORTATION

1449. The DOTr as the proponent for the proposed MCRP, is the primary policy, planning, programming, coordinating, implementing and administrative entity of the executive branch of the government on the promotion, development and regulation of a dependable and coordinated network of transportation system, as well as in the fast, safe, efficient and reliable transportation.

1450. The DOTr plays a crucial role in accelerating the country's economic development. It provides the backbone for growth and enhances the country's competitive edge by providing effective and efficient transportation infrastructure systems that narrow the geographical and physical divide, connecting the country, its islands, and its people to the rest of the world.

(1) Vision

1451. By 2030, DOTr is a world class organization, providing integrated transport, connecting people, islands, families, communities and the nation with the rest of the world, and constantly responding for environmentally sustainable and globally competitive transport system.

(2) Mission

1452. To provide the country with efficient, effective and secure transportation systems those are globally competitive, compliant with international standards and responsive to the changing times.

(3) Sectorial and Attached Agencies

1453. The DOTr has three (3) Sectoral Offices and sixteen (16) Attached Agencies. The sectorial offices include the Maritime, Road and Rail Transport Offices. The latter includes the MRT 3 which is a Project Management Office (PMO) of the Department. Among the attached agencies are three (3) Railway agencies namely: PNR, Light Rail Transit Authority (LRTA), and North Luzon Railways Corporation (NLRC or Northrail).

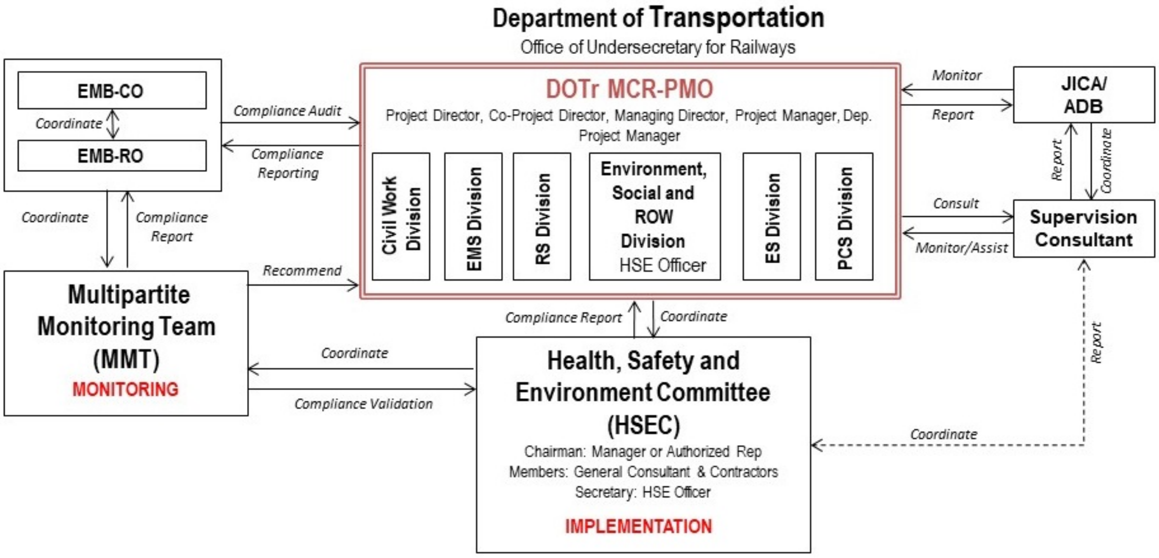
(4) DOTr Roles of the EMP

1454. The DOTr as the Implementing Agency will be responsible for providing overall policy and guidance with regards to the implementation of the proposed MCRP. DOTr will ensure that all the necessary provisions for implementing the EMP and EMoP, including budgets and agreements with other concerned national and local government agencies are included in all contracts, and in accordance with JICA Guideline and ADB Safeguard Policy agreed conditionalities.

10.2 IMPLEMENTATION OF THE EMP

(1) Institutional Structure

1455. The organizational structure for the EMP constitutes the DOTr PMO and its Environment, Social and ROW Division (ESRD); Health, Safety and Environment Committee (HSEC), Supervising Consultant, Contractor (including Sub-Contractor) and MMT as key entities for its effective implementation. **Figure 10.2.1** presents the simplified institutional diagram for the EMP implementation, showing the management/ relationship line among these entities.



Source: JICA Study Team

Figure 10.2.1. Simplified Institutional Plan for Implementing the EMP

1456. DOTr will create a new office or designate one of the railway attached agencies to serve as PMO. Under the PMO, HSEC will be created to implement the EMP during pre-construction and operational phases of the proposed MCRP. The Contractors for the Works will be tasked to implement the EMP for the construction phase. Environmental compliance monitoring will be undertaken by the MMT which will monitor the compliance of the Contractors and the PMO with the ECC conditions, EMP and EMoP in accordance with the guidelines of DAO 2003-30, DAO 2017-15, JICA Guidelines and ADB Safeguards Policy.

1457. The HSEC and the Contractor's implementation of the EMP will be in coordination with the following entities:

1. EMB-Central Office
2. EMB-Region 3
3. DENR Forest Management Bureau (FMB) and BMB
4. DOTr Attached Agencies –PNR
5. Other Relevant NGAs – BCDA , CIAC, NCCA, NHCP, NM, NCIP, DPWH, NHA
6. LGUs of Malolos, Calumpit, Apalit, Minalin, Sto. Tomas, San Fernando, Angeles, Mabalacat, Bamban, Capas
7. MMT

(2) DOTr MCR Project Management Office (MCR PMO)

1458. The MCR PMO will be established as the representative of the DOTr in all activities pertaining to the planning, design review, and implementation of the project. It will be guided by the Operational Procedures.

1459. The following will be responsible for the decision-making, planning and implementation of the overall project activities: Project Director, Co-Project Director and Management Director (**Table 10.2.1**), whereas a Project Manager and Deputy Project Manager will be acting management of the MCRP.

Table 10.2.1 Composition of MCR PMO (Provisional)

	Position	Member
1	Oversight Functions	• Project Director: Assistant Secretary for Railways • Co-Project Director : PNR General Manager • Managing Director: Representative from DOTr
2	Manager	• Project Manager: Representative from DOTr/PNR • Deputy Project Manager : Representative from DOTr/PNR
3	Division	Six (6) Divisions headed by a Division Chiefs. • Civil Works Division • Electricity and Mechanical System Division (EMS Division) • Rolling Stock Division (RS Division) • Engineering Support Division (ES Division) • Environment Social and ROW division (ESR Division) • Project Control and Support Division (PCS Division)

(3) Environment Social and ROW Division of MCR - PMO

1460. Under the MCR PMO, the ESRD will be created and staffed with Health, Safety and Environment Officer (HSEO), Environmental Engineers and other specialists, including environmental consultants who will provide the necessary guidance and technical assistance, and at the same time, together with the office staff, implement the conditions of the ECC and the activities laid out in the EMP and EMoP which is an integral part of this EISR, and in line with JICA Guidelines and ADB Safeguard Policy agreed.

- Ensure that all engineering interventions and conditions in the approved EMP, RAP, ECC and requirements of JICA guideline and ADB Safeguard Policy are implemented accordingly;
- Supervise the contractors in the conduct of self-monitoring activities;
- Report periodically the status of compliance to the DENR-EMB following prescribed formats; and
- Report periodically the status of compliance to the JICA Guideline and ADB Safeguard Policy to JICA and ADB.

1461. A training program for capacity building of the PMO-ESR will be designed by professional training institution offering environmental courses like the Pollution Control Association of the Philippines (PCAPI), Manila Observatory, Miriam College, UP Los Baños SESAM, or PWU. The training course will be conducted through any of these training institution, or through the Development Academy of the Philippines (DAP) to help build the capability of the environmental staff for environmental management and monitoring. It will be required that the hiring of environmental unit staff will be those who are graduates of environmental management courses, or have at least 5 to 10-year experience in the environmental management field.

(4) Health, Safety and Environment Officer

The HSEO will provide appropriate action on complaints brought before the ESRD-MCRP PMO for resolution. Further, the HSEO will closely coordinate with the Health, Safety and Environment Unit of the Contractor on matters of mutual concern during construction phase. Among others, the HSEO is responsible for the following:

- Guide the PMO-ESRD engineers and technical personnel in the implementation of the conditions of the ECC and such other activities laid out in the EMP and EMoP both of which are integral parts of this EISR;
- Prepare environment monitoring reports including Compliance Monitoring Report (CMR), as well as reporting to EMB, JICA and ADB ;
- Assist in preparing the "DOTr Environment Protection Clauses" of the Bid Documents,
- Review contract environmental clauses (such as inclusion of ECC conditionalities, required engineering interventions in approved EMP/EMoP, etc.) with bidders to ensure proper understanding and compliance.

(5) Health, Safety and Environment Committee

1462. The HSE Committee will be under the PMO which will also comprise representatives from the DOTr, general consultant and contractors on-site. Their role and responsibilities are as follows:

- Conduct weekly meetings to discuss issues and complaints as well as resolve them;
- Issues not resolved will be forwarded to MMT / DOTR management level. If the MMT cannot resolve the critical issue, it will be referred to the DENR-EMB resolution;
- Monitor compliance of contractors' implementation of the EMP;
- Identify sources of pollution issues;
- Monitor the effectiveness of mitigating/enhancement measures;
- Based on monitoring results, find solutions/alternatives to enhance the EMP;
- Coordinate with EMB and other relevant oversight agencies and other stakeholders;
- Regular reporting of compliance to the ECC and its Conditionality's;
- Submit of the Self-Monitoring Reports (SMR) detailing status of compliance with ECC and other environmental regulations quarterly to EMB-DENR, JICA and ADB.

(6) Multi-Partite Monitoring Team

1463. The MMT is an independent third-party entity formed after the issuance of the ECC to encourage participation of the project's various stakeholders and to monitor the project's compliance with ECC conditions as well as the EMP and EMoP during the pre-construction, construction and operation phases of the proposed project. MMT's Compliance Validation Monitoring Reports (CMVRs) as prescribed in the RPM for DAO 03-30 will be submitted to DENR-EMB, JICA and ADB.

1464. The formation of the MMT will be initiated by the DOTr (PMO) through a Memorandum of Agreement (MOA) between the EMB-CO and the DOTr (PMO) with conformity of the identified MMT members. Based on DAO No. 2017-15, the MMT will be composed of representatives of relevant stakeholders. As such, the EMB and the DOTr, being principal project parties, will no longer be members of the MMT. Instead, the EMB will provide oversight guidance to the MMT and consider its reports and recommendations in its impact and compliance evaluation. On the other hand, DOTr will provide funds for the MMT activities based on the Annual Work and Financial Plan approved by the EMB. The key stakeholder members of the MMT are enumerated below as stipulated in DAO 2017-15.

1. Local Government Unit (LGU)

- One (1) Provincial Environment and Natural Resources Office (PENRO) representative from each affected province;

- In case there is no PENRO, one (1) representative each from the Municipal/City Environmental and Natural Resources Office (M/CENRO), Municipal/City Planning and Development Office (M/CPDO) or the Sanguniang Barangay (SB) Environment Committee Chairman;
- RHU Chiefs; and
- Concerned Barangay Captains.

2. Non-Government Organization (NGO)/ People's Organization (PO)

- One (1) environmental NGO representative;
- In case there is no environmental NGO, 1 representative from other NGOs; and
- Maximum of two (2) from locally-recognized community leaders representing vulnerable sectors such as IPs, women, senior citizen, etc.

3. Academe

- Maximum of two (2) representatives from the academe

4. National Government Agencies (NGAs)

- Maximum of three (3) representatives with related mandate on the proposed MCRP
- On special environmental concerns (e.g. biodiversity), DENR membership will be endorsed by concerned Bureau Director

1465. The specific functions of the MMT will include the following:

- Conduct quarterly ocular site visit to validate the proponent's compliance with the ECC conditions and the Environmental Management and Monitoring Plan including the requirement to conduct self-monitoring and submit corresponding reports regularly;
- Observe sampling activities conducted by the project proponent;
- Prepare and submit its report to EMB-Region 3, EMB-Central Office, JICA and ADB using EMB-prescribed format semi-annually; and
- Institute an environmental emergency, complaints receiving and management mechanism which will include systems for transmitting recommendations for necessary regulatory action to EMB in a timely manner to prevent adverse environmental impacts.

(7) The Contractor

1466. The Contractor will be jointly responsible for implementing the EMP, and liable to any and all sanctions and penalties to be incurred by DOTr in relation to non-compliance to conditions set in the ECC. They will provide the necessary funds for implementing the EMP. It will be stipulated in the "DOTr Environmental Protection Clauses" of the Bid Documents. They will be jointly (with DOTr) responsible for ensuring that all engineering interventions in the approved EMP, RAP, and ECC issued are implemented and document these for reporting to DENR-EMB, JICA and ADB. These will be included in the TOR of the Detailed Engineering Design.

10.3 INFORMATION DISCLOSURE

1467. DOTr will disclose relevant information including the potential impacts of the proposed MCRP and the corresponding mitigating measures to the stakeholders in line with JICA Guidelines and ADB Safeguard Policy Statement. Information Disclosure aims to achieve the following objectives:

- Enhance the sustainability of projects by ensuring that interventions are relevant to the people of the area;
- Learn from the various social groups living in a project area how they perceive the existing situation, recent trends, existing problems, and potential solutions;
- Collect local knowledge, information, and ideas about the technical implications and impacts of project design; and
- Determine potential social, economic, and cultural impacts not always foreseen in survey based socio-economic studies.

1468. DOTr will provide following documents to JICA and ADB to disclose on their website:

- Draft EISR to be disclosed at least 120 days in advance for their review;
- Final EISR;
- A new/updated EISR and corrective action plan prepared during project implementation if any; and
- Environment monitoring reports.

1469. In addition, DOTr will disclose key information to the PAPs and other stakeholders in plain and understandable Philippine language and suitable communication methods.

1470. Key Information includes; Project outlines and activities, implementation schedule, project location, duration and potential impact/risks to be affected and corresponding mitigation measures, consultation process and GRM.

1471. Media to be used: public consultations, brochures, leaflet, booklet, poster, radio, web-site, info-graphics etc.

10.4 REPORTING

1472. The MCRP PMO will submit internal and external monitoring reports to DENR-EMB, JICA and ADB during construction until the project completion report is issued. In addition, the results of public consultation and information disclosure will also be submitted. The report is also to be disclosed to the public.

11. PUBLIC CONSULTATION DOCUMENTATION

11.1 INFORMATION, EDUCATION AND COMMUNICATION AND INITIAL PERCEPTION SURVEY

1474. The IEC was conducted to provide updated information about the proposed Project and encourage the concerned stakeholders to participate in the EIA study. The IEC sessions are shown in **Table 11.1.1** with the summary of major issues and concerns in **Table 11.1.2.**

Table 11.1.1 IEC Conducted for the EIA Study of the Proposed Project

Date and Time	Venue	Target Affected LGU	Main Participants	No. of Participants: Female	No. of Participants: Male	No. of Participants: Total
2017/12/11, 10:00 - 11:30	Malolos Sports and Convention Centre, Malolos, Bulacan	Malolos and Calumpit, Bulacan	• City Officials • Barangay Chairmen • Municipal Officials • Barangay Chairmen	7	16	23
2017/12/11, 15:30 - 16:00	Provincial Capital Residence, Malolos, Bulacan	Provincial Government of Bulacan	• Provincial Governor • Provincial Government Staff	5	7	12
2017/12/12, 14:00 - 16:00	Apalit Municipal Hall, Pampanga	Apalit, Pampanga	• Municipal Mayor • Municipal Officials	5	13	18
2017/12/14, 13:00 - 15:00	Department of Transportation – Central Office, S. Osmeña St., CSFZ, Angeles, Pampanga	BCDA	• BCDA representative • CDC Representative • CIAC Representative • ADB Representative	7	6	13
2017/12/14, 17:00 - 18:00	Heroes Hall, Barangay North Tiburcio, San Fernando, Pampanga	San Fernando and Sto. Tomas, Pampanga	• City Mayor of San Fernando • Barangay Chairmen • Municipal Mayor of Sto. Tomas • Municipal Officials	2	13	15
2017/12/20, 10:00 - 11:30	Angels City Hall, Pampanga	Angeles, Pampanga	• City Officials • Barangay Chairmen	9	12	21
2017/12/22, 10:00 - 11:30	Office of the Governor, Pampanga	Provincial Government of Pampanga	• Provincial Governor • Provincial Government Staff	4	6	10
2018/01/04, 14:000 - 11:00	Mabalacat City Hall, Panpanga	Mabalacat, Pampanga	• City Officials	1	13	14
2018/01/04, 14:00 - 15:00	Capas Municipal Hall, Tarlac	Capas, Tarlac	• Municipal Officials	6	7	13
2018/01/05, 10:00 - 11:00	Bamban Municipal Hall, Tarlac	Bamban, Tarlac	• Municipal Officials	6	13	22
2018/01/10, 10:00 - 11:00	Minalin Municipal Hall, Pampanga	Minalin, Pampanga	• Municipal Officials • Barangay Chairmen	6	7	13
2018/1/11, 9:00 - 10:30	Provincial Gov. Tarlac	Provincial Government of Tarlac	• Provincial Government Staff	7	5	12

Source: JICA Study Team

Table 11.1.2 Summary of Major Issues and Concerns during IEC

LGU	Concerns: EIA	Concerns: RAP	Answers
Malolos, Bulacan	Malolos City Engineer raised their concern on flooding in their area. Malolos barangay councilor inquired regarding the construction of fences during construction. What about the preservation of PNR Old station?		• Drainage Plans for MCRP will match those of NSCR. • As part of DOTr's policy, no access roads will be blocked. There will be approved points of access. Fence will also be put up. • DOTr will discuss the preservation of old PNR structures with PNR and NHCP.
Calumpit, Bulacan	There is a garbage pile located near the intersection of Barangay Iba O' Este.		DOTr will check the location and situation of the garbage pile.

<table>
<tr><th rowspan="2">LGU</th><th colspan="2">Concerns</th><th rowspan="2">Answers</th></tr>
<tr><th>EIA</th><th>RAP</th></tr>
<tr><td rowspan="5"></td><td></td><td>Are there remaining ISFs within PNR ROW?</td><td>There are remaining ISFs who will have to be relocated.</td></tr>
<tr><td></td><td>Northrail Project provided housing for 2000 households, but only 400 households have relocated to the Northville 9 Relocation site in Calumpit.</td><td>DOTr will gather information concerning relocation to Northville 9.</td></tr>
<tr><td></td><td>There are still some ISFs within PNR non-core properties.</td><td>Noted.</td></tr>
<tr><td>What about the preservation of PNR Old station?</td><td></td><td>DOTr will discuss the preservation of old PNR stations with PNR, NHCP and DOTr.</td></tr>
<tr><td>What will be done for the drainage/ water canal along PNR?</td><td></td><td>Drainage Plans for MCRP will match those of NSCR.</td></tr>
<tr><td>Office of the Governor, Bulacan</td><td>The Governor requested to coordinate with the Calumpit LGU regarding the Old PNR Station and proposed station location.</td><td></td><td>It has already been taken into account.</td></tr>
<tr><td>Apalit, Pampanga</td><td></td><td>ISFs have been relocated to a Northville resettlement site, and that the PNR ROW is cleared of structures.</td><td>Noted.</td></tr>
<tr><td>Minalin, Pampanga</td><td>The LGU raised concerns about impact on rivers.</td><td></td><td>Noted.</td></tr>
<tr><td rowspan="2">San Fernando, Pampanga</td><td></td><td>The ISFs within PNR ROW were relocated during NSCR Project.</td><td>DOTr requested information concerning the relocation.</td></tr>
<tr><td>What about the preservation of PNR Old station: (Already registered with NHCP)</td><td></td><td rowspan="2">DOTr will discuss the preservation of old PNR stations with PNR and NHCP.</td></tr>
<tr><td>Sto. Tomas, Pampanga</td><td>What about the preservation of PNR Old station (LGU plans to rehabilitate the station (i.e. museum and park)</td><td></td></tr>
<tr><td>Angeles, Pampanga</td><td>Will the trees near the station be cut down?</td><td></td><td>DOTr will check for permission to cut.</td></tr>
<tr><td>Mabalacat, Pampanga</td><td>Proposed alignment need to avoid the ancestral land. There is a history of a longstanding agreement being prepared between CDC and the Tribung Aeta regarding the development of a 10,684 ha. Ancestral land.</td><td></td><td>• DOTr will confirm the details of Ancestral Domain with NCIP.
• If alignment will pass through an ancestral land with indigenous people (IP) as part of the PAFPs, an IP Development Plan (IPDP), will be prepared.</td></tr>
<tr><td>Bamban,Tarlac</td><td></td><td>The Dapdap resettlement site is managed by Pinatubo Committee, as well as NHA.</td><td>DOTr will avoid the Dapdap resettlement site.</td></tr>
</table>

Source: JICA Study Team

1475. The initial perception survey was conducted after the IEC in Angeles, Mabalacat and Capas. Survey questionnaires were distributed to the participants after the IEC sessions. The survey covers the demographic characteristics, source of income, livelihood, health and sanitation, education, employment, their knowledge and attitude towards the proposed Project.

1476. IEC documents such as attendance, issues raised, and photos taken during the IEC are presented **Annex 11-1**.

11.2 STAKEHOLDER CONSULTATION MEETINGS

11.2.1 First Round of the Stakeholder Consultation Meetings

The 1st round of Stakeholder Consultation Meeting (SCM) was conducted in each LGU as shown in **Table 11.2.1**. The 1st SCM started with the disclosure of the Project in terms of (i) areas that the

Project will traverse, (ii) its components such as the stations, depot, and (iii) other features such as envisioned width of the ROW. This was followed by a description of the RAP Study, with particular focus on the following topics: (i) Basic principles of resettlement; (ii) Socio-economic survey activities, and (iii) RAP schedule of activities. At the end of each meeting, the invited PAPs were encouraged to participate in the open forum to express their views/opinions. A summary of the main concerns/issues raised during the first SCMs is provided in **Table 11.2.2**.

Table 11.2.1 Outline of the First Round of SCMs

LGUs	Venue	Date & Time	Main Participants	Number of Participants		
				Male	Female	Total
Malolos, Bulacan	Aldaba Hall, Malolos City Integrated School (Malolos Central School), Brgy. Sto. Rosario	17 January 2018 08:30 A.M.	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	28	41	69
Apalit, Pampanga	Sampaga Covered Court, Brgy.San Vicente, Apalit, Pampanga	17 January 2018 08:30 A.M.	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	55	31	86
Calumpit, Bulacan	Covered Court, Calumpit Municipal Hall Compound, Calumpit, Bulacan	17 January 2018 1:30 P.M.	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	61	88	149
Minalin, Pampanga	Technical Training Center, Minalin Municipal Hall, Minalin, Pampanga	17 January 2018 1:30 P.M.	LGUs, PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	13	3	16
Santo Tomas, Pampanga	Auditorium, Municipal Hall, Santo Tomas, Pampanga	18 January 2018 08:30 A.M.	LGUs, PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	24	3	27
Angeles, Pampanga	New Legislative Building, City Hall Compound, Angeles City, Pampanga	18 January 2018 08:30 A.M.	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	45	38	83
San Fernando, Pampanga	Covered Court, Brgy. Santo Niño	18 January 2018 1:30 P.M.	LGUs, PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	57	46	103
Mabalacat, Pampanga	Xevera Covered Court, Xevera, Mabalacat, Pampanga	18 January 2018 1:30 P.M.	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	186	354	540

Table 11.2.2 Summary of Issues, Concerns, Comments, and Suggestions Raised during the 1st SCM

Queries/Concerns/Suggestions/ Comments	Responses To Queries
Entitlements and Rights of ISFs	
• If recipients of previous relocation program be included in the housing program for this project	• Confirmed that if a person did not avail any relocation program before, it means that the individual is not a recipient of a housing program; • The NHA has a master list of those who were previously awarded with relocation sites; • Those who have already been awarded with relocation sites before will not be qualified for relocation again; • It would be unfair for the government to provide relocation sites for those who abandoned or sold the rights to relocation sites previously awarded to them by the government; • If those previously awarded with relocation sites officially returned the same to the housing agency concerned, then they could have still been qualified for relocation

Queries/Concerns/Suggestions/ Comments	Responses To Queries
• Considerations for the Northville relocation program awardees who returned to illegal settling along the tracks in San Vicente	• As part of the RAP study, the Team will gather data of previous housing project awardees from the barangay; • The survey to be undertaken will establish the present status of the PAPs; • The RAP Team could only recommend who are qualified, but it is the partner housing agency of the DOTr who will decide if the PAP is qualified for the relocation program/compensation or not
• If landowners are qualified for relocation	• Private lands to be affected by the project will be compensated
• If structure owners are qualified to the relocation program for the project	• Qualifications of the structure owners to the relocation program will be discussed in detail during the 2nd SCM; • Reminded the stakeholders that the housing is not free and will be amortized monthly
• If the relocation program will be awarded per family or per structure	• Relocation program will be per household; • One household is defined by a separate kitchen and food budget
Issues and Concerns on the Tagging and Survey	
• Before the administration's Build Build Build plan, a tagging and a study were already undertaken in the area	• A new tagging will be implemented for this project
• Structure owners may not be present during the tagging, census and survey due to work schedule, particularly during weekdays	• Permission will be requested from the structure owners prior to tagging; • Suggested to the PAPs to authorize their neighbors to permit the tagging in case the owners are not present; • Schedule of the interview could be arranged with Team on weekends as the enumerators are staying in the area, to accommodate PAPs who are working during weekdays
• If tagging of structures depends on the number of families living in the house	• Clarified that the tagging will be per structure, not per household or per family; • Explained that structures tagged at this stage are considered potentially affected only; • There may be additional structures to be tagged once the parcellary survey is completed; • After the tagging, the enumerators/interviewers will start the survey and census
• Requested that the survey and census be coordinated and verified with the barangay	• Assured the stakeholders that the tagging, survey and census teams will coordinate with the barangay official prior to undertaking of any activities related to the project
Alternative Livelihood and Restoration Program	
• Alternative source of livelihood must be provided to the PAPs who will be resettled	• The socio-economic survey to be undertaken will establish the present socio-economic status of the PAPs; • A detailed explanation on the livelihood restoration program for the PAPs will be discussed in the next SCM
• Most of the affected area in Minalin are fish ponds and even if only a fraction will be acquired, the fish pond will not be functional; • If the affected fish ponds could still be utilized or will it be fenced, and fishing would be prohibited	• If the remaining part of the fish pond is no longer viable for business, there is a possibility that the whole property will be acquired; • The extent of the areas to be affected cannot determined yet as the exact measurements are. • The policy now is that even if DOTr will build above the land, no structures are allowed to be constructed below; • There is a plan to fence the ROW
Temporary Employment	
• Suggested that out-of-school youths along the tracks be hired during construction stage of the project	• Part of the study is to identify who are these youths and what skills they can offer. This is also why we're coordinating with you and the barangay. • Suggestion is noted
Concerns on the Relocation Site	
• If existing relocation sites be used for those who will be relocated	• Relocation sites will depend on the study of EcosysCorp, the RAP subcontractor (Consultant) of the project; • EcosysCorp, DOTr's Consutant for the RAP will consult the PAPs, LGUs, PNR, and other concerned agencies; • Coordination with the LGUs and the NHA will be will be undertaken to ascertain the availability of relocation sites within the municipality/city or those near the area; • If there are no relocation site available, DOTr will give the PAPs choices for relocation sites; • If there are many PAPs to be relocated, the concerned LGU or the PAPs could offer a lot where a 2-storey or 3-storey building could be built as your relocation site using the budget allotted for your relocation (People's Plan);

Queries/Concerns/Suggestions/ Comments	Responses To Queries
	• Encouraged the PAPs to provide accurate inputs during the survey, especially about their compensation and entitlements
• Asserted that there are relocation sites without basic utilities such as electricity	• In the JICA guidelines, those relocated should at least have electricity and water
• If there is an identified relocation site for the PAPs affected by Phase 1	• In-city relocation is the priority; • For Phase 1, informal settlers may be relocated in NHA projects such as Bustos, Caloocan, and Harmony Hills in San Jose Del Monte, Bulacan. • According to the NHA, Northville in Malolos is already fully occupied; • Livelihood packages will be included for those who will be relocated; • There will be three (3) SCMs per stage of the project, and the 3rd SCM will tackle the issues concerning the potential relocation sites and the entitlements of the PAPs
Right-Of-Way Issues	
• How wide is the PNR ROW	• The PNR ROW is approximately 30 m wide; • ROW required by the project is 15-15m from the centerline of the PNR ROW, however, it would still depend on the final design of the project
• If the 30-m ROW measures 15 m to the left and 15 m to the right of the centerline • Reckoning point of the 30-meter PNR ROW	• The 30-m ROW means 15 meters to the left plus 15 meters to the right of the centerline; • Explained that the 30-m area as for now will only be used for surveys to determine the current condition of the area and for DOTr to be able to prepare the budget request; • The final ROW required by the project has not been finalized yet; • Explained that the surveyors are still locating the boundary of the 30 m ROW
• There is an existing list of legitimate occupants of PNR property, and there are delinquent members or informal settlers	• If the property is within a public land, DOTr will verify if the government allowed the subject property to be occupied, and look for proof recognized by the concerned government entity who owns the land; • Explained that if it is proven that the government allowed its land to be occupied, then those occupying the said property are not classified as informal settlers, and their compensation will be different; • If any land owner, in general, does not acknowledge whoever is occupying their land, those occupants will be classified as informal settlers.
• If the new railway will be constructed where the old railway is	• Yes, the new railway will utilize the existing PNR ROW
• Possibility that the ROW required would exceed 30 meters, considering the planned cargo/freight train	• The surveys will be undertaken within the 30-meter area; • The alignment of the cargo/freight train is not final yet
• Location of the cargo/freight train along McArthur Highway	• As of now, location of the cargo/freight train is not determined yet as the studies are still on-going; • In Phase 1, the alignment of the cargo/freight train changes: there are areas where the trains are on the right side of the elevated railway, and there are areas where the trains cross to the left side of the elevated railway; • The location of the cargo/freight railway depends on the availability of land, final design, and the over-all ROW.
• Several Barangay Roads in San Fernando City is beside the 15-m PNR ROW	• Barangay Roads and access of the PAPs are considered in the desugn; • DOTr will find a way for affected areas to be accessible; • There will be an inventory of all affected crossings; • Areas with no viable alternative access routes will be considered in the design of the project
• Basis of compensation for private lands	• A more detailed explanation on compensation of private lands will be discussed in the 2nd SCM; • The latest ROW law, R.A. 10752 will be implemented for the compensation of affected private properties
• Possibility that the areas below the elevated railway could be utilized as alternative roads	• The matter will be referred to DOTr as the agency may have other plans for the areas underneath the elevated guideway
Concern on Access (Vehicles & Residents)	
• If barangay roads crossing the PNR ROW be maintained	• Legitimate public, municipal, and barangay roads will not be closed, but with regards to private roads crossing the PNR ROW, the matter must be discussed with the PNR; • An inventory of private access roads crossing the PNR ROW will be undertaken
• Concern about the subdivision access (Brgy. Cruzcosa, Calumpit) to the other	• Existing public and national roads will not be closed during construction; • Subdivisions with access roads crossing the PNR ROW and private property

Queries/Concerns/Suggestions/ Comments	Responses To Queries
side of the tracks during construction period when the ROW is fenced; • Asked if access to the other side of the railway tracks will be provided once the line is operational	owners or private properties crossing the PNR ROW without the permission of PNR may be closed, unless the subdivisions or private property owners execute an agreement with PNR; • When the required ROW is measured, access to areas with numerous structures that will be blocked will be noted and these will be studied to find ways how to provide access; • Access will most probably be located away from the PNR ROW
• Concern on the possible closure of public roads crossing the tracks, which are major access points to schools in Sta. Isabel, Malolos City	• Major public roads such as those used by the municipalities and barangays will not be blocked/closed; • Operating hours of the future cargo/freight train will only be at night as many intersections will be affected
• Provision of access for residents crossing the tracks	• Clarified that unauthorized access to public will no longer be allowed once operational; • The survey will include questionnaire regarding access, to understand the need of the residents for access to cross over to the other side of the tracks, and the importance of the access that will be lost; • The RAP Preparer could recommend the provision of the access to the other side of the tracks if the purpose for crossing over is valid, such as going to a day care or school
• Concern on the possible closure of existing road crossings and public access points	• All existing legal roads crossed by the alignment such as National Roads, City Roads, and Barangay Roads will be maintained and not closed/blocked; • Provision of alternative access to affected access roads and crossings are being considered in the design; • Assured that the concern is being carefully studied by the traffic engineering design team
Timeline of the Project	
• Target date of relocation or clearing	• The project is currently in the Feasibility Study stage; • DOTr will have to adjust the design of the project based on the results of the study; • DOTr will send out the letter of notice prior to implementation to enable the PAPs to prepare
• Date of clearing in the affected areas; • Expected completion of NSCR Project; • Expected start of the proposed MCRP	• For NSCR Project, affected areas will be cleared and affected families will be resettled/relocated in April or May 2018; • Less than 10 are affected by the NSCR Project; • Construction of NSCR Project will start between July to September 2018; • Disclosed that DOTr is currently conducting a supplemental feasibility study for the proposed MCRP; • The basic design for the proposed MCRP is expected to be completed by August 2018; • The Detailed Engineering Design stage of the project will be from September 2018 to May 2019; • The signing of the loan agreement will be on December 2018; • Essentially, after May 2019, there will be a final RAP containing the final list of project PAPs; • The construction of the proposed MCRP may start in 2019; • The aim is to connect Manila to Clark Airport by 2022, even if other stations have not been built yet
• Transition period allowed by the DOTr for the PAPs to fully vacate the area	• Assured the PAPs that they will have enough time to prepare before the actual relocation is implemented, as they will be involved in the planning period
• Exact date that the affected area will be determined	• Based on the project's tentative timeline, the DED will be undertaken by August 2018; • The specific areas to be affected will be determined during the DED stage
Engineering Design	
• If the 30-m PNR ROW will be fenced once the railway is operational	• Yes, the ROW will be fenced to limit access to the public to ensure safety; • Unauthorized access to the ROW will be limited
• If the railway project is elevated	• Yes, and there are also some sections on embankment
• Height of the elevation (vertical clearance)	• Explained that the DOTr will follow the guidelines on clearance (vertical) set by the country in designing the project; • The DPWH follows a 5.02-meter clearance for national roads; • Informed the stakeholders that in the design of Phase 1 or the Tutuban to Malolos Line, 5.2 m clearance from ground level is usually used, so that access roads (national roads, public roads, municipal roads, etc.) crossing

Queries/Concerns/Suggestions/ Comments	Responses To Queries
	the Line would still be passable; • Disclosed that the proposed project is funded by the Japan International Cooperation Agency (JICA), and further explained that JICA has guidelines on environmental and social considerations
• Suggested that a station be located in Brgy. Lourdes, Minalin, as there was an old station in the area before, and ridership is relatively high	• Explained that the project is already approved by NEDA; • In case a new station will be built, it will be just an additional station, and maybe not a part of this project but of future projects; • The suggestion was noted and will be related to JDT; • Explained that one of the criteria considered in the station location is the volume of ridership which was absolutely studied by JDT
• If the stations will be elevated	• The guideway and the stations will be elevated • The alignment is a viaduct in principle. The structure of the station is super elevated (in principle)
• Length of the station	• The width of stations is 60 m, while the is approximately 250 m
• If the segment in San Fernando will be on viaducts or embankments	• There will be some areas with embankments, and some areas with viaducts; • The location of viaducts and embankments will depend on ground conditions, and will be finalized in the DED stage
• Requested to include the provision of parking space in the program during the FS stage	• Stated that provision of parking spaces in stations of the railway is already considered
• Requested to consider side streets outside the PNR ROW for tricycles and other vehicles	• In cooperation with the LGU, DOTr will undertake a series of meetings regarding the development of the 7-kilometer radius from the station (transit-oriented development); • The DOTr will help the LGU prepare technical plans for the 7-kilometer radius around the station for the management of traffic to and from the station, for the development of an inter-modal transport system
• Location of the stations	• Old stations may be preserved; • The new stations may be located within the area of the old stations, but studies will still be undertaken; • The location of stations would depend on factors such as accessibility; • The final locations of stations might be available by the time 3rd SCM is held;
• Location of San Fernando Station; • If the suggestions of the LGU on the location of the new station to optimize ridership be considered in the design • If the LGU will be ask for their suggestions on where ridership can be optimized, or on where to place the new station	• DOTr is still in the conceptual design stage of the project; • There is an existing PNR San Fernando Station, but it still has to be determined if it could be incorporated into the design of the new station, or if it will be avoided because it is already a heritage site; • The location of the new San Fernando station could be moved, depending on the DED stage of the project; • Factors considered in determining the location of the new stations include the availability of space and ridership; • New stations will be placed in accessible areas where space is available, and ridership can be optimized; • As of now, there are no final locations for stations; • The practice is to coordinate with concerned LGUs
• Related that the City Mayor of San Fernando is requesting for an additional station in Brgy. Sindalan	• Advised the LGU to write the DOTr regarding the request for additional station in Brgy. Sindalan
• Requested to consider re-aligning the railway route to the open spaces in Brgy. Dolores to minimize the residential structures to be affected	• Explained that the affected area of Brgy. Dolores is still not final; • There is a directive from Sec. Tugade that urges the design team to prioritize areas with minimum affected persons
• Related that there was once a PNR station in Santo Tomas; • Requested to add another station in Santo Tomas as the distance between the proposed Apalit Station and San Fernando Station is too far; • The additional station in Santo Tomas can also cater to western municipalities of Pampanga (i.e. Minalin, Sasmuan, Guagua, Macabebe, Masantol) because a new highway will pass through Lubao, Guagua up to NLEX in Santo Tomas	• DOTr can consider a Santo Tomas station in the design stage; • The request and comments are noted
• If the existing structures built under the	• Existing structures from the Northrail project were assessed, and one of the

Queries/Concerns/Suggestions/ Comments	Responses To Queries
Northrail project be retained	recommendations was to build new structures instead: firstly, the Chinese and the Japanese have different standards, secondly, new technology now exists, and thirdly, the PNR Phase 2 is completely a new project; • The PNR line will be reconstructed completely; • The decision to use structures of the Northrail project will be finalized during the DED stage, because the structures will still be assessed further, considering their current state; • Reusing the Northrail structures will translate to savings, the reliability and safety of the railway will have to be considered
• If there will be sections of the railway on embankments in Santo Tomas	• There will be sections with embankments, and there will be sections with elevated viaducts; • The exact areas of embankments and viaducts will be determined after detailed studies which will start in August
Concern on Flooding	
• Flooding is a problem in Brgy. Caniogan, Malolos City • Propose that the old drainage system be revived	• DOTr is aware of the drainage problem in Brgy. Caniogan; • Disclosed that the drainage in the area was clogged during implementation of the Northrail Project; • The design for Phase 1 has been finalized, and DOTr coordinated with the LGU's engineering division/department regarding the drainage; • Informed the stakeholders that the drainage system along the boundary of the project is the concern of the PNR, since that area is within the PNR property; • Drainage systems for areas along the boundaries of the project were considered in the design of the project, however, DOTr needs to work within its loan agreement with JICA
• Purok 1, Brgy. Gatbuca, Calumpit is a flood prone	• Areas prone to flooding are considered in the design of the railway
• Embankment sections in Santo Tomas might aggravate the existing flooding problem in the area	• Flood levels and the findings of the 2013 flood hazard assessment also incorporated into the design of the project
Other Issues and Concerns, and Suggestions	
• There should be coordination with the PNR	• Coordination with the stakeholders will be continuous; • Requested the stakeholders to cooperate with the team conducting surveys and interviews, and provide them with copies of the relevant documents
• There was a station near Brgy. Pio Cruzcosa aside from the main Calumpit Station	• Clarified that there is no other proposed station aside from the main Calumpit Station, however, it may be considered as a "proposed future station"; • For now, there will be no ROW acquisition for "proposed future stations" because these stations are not part of the budget of the current project
• Concern regarding noise impact	• Informed the stakeholders that the noise impact is considered in the EIA study; • Disclosed that in the design of the project, some areas will be provided with noise barriers; • Explained that the trains are relatively quiet as the design will adopt the Japanese technology

11.2.2 Focus Group Discussions

1477. This Focus Group Discussion (FGD) was conducted as part of the consultation with the vulnerable sectors affected by the proposed MCRP. The vulnerable sectors covered by this FGDs will only be limited to the poor, the underprivileged, and the homeless, including socialized housing beneficiaries. Separate FGDs have been designed and conducted for other vulnerable groups such as women, elderly, and children under the Gender Impact Assessment component of the RAP.

1478. Results from the FGDs will be consolidated to substantiate the data gathered from the Socio-Economic Survey and will be analyzed as inputs in the preparation of the Livelihood Restoration and Improvement Program. Topics for the FGDs will focus mainly on Livelihood and Relocation with the following objectives:

- To obtain inputs in the formulation of the Livelihood Restoration and Improvement Program directly from the PAPs;
- To discuss possible relocation options;
- To determine PAPs' apprehensions/concerns regarding displacement of communities in relation to their respective sources of livelihood;
- To understand PAPs' concept of livelihood restoration and improvement;
- To identify other possible entitlements that will be acceptable to PAPs;
- To identify relocation preferences among the PAPs; and
- Based on output of the FGD, recommend mitigation measures to be included in the Compensation and Entitlement Matrix of the RAP.

1479. The FGDs were conducted in the Cities/Municipalities of Angeles, San Fernando, and Sto. Tomas in Pampanga and Calumpit and Malolos in Bulacan (**Table 11.2.3**). Participants were selected from the list of respondents of the Socio-Economic Survey. Criteria for selection were based on sectoral, age, and gender representation. Upon registration, participants were asked to sign a consent form that signifies their voluntary involvement in the FGD. The activity also deviated from the usual FGD process wherein participants will just talk about their ideas or opinions on the subject matter. The activity made use of meta cards to allow participants to individually write their answers to the guide questions. That way, everyone was able to contribute in the process and no individual dominated the discussion. Similar responses were grouped and synthesized. If ideas were somewhat vague, facilitators probed and allow participants to elaborate on their ideas to stimulate discussion. To enable mothers with children in tow to participate in the activity, children were gathered in a corner and were provided with coloring pages and crayons to entertain them while the session is ongoing.

Table 11.2.3 FGD Sessions

City/ Municipality	Province	Date	Time	Venue	Sector	No. of Participants		
						Female	Male	Total
Angeles	Pampanga	16 April 2018	2:00 PM	Angeles Elem. School, Brgy. Pulungbulu	Vulnerable / Household	12	17	29
					Business	3	4	7
San Fernando	Pampanga	17 April 2018	9:00 AM	City College of San Fernando, San Juan	Vulnerable / Household	9	7	16
					Business	1	2	3
Calumpit	Bulacan	19 April 2018	9:00 AM	F. Mendoza Memorial Elem. School	Vulnerable / Household and Business	13	13	26
Malolos	Bulacan	19 April 2018	2:00 PM	City of Malolos Integrated School	Vulnerable / Household	5	2	7
					Business	1	0	1
Santo Tomas	Pampanga	20 April 2018	9:00 AM	Santo Tomas Municipal Hall	Vulnerable / Household	22	9	31
					Business	0	1	1
Minalin	Pampanga	20 April 2018	2:00 PM	Brgy. Hall, Minalin	Business (Fishpens)	0	2	2

Source: JICA Design Team

11.2.2.1 FGD with Affected Business Sector

1480. Those who attended the FGDs represented a diverse array of businesses—fishponds, piggery, eatery, soy sauce manufacturing, general merchandise, commercial/residential space rental, junk shop, and learning center for children with special needs. Participants shared the how the eventual relocation of their business would impact their businesses. For some, it is simply about finding another location and starting over with a little assistance while for others it could mean a total upheaval. This is especially true for the learning center for children with special needs (i.e. blind, autism, among others) in San Fernando, Pampanga. Relocation would disorient their learners and would entail having to re-educate them all over again about their new environment. It would also mean that whatever progress they gained with their learners would be undone.

1481. In Minalin, Pampanga, only three fishpond owners will be possibly affected by the project. Although a big portion of the properties will be affected, respondents were confident that they would still be able to continue the business operations. Assistance in the form of interest-free capital would be helpful in boosting production to compensate for the acquisition of affected property and ensuring steady income flow.

1482. In Malolos, Bulacan, the only business owner who attended was pretty sure that her property will not be affected at all even if it was included in the tagging and survey.

1483. Overall, the business owners and/or their representatives were supportive of the project despite its impact in their respective businesses. Their only hope is that the project would push through and that they won't simply be relocated for nothing. **Table 11.2.4** reflects the responses of the participants for each project area.

Table 11.2.4. Results of FGD with Affected Business Sector

Guide Questions	Responses
Angeles, Pampanga	
1. On the business side - What are your apprehensions/concerns regarding acquisition of your property?	• Loss of property • What will happen to the business? • Loss of access if railway will be fenced • What will happen to the remaining property if not all will be acquired • What will happen to tenants? Will there also be financial assistance to tenants?
2. What are your expectations regarding livelihood restoration and improvement?	• Compensation for loss of property • Financial assistance to relocate business/mobilization of tools and equipment • Opportunity to have space to re-establish business • Opportunity to land a job while re-establishing eatery • On-time payment of compensation
3. What possible project benefit sharing schemes can you suggest?	
a. During Construction?	• Opportunity to put up eatery
b. During Operation?	• Opportunity to put up eatery
4. What is your expected timeline for this?	
a. During Construction?	• No answer
b. During Operation?	• No answer
5. What do you consider as "deal breakers" for the schemes presented?	• Delays in compensation for property
San Fernando, Pampanga	
1. On the business side - What are your apprehensions/concerns regarding acquisition of your property?	• Loss of space • Loss of investment • Where to relocate business • Finding a conducive location • Transferring factory equipment and supplies • Loss of income • Takes time to re-establish business • Business will become unstable • How to ensure that business will become successful in a new location • Where to get staff salary during transition • Time-frame of the project (to allow them to plan for the transition) • Loss of social network • What will happen to properties that will only be partially affected? • How the transfer will affect the education of the learners with special needs
2. What are your expectations regarding livelihood restoration and improvement?	• Opportunity to find a building/space within the city • Transition allowance • Assistance in transferring equipment
3. What possible project benefit sharing schemes can you suggest?	
a. During Construction?	• Opportunity to have space to put up eatery
b. During Operation?	• Opportunity to have space to put up business (selling)
4. What is your expected timeline for this?	
a. During Construction?	• No response
b. During Operation?	• No response

Guide Questions	Responses
5. What do you consider as "deal breakers" for the schemes presented?	• Delays in payment of land and structure
Calumpit, Bulacan	
1. On the business side - What are your apprehensions/concerns regarding acquisition of your property?	• It will be a new chapter in their lives • Difficulty in setting up/re-establishing business • Distance in new place • Losing customers • Effect on income (product has shelf life)
2. What are your expectations regarding livelihood restoration and improvement?	• Assistance in finding space for business • Financial assistance in transporting equipment/machinery/products • Additional capital to purchase machinery
3. What possible project benefit sharing schemes can you suggest?	
a. During Construction?	• No response
b. During Operation?	• No response
4. What is your expected timeline for this?	
a. During Construction?	• No response
b. During Operation?	• No response
5. What do you consider as "deal breakers" for the schemes presented?	• Unjust compensation
Santo Tomas, Pampanga	
1. On the business side - What are your apprehensions/concerns regarding acquisition of your property?	• None, only a small portion of the property will be affected. Business operation will not be affected at all.
2. What are your expectations regarding livelihood restoration and improvement?	• Fair compensation of affected property
3. What possible project benefit sharing schemes can you suggest?	
a. During Construction?	• Not applicable
b. During Operation?	• Not applicable
4. What is your expected timeline for this?	
a. During Construction?	• Not applicable
b. During Operation?	• No applicable
5. What do you consider as "deal breakers" for the schemes presented?	• None
Minalin, Pampanga	•
1. On the business side - What are your apprehensions/concerns regarding acquisition of your property?	• Space for fishpond will become smaller • Compensation for the expenses incurred in developing fishpond
2. What are your expectations regarding livelihood restoration and improvement?	• Compensation for the portion of affected property so that they can purchase equipment/materials • Assistance to avail of loan with no interest to be able for additional capital to purchase good fingerlings to boost production and ensure steady income
3. What possible project benefit sharing schemes can you suggest?	
a. During Construction?	• Not applicable
b. During Operation?	• Not applicable
4. What is your expected timeline for this?	
a. During Construction?	• Not applicable
b. During Operation?	• Not applicable
5. What do you consider as "deal breakers" for the schemes presented?	• No response

11.2.2.2 FGD with Affected Vulnerable Sector

1484. There was so much anxiety among participants regarding their plight as a result of the project. Concerns were mostly centered on where they will be relocated and what will happen to their lives in the relocation site rather than its effect on their livelihood. Although they were not hostile, it was difficult to draw out responses on the livelihood topic. The feedback was that they can easily re-establish their lives and sources of income once they know where they will be relocated. The results of the FGD per LGU are presented in **Table 11.2.5**.

Table 11.2.5 Results of FGD with Affected Vulnerable Sector

Questions	Responses
Angeles City, Pampanga	
1. What are your apprehensions /concerns regarding the potential impact of resettlement on your livelihoods?	• Location of relocation site might be far from where we currently are and we will lose our customers • Longer time to get to our current work if relocation site will be far from where we live now notwithstanding the bad traffic situation • Concerns over distance from hospitals, school, market, church, livelihoods. Most of these are just a short distance from where we live, hence we either just walk or pay minimal fare. Other concerns: • Takes time to adjust with new neighbors at relocation site
2. What support programs do you think are necessary to help you cope up with the possible impacts on your livelihoods?	• Financial assistance to augment potential capital losses due to relocation impacts (ex. fish vending) • Sari-sari store owners and vendors should be provided stalls at the market near or within the relocation site • Establish transport terminal at the relocation site that operates 24 hours employees/ workers have access to transportation anytime (ex. call center employees etc.) • Existence of or creation of a transport operators/drivers association (TODA) at the relocation site so we could still continue driving tricycles/jeepneys
3. If livelihood restoration is not possible, what alternative livelihood programs can you suggest?	• Financial Support to start a new business (e.g. Sari-sari Store) • Opportunities for tailors and dress makers to enter into business contracts with the government or anything that the affected communities can benefit from • Be provided with an area to carry out farming • Training on farming technologies • Skills training programs on bag-making, slippers-making or handicrafts/decorations-making to sell • Put-up a market area at the relocation site so we could sell there • Relocation near factories or encourage investors near relocation sites to open up employment opportunities
4. What other programs can you suggest to help improve existing/alternative livelihoods and consequently help improve household income?	• Skills training program to improve our current livelihoods • Create more jobs • Trainings on financial literacy and business management
5. How do you think the project can help you cope better with the livelihood impacts?	During Construction: • Training for affected communities on skills needed for construction so we can be employed • Training programs should be free for affected persons • Priority in employment during construction and provide service for those coming from the relocation site. Vehicle service contract should be awarded to the affected persons whose livelihood depend on it
	During Operation: • No age limit in hiring employees as able and capable • Prioritize our new graduates in employment • Employment opportunities during the operation should include benefits similar to what we are currently enjoying in our work (promotions for good performance etc.)
6. What is your relocation preference?	• Implement sports program so those without work become productive and not become a problem to the community • Access to power and water • Low cost and affordable payment terms • Free relocation housing because we have been physically displaced involuntarily • Secure place and near police station • Peace and order at the relocation site • Site should have trees so its not hot • We prefer to be relocated here in Angeles City • Near hospital and market place (we currently just walk to the market) • Presence of a chapel/church so we can continue to be close to our creator

Questions	Responses
	• Assignment of relocation houses should consider current neighborhood locations so we maintain our support network and adjustment is easy • Bigger lot area (120sqm) and floor area (at least bigger than the government standard of 40sqm) • Single-detached houses and not multi-storey buildings
7. What are the factors influencing your relocation preference?	• Relocation site of our neighbors who here relocated earlier were not orderly, very hot like a desert that's why most relocates left and went back to where they came from • Current community where we live have peace and order issues • Our current neighborhood are our source of support in times of need, hence, its important that we remain neighbors in the relocation site
8. Other suggested resettlement support/assistance	• Give enough time for adjustment to better understand our situation • Financial assistance while we are adjusting at the relocation site • Provide trucks during physical relocation or financial assistance so we can hire vehicle/trucks • Provide relief goods during relocation in the form of food assistance during 1-2 months transition period • We hope that financial assistance will reach the affected senior citizens • Relocation should be carried out during dry period so it would be less difficult
Malolos, Bulacan	
1. What are your apprehensions /concerns regarding the potential impact of resettlement on your livelihoods?	• No livelihood opportunities at relocation site • No water and electricity at relocation site • Our livelihoods will be affected (ex. eatery, sari-sari store) Other concerns: • Are we qualified for relocation at government appointed site/s • What happens to us who are still paying our housing loans, newly built fences? • Who should talk about this with Pag-ibig, subdivision developer? Have there been discussions with these entities?
2. What support programs do you think are necessary to help you cope up with the possible impacts on your livelihoods?	• Relocate us in single-detached houing units so we can still continue our mini-food stores / eatery • Relocation near main roads so we can still continue vending/selling our products
3. If livelihood restoration is not possible, what alternative livelihood programs can you suggest?	• No response (respondents indicate that it is still possible to continue their income source (i.e. Seaman, Sari-sari store business)
4. What other programs can you suggest to help improve existing/alternative livelihoods and consequently help improve household income?	• Financial support to help us diversify our livelihoods /additional business
5. How do you think the project can help you cope better with the livelihood impacts?	During Construction: • Opportunity to set up stores near construction sites • Priority in employment during construction
	During Operation: • Employment opportunities for affected persons when the project operates
6. What is your relocation preference?	• Even if the relocation houses are small provided that we have enough space to extend • Commercial space for our business at relocation site • We hope that houses are already finished before we relocate • Housing structures should be made of quality sturdy materials • Affordable housing and convenient payment terms • Relocation site must be safe and peaceful • Must have available power and water supply system • Single detached houses and not multi-storey buildings • Must be accessible to basic services and amenities (school, market, hospital)
7. What are the factors influencing your relocation preference?	• We have had experiences in our current community where peace and order is a problem (ex. robbery etc.)
8. Other suggested resettlement support/assistance	• Financial assistance while we are reestablishing our livelihoods at the relocation site to support our day to day needs and activities • Provide trucks during physical relocation or financial assistance so we can hire vehicle/trucks
Sto. Tomas, Pampanga	
1. What are your apprehensions /concerns	• Will the relocation site be far away from our workplace?

Questions	Responses
regarding the potential impact of resettlement on your livelihoods?	• Higher transport fares • Reduced incomes • Will I have a place to sell my goods at the relocation site? • Will we be relocated far from where we purchase our goods to sell? Other concerns: • How about our access when the project proceeds? Only a portion of my house and lot will be affected • What happens with the house we have been paying in Pag-Ibig? We have also spent money extending our houses, will we be compensated for our investments? • What happens to our kids' education? • Will we get paid for the house that will be affected?
2. What support programs do you think are necessary to help you cope up with the possible impacts on your livelihoods?	• Commercial space at relocation site to continue selling our goods • Additional capital to augment the additional expenses to buy commercial goods from distant sources • The government to provide service/shuttle bus to workers whose jobs will be far from the relocation site
3. If livelihood restoration is not possible, what alternative livelihood programs can you suggest?	• Financial assistance for those affected to help re-establish livelihoods • We hope that there are also factories of caskets and pots at the relocation site so that we can continue working in the same kind of job
4. What other programs can you suggest to help improve existing/alternative livelihoods and consequently help improve household income?	• Free training programs to be carried out at the relocation site so that affected persons will have the opportunity to learn new skills and establish new livelihood enterprises
5. How do you think the project can help you cope better with the livelihood impacts?	*Respondents expressed that they have just been relocated in the NHA Housing and now they have to be relocated again. They are still in the process of adjusting hence, they have difficulty thinking about it and didn't want to give any response to this question.*
6. What is your relocation preference?	• To be relocated in the current subdivision (Bondocville) • Sturdy housing materials • Regulated transport fare so that no one will take advantage of the relocates situation • Peaceful relocation site safe for our children • Opportunities for employment at relocation site • Relocation near current residence • Single detached housing units • Accessible jeepney terminal • Low cost housing • Near school, church, market, police station
7. What are the factors influencing your relocation preference?	• We prefer Bondocville because it is not crowded, with wide streets, house sizes are big with the option to extend upwards (2nd floor) • The Northville relocation experience wasn't good. • Some previous government housing projects are not good, not sturdy, design and materials for windows and doors did not consider security of occupants
8. Other suggested resettlement support/assistance	• Cash compensation for affected properties should be paid early so we can use them to rebuild our lives • Vehicle or financial assistance for renting trucks during the physical move or relocation • Financial support while we are in the process of rebuilding our lives and livelihoods
San Fernando, Pampanga	
1. What are your apprehensions /concerns regarding the potential impact of resettlement on your livelihoods?	• This could be another case of relocation similar to Northville where progress is too slow (no livelihood opportunities, poor housing structures etc.) • We will lose our regular customers/clients • Far distance from our current jobs would mean additional transport expense (currently just a walking distance from residence) • Additional business cost and lesser income Other concerns: • Access to schools, hospitals, police station • Peace and order at relocation site

Questions	Responses
	• Access to communication • Please consider the psychological effects of relocation (People are already becoming anxious at being relocated and what the situation in the relocation site would be)
2. What support programs do you think are necessary to help you cope up with the possible impacts on your livelihoods?	• Provide place to sell goods • Additional capital as relocation would mean cost • Access to transportation at relocation site so we can continue keeping up with our regular customers/clients • Assistance in organizing a new transport association and line at relocation site • Provision of commercial site at relocation where we can still continue selling our goods
3. If livelihood restoration is not possible, what alternative livelihood programs can you suggest?	• Skills training and financial assistance to start new livelihood • Provision of land space so we could continue planting vegetables and herbal plants or raise livestock like pig and poultry and dogs. • Financial assistance for senior citizens who are no longer able to engage in any other alternative livelihoods
4. What other programs can you suggest to help improve existing/alternative livelihoods and consequently help improve household income?	• Assistance to improve our products (ex. improved packaging for ice cream and processed meat) • Provision of better appliance/machine for ice cream making • Access to micro-finance or funding institutions • Encourage investors to put up industries near relocation site so more jobs can be generated • Provide permanent job opportunities • Training on business management and financial management
5. How do you think the project can help you cope better with the livelihood impacts?	During Construction: • Opportunity to set up stores near construction sites • Priority in employment during construction (mason, welder, carpenter etc.)
	During Operation: • Provide employment opportunities (ex. janitor, security guard
6. What is your relocation preference?	• Near our current residence • Relocation site should have trees and not hot • Housing amortization payment should not start till after a year to give us time to reestablish our livelihoods and be able to save for payment • Give us 5 years before we start paying the housing amortization • The government should closely monitor housing construction contractors so they don't rob construction materials • Near market, church, school and hospital and near business center • We want to be relocated together in one place • Not to be relocated in remote areas • Flood-free area • Relocation with San Fernando • Safe location • Sturdy houses • Housing through Pag-ibig with low monthly fees • Single detached housing • Bigger houses • Access to communication signal (internet, tv, etc.) • Power and water facilities
7. What are the factors influencing your relocation preference?	• So that the cost of housing is not going to add burden to our household • To be near our current workplace/jobs • Government housing are weak. Roofs get blown during heavy winds • So we could still plant around our houses to take away our stresses • Too noisy for houses to be too close to each other • To have some privacy if houses are not closely located with each other • Floods are sources of illnesses
8. Other suggested resettlement support/assistance	• Free vehicle to use during the actual physical move • Financial assistance during relocation • Financial assistance for 3 months while we are in the process of reestablishing our livelihoods to cover for our day to day expenses/needs example: kids' school expenses etc. • Food allowance during relocation
Calumpit, Bulacan	
1. What are your apprehensions /concerns	• Where to be relocated?

Questions	Responses
regarding the potential impact of resettlement on your livelihoods?	• No assurance on what will happen in the relocation site • Losing only source of income/business (i.e. sewing, vending, transport, furniture, garage, workshop) • Will be relocated far from market • Losing customers • There might be a lot of similar business in the relocation site (e.g. sari-sari store)
2. What support programs do you think are necessary to help you cope up with the possible impacts on your livelihoods?	• Agricultural program on livestock and poultry raising • Establish commercial/business center near the relocation site or highway • Provision of financial assistance/loan for additional capitalization • Provision of space to continue business • Public transportation terminal/Garage
3. If livelihood restoration is not possible, what alternative livelihood programs can you suggest?	• Employment opportunity for affected persons • Livelihood program/business where government will provide wages • Capital to put up business (e.g. Sari-sari store, Dress shop • Free Training/Seminars on TESDA Courses • Invite businesses to invest in the community
4. What other programs can you suggest to help improve existing livelihoods and consequently help improve household income?	• No response
5. How do you think the project can help you cope better with the livelihood impacts?	
a. During Construction	• Inform affected community about employment opportunity • Priority to work in the construction site • Opportunity to sell within the construction site
b. During Operation	• No response
6. What is your relocation preference?	• Low/affordable monthly amortization • Same as the HDMF System (25-30 years to pay) • Monthly amortization to start after two years • Free housing • Sturdy housing • Accessible/near highway • Within Calumpit • Flood-free • Peaceful community • Clean surroundings • With water and electricity • With garage • Near schools, market, hospital • Access to public transportation • With wide roads • A Relocation site that is not a squatters' area • A site that will be properly maintained and would not look like a squatters' area
7. What are the factors influencing your relocation preference?	• People in the squatters' area mostly drink and create trouble in the community • Water and electricity are essential • Most government housing are substandard • Other relocation sites are prone to flooding
8. Other suggested resettlement support/assistance	• Provide transportation/allowance for hauling • Transitional allowance while re-establishing business/income source • Security during relocation to avoid looting • Food allowance during relocation • Labor assistance during relocation • Ensure that timing of relocation would not affect the schooling of children

11.3 PUBLIC SCOPING

1485. The Public Scoping was conducted in two (2) cluster areas on January 22 and 23, 2018 which details are presented in **Table 11.3.1**. The Public Scoping was facilitated by the representatives from the EIA Division of the EMB-Central Office to provide information about the Project and to collect site-specific issues, concerns, and inputs to the EIA Study. In order to encourage the attendance, invitation was sent to key stakeholders and barangay chairmen by sub-contractor on behalf of EMB so that they disseminate the events further to the general public, and the notice of public scoping was displayed at the venue. The presentation was conducted in Tagalog.

Table 11.3.1 Schedule, Venue and Participants of the Public Scoping

Date and Time	Venue	Target Affected LGU	Main Participants	No. of Participants		
				Female	Male	Total
2018/01/22 13:00	The Pavilion Hiyas ng Bulacan Convention Center, Malolos, Bulacan	• Malolos • Calumpit • DENR- PENRO Tarlac • MGB Region 3	• EIAMD Case Handlers, DENR - EMB Central Office • EMB Region 3 Representative • DENR – PENRO Bulacan • MGB Region 3 Representative • Malolos LGUs (Representative from the Office of the Mayor, Vice Mayor, City Councilors and representatives, City Department Heads, concerned Barangay Chairmen, Barangay Councilors and representatives) • Calumpit LGUs (Representatives from the Office of the Mayor and Vice-Mayor, Department Heads, concerned Barangay Chairmen, Barangay Councilors and Representatives) • Residents	43	42	85
2018/01/23 13:00	Xevera Basketball Court, Xevera Subdivision, Brgy. Tabun, Mabalacat, Pampanga	• Apalit • Minalin • Sto. Tomas • San Fernando • Angeles • Mabalacat • DENR- PENRO Tarlac • MGB Region 3	• EIAMD Case Handlers, DENR - EMB Central Office • MGB Region 3 Representative • DENR – PENRO Tarlac • Apalit LGUs (Representative from the Office of the Mayor, Vice Mayor, Department Heads and concerned Barangay Chairmen and Councilors) • Sto. Tomas LGUs (Representative from the Office of the Vice Mayor, Mayor, Department Heads, concerned Barangay Chairmen and Councilors) • San Fernando LGUs (concerned Barangay Chairmen) • Angeles LGUs (Representative from the Office of the Mayor and Vice Mayor, Department Heads, concerned Barangay Chairmen and Councilors) • Mabalacat LGUs (Department Heads, concerned Barangay Chairmen and Councilors) • Capas LGUs (Representative from the Office of the Mayor and Vice Mayor, Department Heads) • Bamban LGUs (concerned Barangay Chairmen and Kagawad) • SB Members of Apalit and Sto. Tomas • Residents	37	72	109

Source: JICA Study Team

1486. The agenda for the Public Scoping started with a prayer followed by the national anthem. The welcome remarks were given by the host LGUs and followed by the introduction of participants prior to the presentation of the EIA Process and Project Description. A two-hour open forum was allotted to the participants to raise their issues, concerns and inputs to the EIA Study.

1487. The overview of the EIA Study and the objectives of Public Scoping were presented by the representatives from the EMB EIA-Central Office. The description and benefits of the Project were presented by the Department of Transportation as the Project Proponent, while the Potential Associated Impacts and Mitigating Measures as well as the Benefits of the Project were discussed by Engr. Ledicia T. dela Cruz of GEOSPHERE Technologies Inc. After the presentations, an open forum was held, which was facilitated by the representatives from EMB EIA-Central Office, to solicit inputs to the EIA study of the project from the stakeholders. After the open forum, the issues, comments, and suggestions to the EIA Study were summarized by Engr. Ledicia T. dela Cruz and Engr. Carlo Vic Arida of the EMB-DENR. The participants were also advised to contact the EMB-DENR, DOTr and GEOSPHERE for additional issues, concerns and inputs that they may want to raise after the Public Scoping. The Public Scoping was then adjourned after the closing remarks from the DOTr.

1488. The receipt copy of the invitation letters, attendance sheets, photos taken during Public Scoping and the accomplished **Annex 2-7c** (Proforma Public Scoping List of Issues) are presented in **Annex 11-2**.

11.4 PUBLIC HEARING

1489. Three (3) sessions of clustered Public Hearing will be conducted; one for Bulacan in Malolos on June 29, 2018, one for Pampanga in San Fernando on June 26, 2018 and another one for Tarlac in Bamban on June 27, 2018. These will be presided by the EMB-Central Office and the EIARC. The additional issues that will be raised during the Public Hearing will be incorporated into the EISR and will be submitted to EMB-Central Office for review by the EIARC.

11.5 INFORMATION DISCLOSURE

1490. The following information were presented to the public during IEC, FGD and Public Scoping:

- Project Description
- Possible impacts of the proposed MCRP
- Proposed mitigating measures

1491. Prior to Public Scoping, the Project Description and the proof for the conduct of IEC such as attendance sheets, photos, received invitation lettes and list of issues raised by the participants were posted in the EMB Website. The hard copies of the above-mentioned documents were also distributed to the invited participant as attachment of the invitation letters.

1492. The draft Environmental Impact Statement Report (EISR) and the EIS Summary for the Public (ESP) will be posted in the EMB website (www.emb.gov.ph) at least 20 days before the public hearing. After the review process, the final EISR of the proposed MCRP will be distributed to the following:

Provincial Government of Bulacan Bulacan Provincial Capitol MacArthur Highway, Malolos City, Bulacan	Municipal Government of Minalin Minalin Municipal Hall Poblacion, Minalin, Pampanga	Provincial Government of Tarlac Tarlac Provincial Capitol Capitol Site Street, Tarlac City, Tarlac
City Government of Malolos Malolos Municipal Building, Pariancillo Street, Malolos City, Bulacan	Municipal Government of Sto. Tomas Sto. Tomas Municipal Hall, Magsaysay Street, Santo Tomas, Pampanga	Municipal Government of Bamban Bamban Municipal Hall Brgy. Anupul, Bamban, Tarlac
Municipal Government of Calumpit Calumpit Municipal Hall Poblacion, Calumpit, Bulacan 3003	City Government of San Fernando New Municipal Hall Building, A Consunji Street, San Fernando City, Pampanga	Municipal Government of Bamban Bamban Municipal Hall Brgy. Anupul, Bamban, Tarlac
Provincial Government of Pampanga Capitol Boulevard, Capitol Compound, San Fernando City, Pampanga	City Government of Angeles Angeles City Hall Angeles City, Pampanga	Municipal Government of Capas Capas Municipal Hall Sto. Domingo 2nd, Capas, Tarlac
Municipal Government of Apalit Apalit Municipal Hall San Juan , Apalit, Pampanga 2016	City Government of Mabalacat Mabalacat City Hall Delfin Drive, Mabalacat, Pampanga	Environmental Management Bureau DENR Compound, Visayas Ave, Diliman, Quezon City, 1116 Metro Manila

12. CONCLUSION AND RECOMMENDATION

1493. The proposed MCRP is a mass public transport that will connect Metro Manila to the Provinces of Bulacan, Pampanga and Tarlac and offer shorter travel time and convenience for the commuters. With the proposed MCRP, the traffic situation within the project area will generally improve due to expected shift of commuters from road-based to rail-based transport system. It will also create new business and job opportunities, provide a better international gateway, and promote urban and economic development in Region III.

1494. The major adverse impacts of the proposed MCRP are the relocation of the residents living the along the ROW, diversion/relocation of utility facilities, blockage of access roads, disruption of school activities. Other anticipated impacts during construction are degradation of air quality due to fugitive dust emissions, increase in noise level and vibration, and nuisance to nearby residents from construction activities. There may maybe health and safety risk due to increase in heavy equipment and machineries. Specific measures to address these concerns are included in the EMP. DOTr also commits to conduct regular monitoring activities to monitor and evaluate its performance in implementing the mitigating measures.

1495. In general, the proposed MCRP was supported by the local people. The local people appreciated that the proposed MCRP will offer express commute from Manila to Capas, improve the traffic scenario in the region and lessen the air and noise pollution from vehicles.

1496. Based on the analysis of information and feedback received from various stakeholders, this EIA concludes that potential significant ecological impacts from the project can be addressed and it is unlikely that there will be any significant residual environmental impacts.

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