APPENDICES

A. Review of Specifications of Existing Railway Facilities and Systems
   1. Route and Civil Facility
   2. E&M System
   3. Rolling Stock

B. Others
   1. Civil
   2. Rolling Stock

C. Demand Forecast for Line 1 Cavite Extension Project

D. Traffic Survey

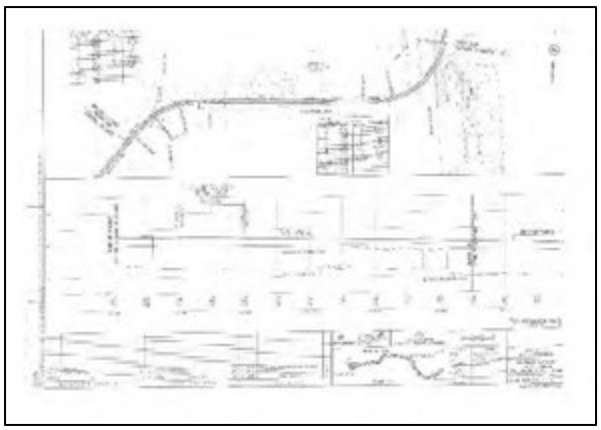
E. Environmental Management Plan

Appendix A: Review of Specifications of Existing Railway Facilities and Systems

1 ROUTE AND CIVIL FACILITY

It reviewed based on the LAVALIN drawing about a plan of main line, civil works facilities planning, and the construction method. As a result, except for a part of plan of main line route, it can be judged that a big problem is not found. The narrow part at the southernmost end of Baclaran station and the intersection part with a heavy-trafficked Roxas Boulevard avenue are places to be warned. Examination and a plan are performed also about them and it can be judged that construction is possible enough. In addition, about No. 2, No. 7, No. 8, No. 17, and No. 21 of the route plans, it was already explained about notes in Chapter 3.1.

The drawing of the route, civil works facilities, and special construction part is shown below.



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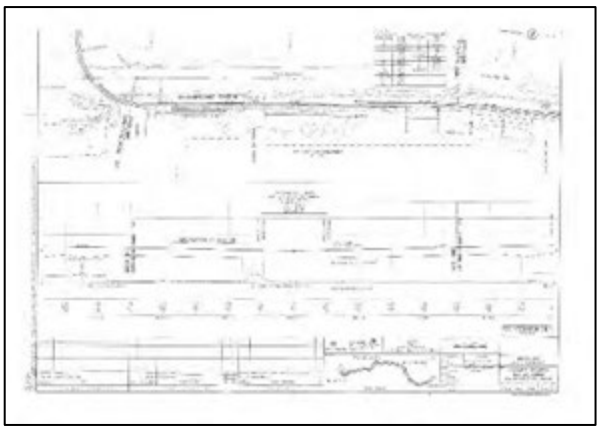

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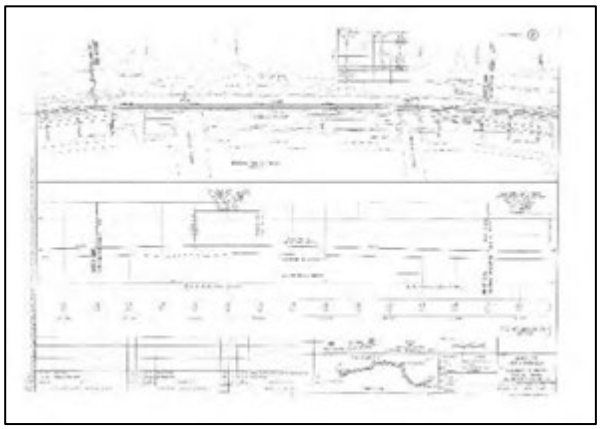

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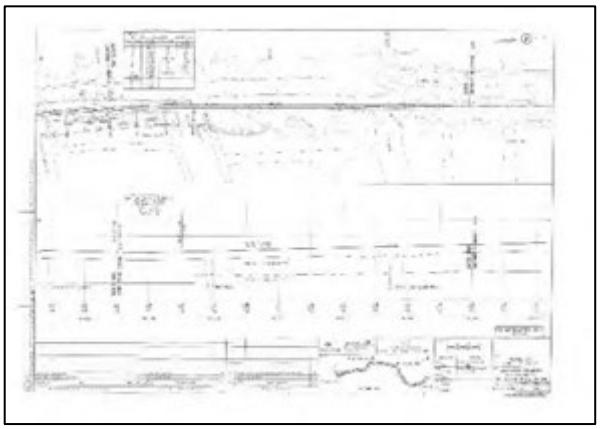

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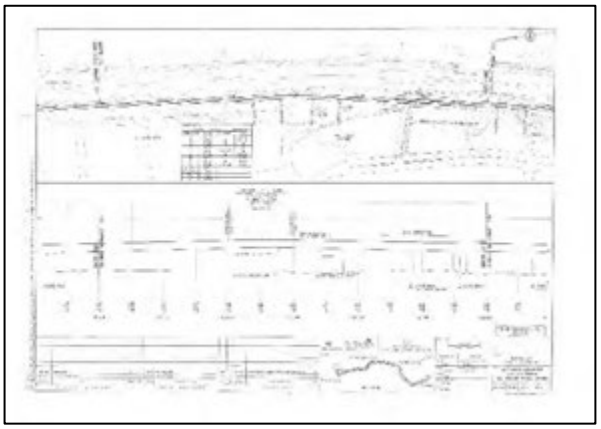
Figure 1-1 Route plan (1)



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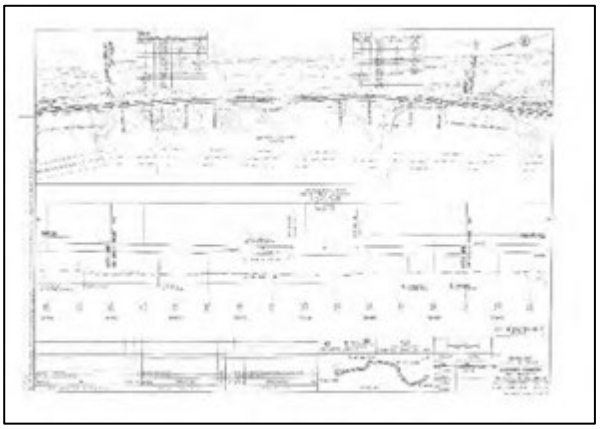

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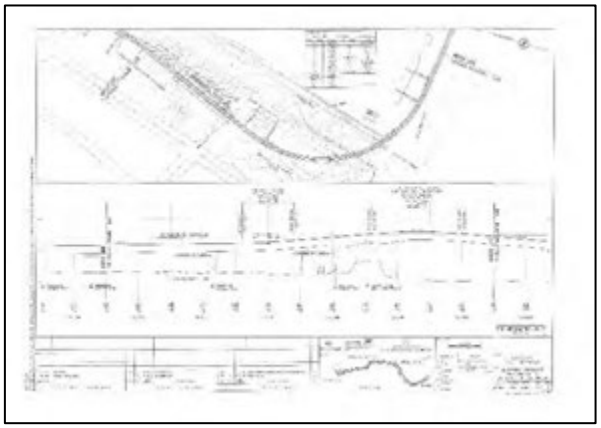

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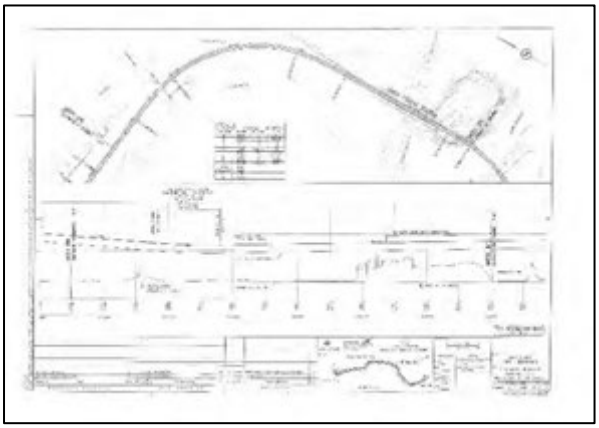

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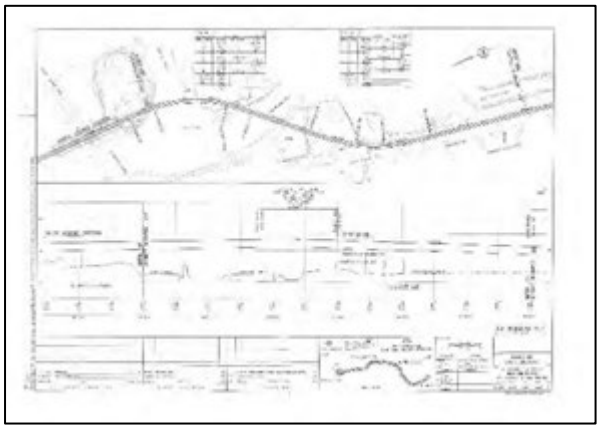

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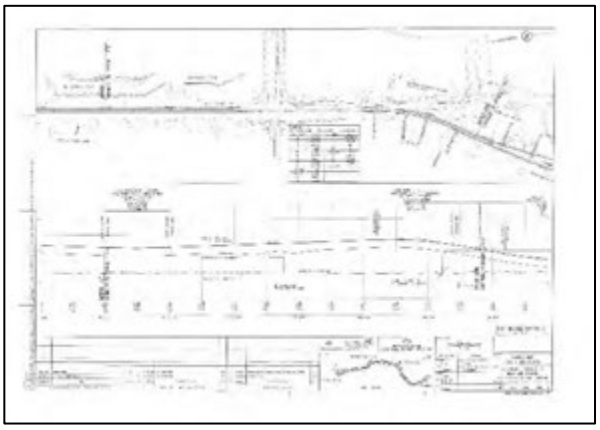

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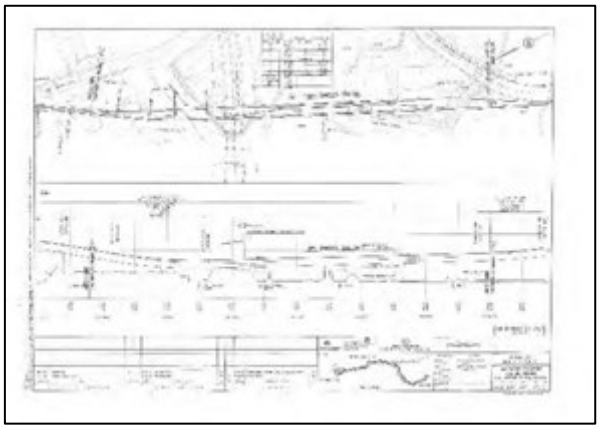
Figure 1-2 Route plan (2)



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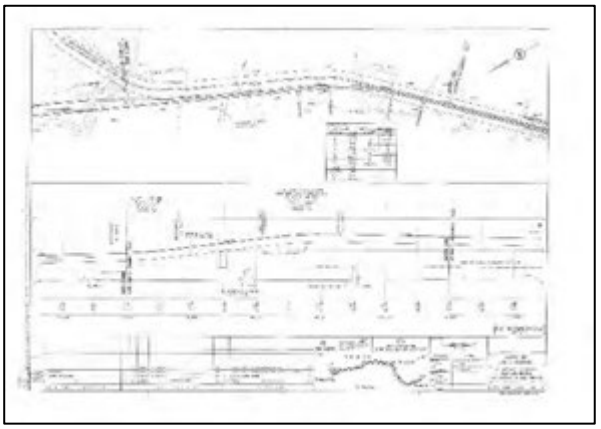

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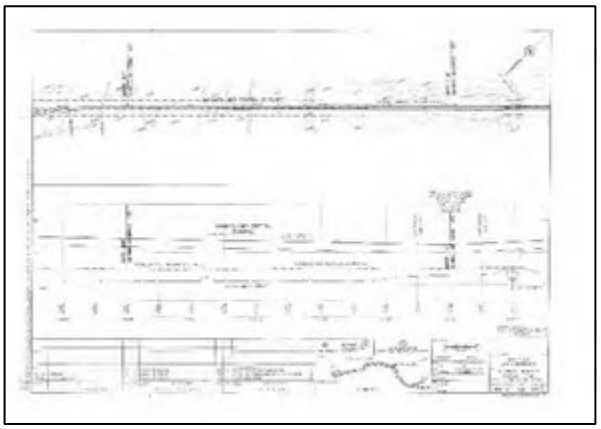

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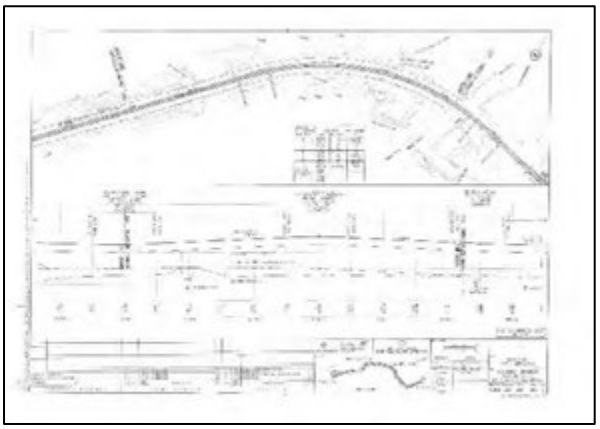

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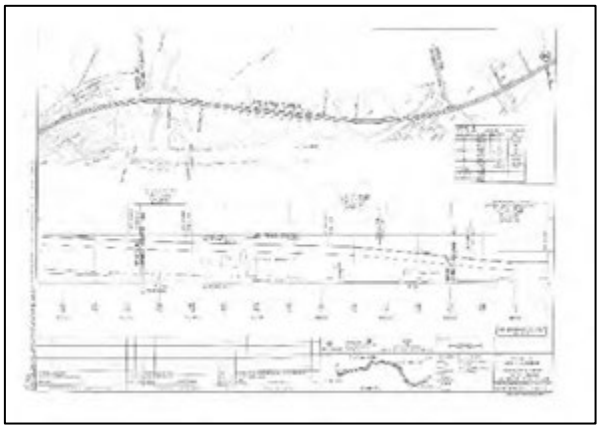

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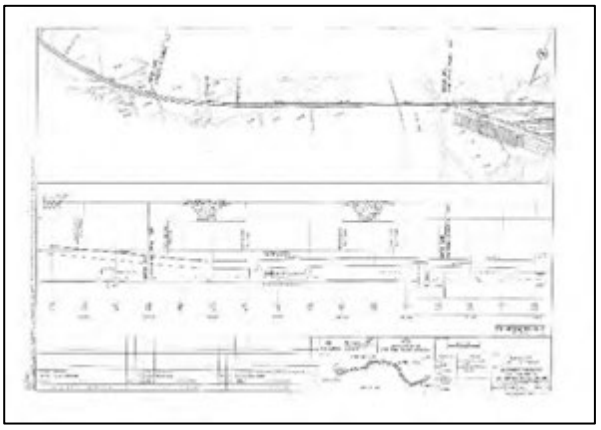

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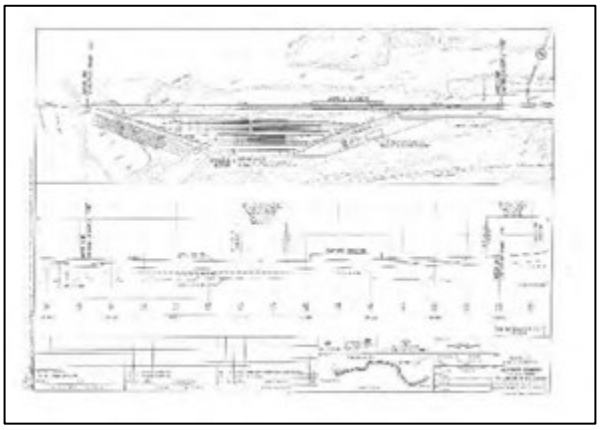
Figure 1-3 Route plan (3)



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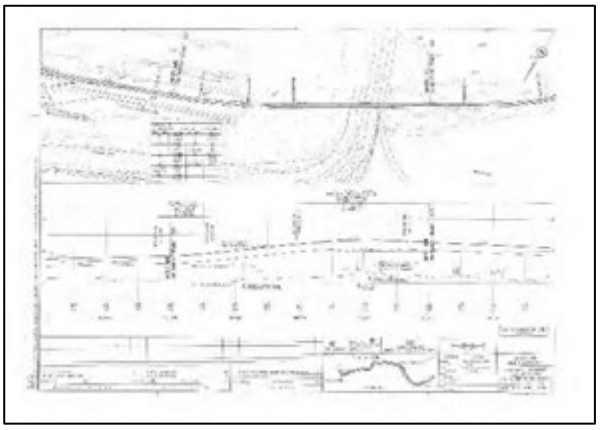

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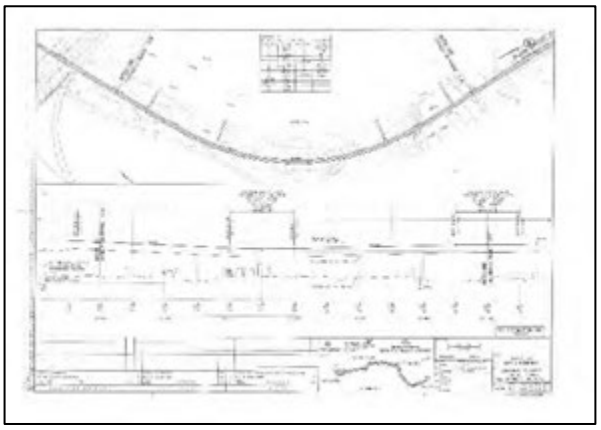

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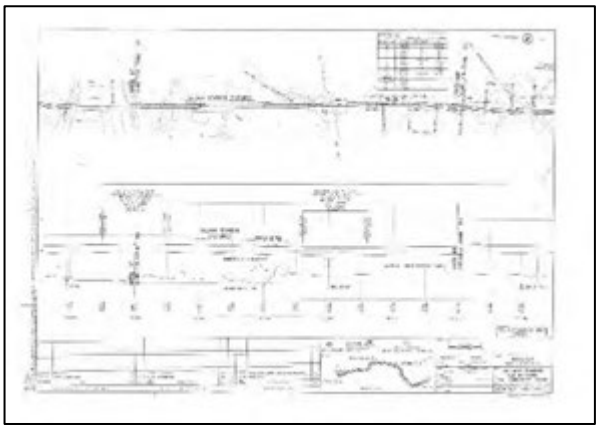

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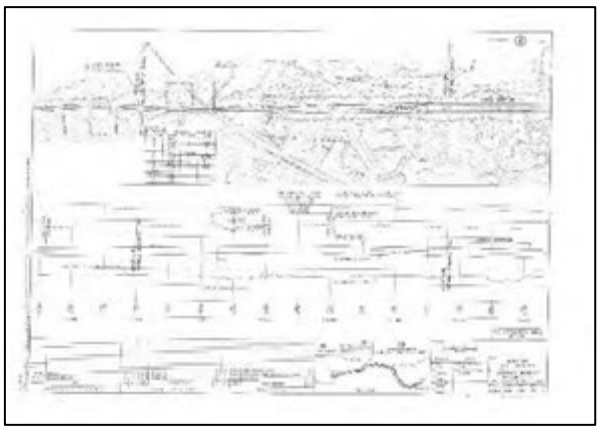

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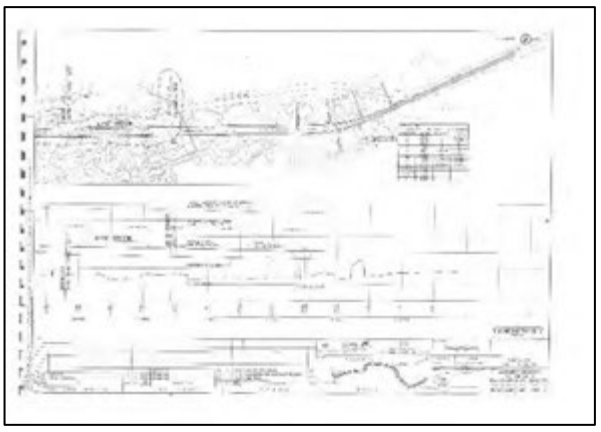

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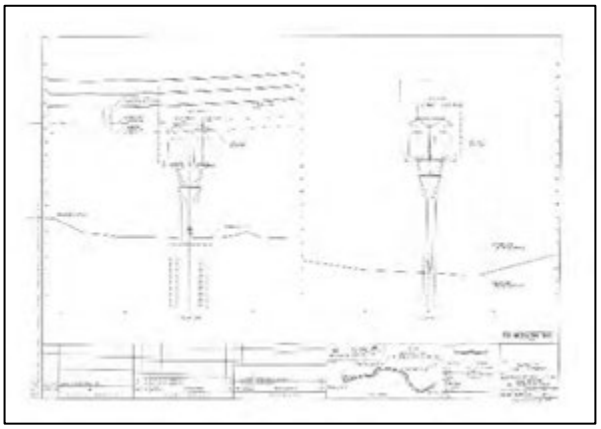
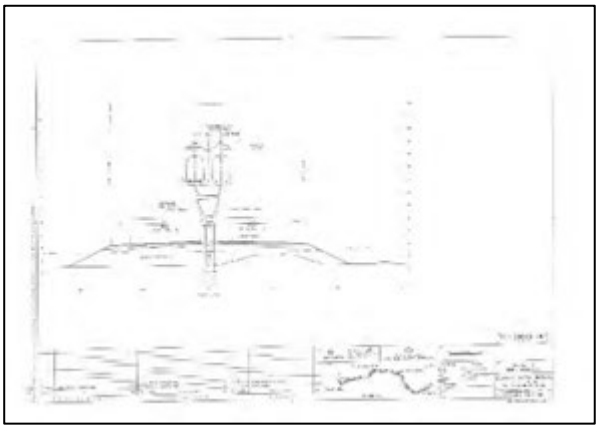
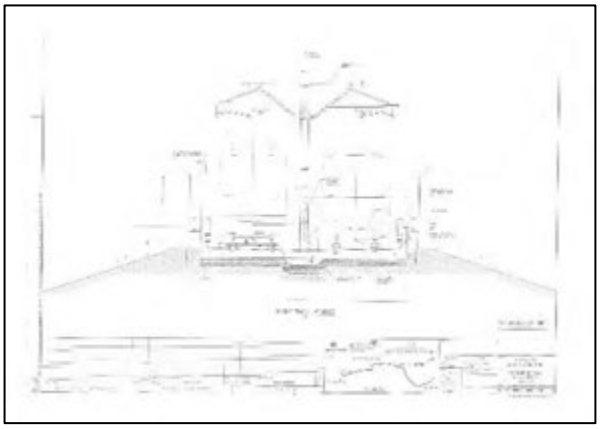
Figure 1-4 Route plan (4)



Elevated section

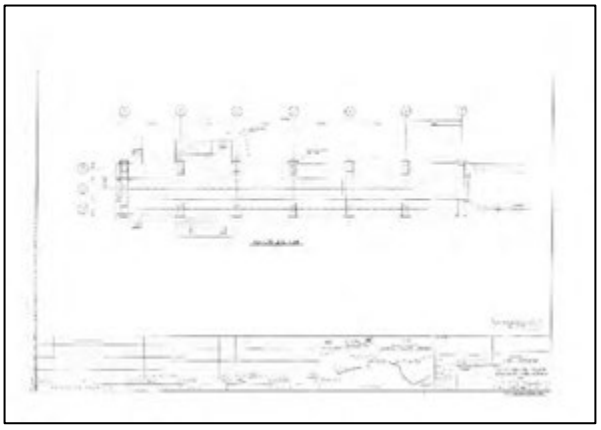


On the road

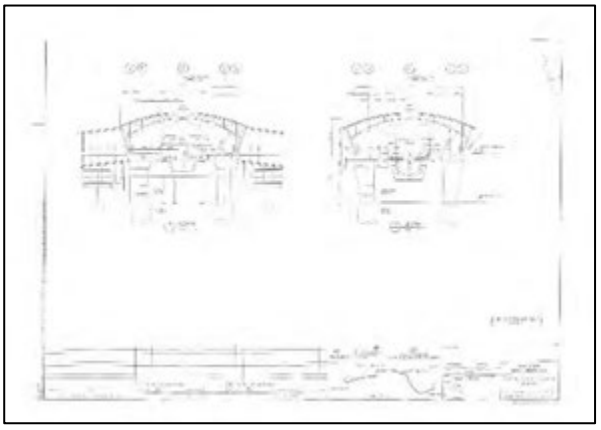


At grade

Figure 1-5 Typical track structure

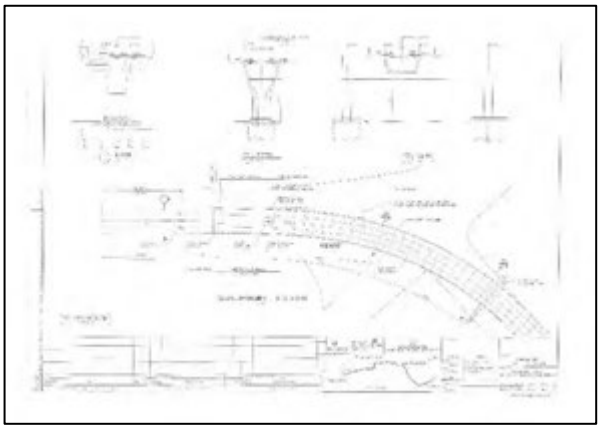


Floor drawing of station

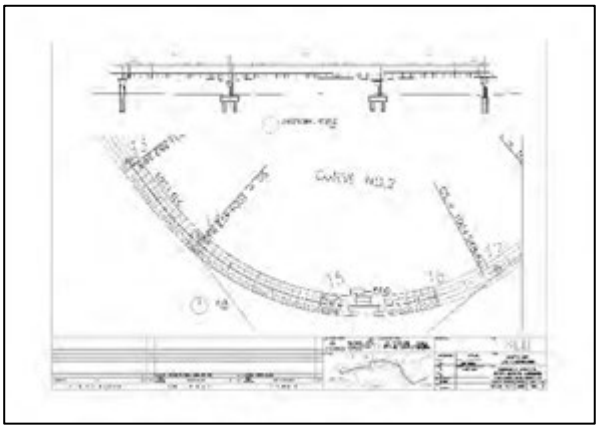


Cross section of station

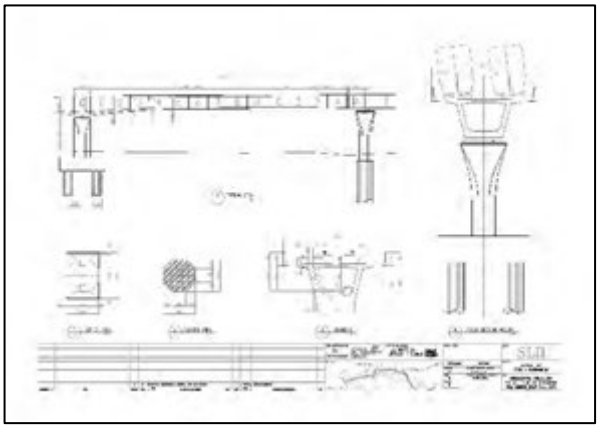
Figure 1-6 Typical station structure



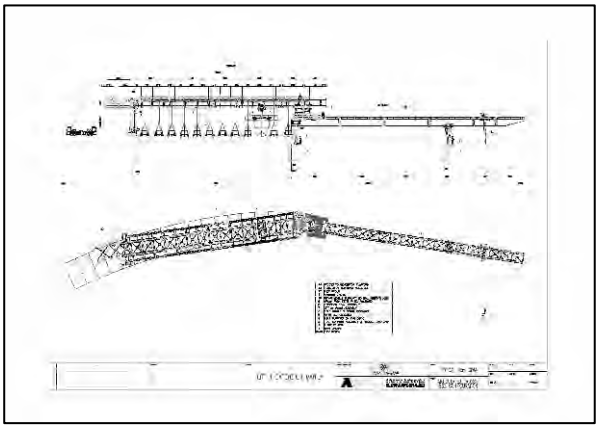
Southernmost end of Baclaran station



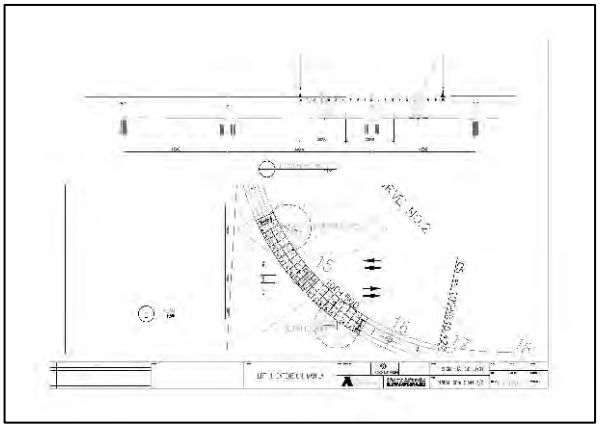
Intersection part with Roxas Blvd.-1



Intersection part with Roxas Blvd.-2



Intersection part with Roxas Blvd.-3



Intersection part with Roxas Blvd.-4

Figure 1-7 Special construction part

2 E&M SYSTEM

In this chapter, the past F/S reports and North Extension Project (NEP) Tender Documents are reviewed and suitable description specification of E&M system is proposed for LRT Line 1 Cavite Extension Project (L1CEP). The review carries out about signaling system, telecommunication system, power supply system, overhead catenary system, and track works.

2.1 Summary Design Criteria of E&M system of LRT Line 1

This section describes the summary design criteria of E&M system of L1CEP. These were excerpted from the following documents:

- NEP Tender Document
- LAVALIN F/S Report
- Draft Feasibility Study Report (v0.10) August 2006

2.1.1 Signaling System

2.2 NEP Tender Document

1) System Capacity of LRT Line 1

The operating capacity of LRTA Line 1 was enhanced to sustain 40,000 pphpd during peak travel times. Consequently, the signaling system is now capable of supporting an operating headway of 112 sec.

2) Signaling System of LRT Line 1

The LRT Line 1 signal system comprises of a fixed block system. It operates as a train control system that provides safety functions for train detection, train separation and control and protection for train movements using a microprocessor-based interlocking. The system is designed as fail-safe; thus any malfunctions will ensure the system reverts to a safe condition. Consecutive blocks are governed by signals positioned at fixed locations throughout the system along the wayside. The peak hour operational headway is 112 seconds. Train movement is controlled by operators from a centralized control center (OCC), which is located within the LRTA Depot in Pasay City. Operation control of the signaling system is confined to the mainline including the Depot connecting line. No signaling is provided within the Depot area, where train speed is restricted to only 5km/h. The signaling system entails the following sub-systems:

- Microprocessor-based interlocking,
- Automatic Train Protection System (ATP),
- Automatic Train Supervision System (ATS)
- Axle Counting System (Train Detection).

a) Train Separation

The line is divided into sections wherein; every entrance of these sections has a fixed wayside signal. A buffer section (overlap) is provided as a safety margin beyond the wayside signals. If a train operator bypasses a red signal (without proper authorization), the train's emergency brakes are applied by the Automatic Train Protection (ATP) system.

b) Speed Control

The control of train speed is provided through the use of an Automatic Train Protection system, which

comprises of wayside and train-borne equipment. Fixed balises located at the wayside signals provide information to the train-borne equipment with respect to the status of the line ahead. This information contains allowable speed, distance-to-go to the next signal and other pertinent data for safe speed control. Similar to the bypassing of a red signal, over speeding, will invoke the train's emergency brakes to bring the train to complete stop.

c) Automatic Train Protection System (ATP) - Train-borne and Wayside Equipment

Currently, eighty (80) train cabs are fitted with ATP train-borne equipment. The sub-system encompasses two sections namely: the train-borne and wayside equipment. The train-borne equipment consists of an on-board computer, which receives data from peripheral equipment for speed and distance traveled, monitoring of the actual speed, and if necessary to apply the service brake or the emergency brake of the vehicle. The system also receives information from the wayside equipment with respect to the status of the line ahead, thereby controlling speed as required. The wayside equipment interfaces with the line-side signals, which in turn receives information from the interlocking and dependent upon the status of the line ahead will transmit the appropriate data for processing by the train-borne system. The information from the wayside system to the train-borne system is transmitted using fail-safe telegrams.

d) Train Detection

The methodology for train detection adopts the use of axle counters. Each fixed block section is composed of either a single or several axle counter sections depending on the distance between two consecutive signals. Train detection is achieved through these axle counters by the effect of train wheels passing through an electro-magnetic field. The wheels/axles are subsequently counted, and for a track section to be declared clear, the number of axle counted into a section must equal the number of wheels/axles counted out. Should the wheels/axles counted not be equal, the track section is declared occupied, i.e. fail-safe principles.

e) Interlocking

The signaling interlocking is a microprocessor-based system adopting a modular structure. The electronic interlocking provides fail-safe connection to outdoor elements, operation control systems and automatic train control systems. The main interlocking computer is located at Baclaran, with control computers located at Baclaran, Central and Monumento. The facility for loading new interlocking software is also located at Baclaran.

f) Emergency Turnback Facilities (TBF)

The original turnback facility required that the emergency switches were controlled locally at the site. However, these facilities now have the capability of being controlled and monitored remotely from the Operations Control Center (OCC) and LOWs. The emergency turnback facilities are located at Gil Puyat and Blumentritt.

g) Automatic Train Supervision System (ATS)

The ATS system controls and monitors the signaling system for the entire rail network. This system is located within the OCC facility. Should a complete failure of the OCC occur, operations may be continued from Local Control Workstations (LOW). These are located at Baclaran, Central and Monumento. Operation of the ATS subsystem uses local area network (LAN) architecture. Workstations generate a geographical representation of the transit system network using single line display pages incorporating user-friendly human/machine interfaces.

The ATS sub-system can display:

- An overview of the system and of individual stations
- Train identification numbers.

The overview mimic panel (overhead projector system) displays the status of the following signaling and train control functions:

- Track section occupation/clear
- Route set
- Turnout position
- Signal aspects
- Train describer
- Alarm handling
- Automatic route-setting with possibility of manual override and manual setting of routes and signals
- Speed limits.

In addition, the following functions are available and parameters adjustable both automatically and manually:

- Automatic train regulation
- Dwell times
- Scheduling
- Train describer and train I.D.
- Headway clock
- Simulation
- Record and Playback

3) Existing Line 1 Operations

- LRTA Line 1 is signaled for uni-directional operation only on all tracks, the exceptions being the reversing areas in the terminal stations, depot departure tracks and turn-back facilities. During normal operation, trains run on the right hand track as viewed from the train driver's cab. Trains normally comprise of 4 cars with an overall length of 106 m.
- The traction supply is distributed by an Overhead Catenary System (OCS). The nominal traction voltage is 750V DC. Both running rails are used for return of traction current. Where insulated rail joints are used, continuity of the traction return current is accomplished by the use of cable traction return bonds.
- The design headway on all tracks used by passenger trains is 90 sec.
- The existing end-to-end run times exclusive of turnaround times is approximately a total of thirty-four (34) minutes.
- Coupling and uncoupling of revenue service trains, except in an emergency, takes place within the depot or in stabling sidings, which are also located in the depot. Revenue service trains of variable length, up to a maximum of 106 m, are equipped with Automatic Train Protection (ATP). In case of a total rolling stock failure, a second train may be used to assist the failed train from the rear.
- Headway is defined as the time interval between successive trains on through track with a specified station stop-time of 40 seconds at each platform. The headway time shall be maintained without any speed limitation to the train, except where unavoidable to meet headway and station stop times at specific stations. Any such limitation in speed shall be justified to and approved by LRTA
- The headway for reversing trains at terminal stations or at stations with turn-back facilities requires special study in relation to the present track layouts. It shall be possible to reverse trains

at all terminal stations at the schedule service using the design headways, and the following additional requirements:

Single Driver reversing.
Shall be allowed a maximum layover of 150 seconds in reversing sidings. This procedure only applies to non-peak hour periods.

Two Drivers reversing.
At stations with reversing tracks, during periods of minimum headway, a second driver will enter the rear cab and drive the train from the reversing track with a maximum layover of 30 seconds. As the reversing takes place in sidings beyond the station, a maximum of 40 seconds shall be allowed for alighting passengers at the arrival platform. A further 40 seconds shall be allowed for passengers to board the train at the departure platform.

4) North Extension Operations

- The signaling system shall be capable of supporting an operational headway of 112 seconds for the Line 1 North Extension Project. The configuration of trains shall remain as 3 and 4-car sets with an expected one way journey time of approximately 43 minutes.
- The additional stations of Balintawak and Roosevelt are designed with “side platforms” while North Avenue Terminal shall be designed with an “island” platform. The expected dwell time at Balintawak and Roosevelt stations shall be 30 seconds.
- In order for the North Extension operations be congruent with the existing Line 1 operations, to support the 112 seconds headway during peak hour time, the Contractor shall consider all aspects in the signaling design and installation to meet the 112 seconds headway requirement especially the configuration of the turnback and platform at North Avenue is different from the existing line.

5) Power Supply and Uninterruptible Power Supply (UPS)

- The power supply for the signaling should be derived from a highly reliable source. For this purpose, a main supply for signaling of three-phase 480 VAC, 60 Hz shall be made available at all stations which are to be provided by electrical interface. The Contractor shall additionally furnish an Uninterruptible Power Supply (UPS) at station to complement the main power source.
- The UPS shall be suitably rated to ensure the signaling system’s continuous operation for a period of not less than four (4) hours in the event of failure of the main supply.
- The input of the UPS shall be protected from over voltages and surges of current. Additionally, it shall be protected from the effects of lightning. The UPS shall also function as a filter in order to remove transients and other noise, which may affect the operation of electronic equipment.
- A static bypass switch shall be provided to circumvent the UPS unit should a malfunction occur. Also a manual bypass switch shall be supplied to enable maintenance to be undertaken to the UPS.
- The batteries shall be installed in a dedicated room with the UPS unit. Cabling between the batteries and UPS shall be sufficient to carry the full load.

2.2.1 Telecommunication System

2.3 NEP Tender Document

1) NEP Scope of Work

- Master Clock for synchronization of all electronic systems in the new stations
- SCADA for the remote control and monitoring of electrical and traction power
- CCTV for the monitoring of passenger safety and security at stations

- SDH / Fiber Optic cable for the transmission of voice, data and video
- Public Address for passenger information, safety, and security at the stations
- PABX existing system to be upgraded with new phones and lines to be added
- Digital Trunked Radio System for enhanced communications
- AFC Local Area Network for efficient collation of revenue data
- Upgrading of the Telecommunication facilities at the Operations Control Center (OCC) for centralized supervision of the additional equipment for the new stations
- Uninterruptible Power Supply (UPS).

2) CAPEX Project

- The present Manila LRTA Line 1 system was installed and commissioned in 1984 by the Belgian based company ACEC Transport (now part of the Alstom group).
- The original system allowed an operating capacity of 18,000 pphpd during peak travel times.
- Modifications to improve the operating capacity of Line 1 to 27,000 pphpd under the CAPEX Project Phase 1 were commenced and completed in 1998.
- The operating capacity of LRTA Line 1 under the recently completed CAPEX Project Phase 2 was further enhanced to sustain 40,000 pphpd during peak travel times.

3) Existing Systems and Equipment

- The existing communications systems being upgraded under CAPEX II Project are based upon digital data, compressed video, digitized audio, UHF radio and telephony currently and automatically exchanged between the depot's Operational Control Center, administration buildings and stations or other LRTA related buildings. IP based CCTV, Public Address systems and SCADA equipment are now installed and operational in all stations and RSS stations using the new SDH Fiber Optic Transmission backbone. For continuous operation and safety of these equipments, UPS and Lightning Protection and Grounding Systems were provided in all 18 stations.
- The existing Trunked radio system used for maintenance purposes operates at 470 MHz in the Ultra-High Frequency band consisting of four (4) base-stations installed in strategic locations along LRT Line 1.
- Additionally, operational personnel used 800 MHz radio sets, which are supplied under a leasing agreement with the DOTC and Nextel.
- The current Private Automatic Branch Exchange (PABX), which was installed as part of the Capacity Expansion Project Phase I was expanded and integrated to the new Synchronous Digital Hierarchy / Fiber Optic Transmission System (SDH/FOTS). New digital and analog telephone sets were also provided.
- A multiport Network Switch for the Ethernet LAN is employed in the SDH equipment in every station as part of the Automatic Fare Collection System. This operates in conjunction with the ticket issuing equipment and data is continually transferred for operational and revenue purposes. The revenue operational parameters, which are used by the station processor system, are currently transferred via the LAN and SDH/FOTS.

4) Sub system

a) Master Clock System

The primary purpose is to provide precision timing to the new display clocks and to synchronize all telecommunications devices and other electronic systems in the new stations, requiring an accurate time reference source. These systems shall include the following:

- SCADA
- SDH/ FOTS
- PABX
- CCTV
- AFC LAN enabled station equipment
- Trunked Radio
- PA system

b) Public Address System (PAS)

- A digital public address system was installed in every LRTA Line 1 stations for public announcement of live, prerecorded, Background Music and emergency messages for passenger safety and information. The new public address and emergency system used web based (IP) technology, digital transportation and processing of all audio signals from OCC and Platform Supervisor's Booths at the stations.
- Control of the PAS in the station is done locally at each station Platform Supervisors Booth and remotely from the OCC through the use of Call stations, Network Controllers and Workstation PCs loaded with licensed configuration and maintenance software.

c) Closed Circuit Television (CCTV)

- All eighteen (18) passenger stations along LRTA Line 1 service route are currently provided with CCTV systems which can be operated independently from the station's Ticket Booth and can be controlled simultaneously from Workstations in the OCC/Depot via the existing Gigabit Network Switches and Fiber Optic backbone.
- Digital recording from the system's 137 cameras on motion activated mode is accomplished at the OCC via redundant Disk Array of Network Video Recorder (NVR) servers.
- Security cameras are also installed at entrance of the OCC building and gates of the Depot in Baclaran.

d) Supervisory Control and Data Acquisition (SCADA)

A newly commissioned SCADA System for the 9 Rectifier Substations enables remote monitoring, telemetering and control of Substation facilities. Smaller SCADA systems were likewise provided in 18 line stations for monitoring of electrical devices, fire alarm systems, UPS and for monitoring the condition of Escalators and Lifts in the stations.

The primary objectives of the SCADA Monitoring system for the new stations shall be as follows:

- Monitor and control of Electrical Distribution and Traction Power systems within each RSS.
- Monitor condition of water sprinkler systems located within certain nominated station rooms, i.e., Electrical, Signaling and Telecommunications.
- Monitor the conditions of the UPS equipment installed in the three (3) new LRT stations and three (3) RSS.
- Monitor position of Circuit breakers supplying AC power for the TER and Ticket Booth in the stations.
- Monitor the condition of Escalators and elevators in designated stations.

e) SDH / Fiber Optic Transmission System

- At present, a 12 core Fiber Optic Cable was recently installed along both sides of the 15 kilometer viaduct from Baclaran Depot and to the 18 stations from Baclaran to Monumento station. The existing optical fiber network is based on Synchronous Digital Hierarchy (STM-1) and Plesiochronous Digital Hierarchy (PDH) systems primarily on G.652 fibers. The fibers installed

conform to ITU-T recommendations.

- The SDH / FOTS serves as the Telecommunication medium for the transmission and reception of Voice, Data and Video information between all 18 line stations, 9 RSS and OCC of the LRTA Line 1 System.

f) AFC-Local Area Network

All 18 Line stations of LRT Line 1 are equipped with multiport Network switches used for interconnecting AFC equipment of the stations with the Central Processing System at the Depot via the SDH transport system.

g) Private Automatic Branch Exchange (PABX)

Overview and Upgrading of the Existing System

- The existing PABX (Ericsson MD110) currently installed within the LRTA system was commissioned in 1994 with an initial load of 306 lines (trunked and locals).
- The PABX has two (2) Line Interface Modules each with 240 lines capacity and presently capable of supporting a total line capacity of 480 lines.
- After the completion of the CAPEX II Project, the total connected lines (locals, tie lines and trunked) as of to date is 435.
- Due to its limited line capacity to handle the telephone requirements of the Line 1 North Extension Project, additional telephone lines in the future for the existing stations and Depot offices, hardware obsolescence, current and future demand for VOIP, packet switching and high speed data for IP based applications, the current MD110 PABX shall be upgraded and migrated to a fully IP enabled Telephone System to support these services.

Upgrading Requirements

- Ericsson MD110 PABX shall be upgraded to MX-ONE TS PABX which is the current upgrading platform for the smooth migration of MD110 PABX.
- The MX-ONE PABX system shall be a completely integrated package consisting of a Line Interface Module having the capabilities and functionalities required to operate with an initial load of 100 telephones for the Line 1 North Extension and Trunk lines at Depot.
- The new switch shall have full compatibility and interoperability with the existing MD110 PABX hardware, user equipment and newly supplied BC13 programming software.

h) Radio System

Current UHF Trunked Radio Network

- The recently installed UHF Trunked Radio System of LRT line 1 comprises of four (4) base stations in strategic locations with twenty (20) repeaters, 89 Train radios, service vehicles and 185 portables operating in the 470-476 MHz Frequency Band.
- The radio system is sharing the usage of all sets frequencies with LRT Line 2 on a first come, first serve basis.
- The current system is presently experiencing difficulty in communication due to radio interference from unknown sources and radio traffic congestion resulting from frequency sharing with Line 2 Radio System. Moreover, the National Telecommunication Commission recently issued a circular which intend to reallocate the UHF frequency band being used by Line 1 and Line 2 to Digital Television Broadcast.
- In view of this development and the technical problems being encountered it was decided to replace the existing UHF Trunked radio with a new TETRA digital Trunked Radio System for the existing Line 1 and Line 1 North Extension.

i) Lightning Protection and Grounding

Presently, there are Lightning Protection, Grounding systems, power and telephone line protection in all revenue stations and OCC to protect human lives in these stations and Telecommunications devices installed in these locations. Similarly, the new stations of the LRTA Line 1 North Extension shall be provided with total facility protection systems.

j) Uninterruptible Power Supply (UPS)

Currently, UPSs are provided for all existing Telecommunication Systems in all 18 stations and in the OCC and Depot in Baclaran.

UPS shall be installed at the following locations:

- 3 LRTA stations (Telecommunications and SCADA equipment),
- 3 Traction Power substations (SCADA equipment), and
- 5 base stations sites.

Preliminary rating of telecommunications loads are given below:

- 5 KVA each for the 3 repeater sites/base stations,
- 5 KVA each for 3 LRTA stations, and
- 3 KVA each for 3 SCADA RTUS for Traction Power substations.

UPS Performance Specifications

- The system shall use microprocessor circuitry in the main inverter or battery charger circuitry.
- The UPS shall be rack mounted and installed inside a NEMA rated cabinet together with the Service Bypass Switch and sealed battery banks.
- The UPS unit shall be capable of single phase, 60 Hertz operation.
- The UPS shall accept the standard voltage of 220vac.
- The UPS System's battery charger shall be completely automatic with a programmed reference, and capable of restoring the battery to capacity within 3 hours after restoration of utility power.
- The UPS back up batteries shall be of the maintenance free type and shall be fully sealed types with no gas leaks. The battery shall operate entirely unattended and shall have a minimum life span of not less than 3 years. Periodic inspection of batteries shall be required but kept to a minimum.

UPS Functional Requirements

- All connected loads shall be continuously supplied by the UPS equipment, which shall be fed from the normal utility power source.
- Upon failure of the utility power input, the load shall automatically continue to be powered via the system's battery and inverter for a minimum of 4 hours.

2.3.1 Power Supply System

2.4 NEP Tender Document

1) Original Power Supply System

- Existing 9 substations are being supplied by Meralco wherein even numbered substation (RSS 2,4,6,8) have 2 incoming 34.5KV feeds while odd substations (RSS 3,5,7,9) have a single incoming 34.5KV feed.
- RSS 1, being a Depot substation has 2 incoming feeds.
- These on-line substations are not incorporated into the existing LRT stations.
- The substations are located either near or between Stations.

- The current catenary system utilizes double catenary contact/messenger system powered by 750V DC substations that are spaced, on the average approximately every 1.5 km to 2.0 km along the LRT corridor.
- The Low Voltage 480V AC system from each substation was designed to supply its neighboring stations and is capable of supplying the remaining adjacent stations if the neighboring substation fails.

2) NEP Power Supply System

- The 5.7 km LRT Line 1 North Extension from Monumento Station to North Avenue Stations is the next priority segment to be implemented. This would link LRT Line 1 to MRT Line 3.
- The Power System capacity should allow for four car trains at 112 seconds headway.
- Operational and architectural requirements in primarily a suburban residential setting. This includes factors such as noise, speed, overall appearance of the system and code clearances that shall be considered.

3) The power supply to NEP will require the following;

- Three (3) additional substations to supply DC traction power requirement for the Trains and AC power requirement for the stations. One substation is located at Balintawak Station (RSS 10) and two (2) substations located at Roosevelt Station (RSS 11 and 12).
- All arrangement and Works related to power utility provider high reliability primary power supply incoming for the substations.
- A High Voltage Supply loop to ensure the redundancy of power supply on the High Voltage AC System of the substations. This requires coordination and approval from the Power Utility Provider.
- A medium voltage loop at 6.5 KV will be installed for the supply of the Low Voltage, in the case that the high voltage loop cannot be installed.
- A Low Voltage Supply (480/220V) to the main AC power supply requirement for the loads in the 3 new passenger stations.
- Earthling, Bonding and Corrosion Protection.

4) Traction Power Substation (TPS)

- 34.5 kV power feeds from the power utility provider
- 34.5 kV High Voltage loop system
- 34.5 kV High Voltage AC Switchgear assemblies
- Step down Rectifier Transformers and Rectifier Units (DC System)
- 750 VDC Switchgears
- Negative panels
- Traction return bond
- Auxiliary Step down Transformers (AC System)
- Low Voltage AC Switchgears Assemblies
- 110V Batteries and Chargers for Control Power Supply
- 110V dc distribution panel boards
- Local annunciator panel
- SCADA interface provisions (including Interfacing Panel)
- 34.5 KV ac insulated power cable and accessories
- Low Voltage ac insulated power cable and accessories
- 750V dc insulated power cable and accessories
- Outgoing DC disconnect switches as maybe required for isolation purposes
- Control cables and accessories
- Installation materials

- Earthling/Bonding/Corrosion control
- Ventilation

System Loads and Parameters

The following requirements must be taken into consideration in the design of the TPS.

- System voltage: System rated voltage 750V DC
- Design voltage drop limits: Minimum operating voltage - 600V DC (80% of rated voltage)
- Absolute voltage drop limits: Absolute minimum operating voltage - 525V DC (70% of rated voltage)
- In addition, the System must be designed to:
  Accommodate trains accelerating from rest to a speed of 60 km/hr.
  Accommodate trains operating on a 112 sec. headway

5) Traction Power Feeder System (TPFS)

The TPFS consists of all feeder (positive and negative) conductors, switches, duct banks, wayside cable trench, cable trays/ladders, and associated hardware that feeds the DC power from the substation to the overhead catenary system via Catenary feeder switch and return from the rails via Traction return bond to the Negative Panel.

Positive Feeder Cables

The DC supply feeder cables must meet the following existing minimum criteria:
All Conductor size shall be 300mm 2 stranded copper

Negative Return Cables

The DC negative return cables must meet the following existing minimum criteria:
All Conductor size shall be 300mm 2 stranded copper

High Voltage AC Power

The high voltage AC power cables should be rated 35kV minimum or as may be specified by the power utility which is ever better, TR-XLPE, shielded armored cable. The minimum allowable cable size is 95mm2 or as may be approved by the power utility company

2.4.1 Draft Feasibility Study Report (v0.10) August 2006

The E&M system includes the provision of a traction power supply and distribution (PSD) system for the line 1 extension. The PSD system will include all die electrical equipment for receiving ac power from MERALCO, converting it into dc traction power for the vehicles, and distributing that power to vehicles on the guide way and in the Satellite Depot. The principal components of the PSD system are:

- Traction power substation (TPS) equipment;
- Overhead contact system (OCS);
- Power and control cables and wires; and
- Earthling systems.

The power source will be provided by MERALCO at medium voltage along the route of the Line 1 extension. The supply characteristic, are expected to be 34.5kV ac, 3 phase, 60Hz and the power will be carried from the MERALCO substations to each TPS buildings via underground power cables and ducts that will be provided and installed by MERALCO.

1) **Traction Power Substations**

There shall be eight TPSs, comprising seven on the extension mainline, and one at the Satellite Depot. The mainline TPSs will be located under the guide way and next to passenger stations wherever possible. The required rating and location for each TPS is shown in the following table.

Table 2-1 The required rating and location for each TPS

TPS Designation[1]	Location	Rectifier Rating	Station	
TPS # 10	100+650	2 x 2000kW	Redemptorist	100+650
TPS #11	102+850	2 x 2000kW	Mia	102+650
TPS # 12	104+430	2 x 2000kW	Ninoy Aquino	104+490
TPS # 13	106+230	2 x 2000kW	Dr. Santos	106+150
TPS # 14	108+080	2x2000kW	Las Piñas	108+000
TPS #15	109+580	2 x 2000kW	Zapote	109+260
TPS #16	111+600	2 x 2000kW	Niyog	111+350
TPS # 17	at Satellite Depot	1 x 2000kW		

Source: LRTA

[1] Last TPS designation for the Existing Line is TPS # 9.

Each TPS will incorporate 34.5kV ac switchgear with the required incoming and metering cells, rectifier-transformer feeder cells and an auxiliary power cell, A station power transformer cell will be provided at each of TPS #10 and TPS #16 to feed the passenger stations power transformer assembly.

Each mainline TPS will be configured with two 12-pulse transformer/rectifier units to convert the 34.5W 3-phase incoming power to 750Vdc traction power. The Satellite Depot TPS shall be configured with one such unit.

Each TPS will be configured with 750-volt dc switchgear comprising two line-ups, positive dc switchboard and negative dc switchboard. The positive dc switchboard will consist of high-speed dc circuit breakers for isolating the transformer-rectifier units, controlling power flow to the OCS and protecting feeders and OCS equipment. The negative dc switchboard will consist of rectifier switches for isolating transformer-rectifier units and an earthling panel for detection and protection of dc equipment from earth fault and limiting rail-to-earth potential. The negative bus in the negative dc switchboard will collect the return current from the running rails.

A station power transformer assembly will be provided at each of TPS #10 and TPS #16, which will comprise a step-down transformer and 6.6kV-ac breaker for supplying power to and protecting the 6.6W ring network.

2) **Passenger Station Power Supply**

The E&M Systems include a power supply system for the new passenger stations, Including:

- Passenger station substation equipment;
- A 6.6kVac cable ring network; and
- Inter-connecting power and control cables and wires for the passenger substation equipment.

Each substation will be configured with 6.6kVac ring-main unit (RMU) switchgear and two step-down 6.6kVac-480V/277V transformers to supply station loads. In normal operation, the transformers shall share the station loads. When one transformer fails essential loads will be automatically transferred to the other transformer.

A 6.6kVac cable ring network will supply power to the station substations equipment from the station power transformer assemblies located at each end of the ring-main network al TPS #10 and TPS #16. The assembly at each of die two TPSs will consist of a 6.6kV ring-main feeder breaker and a 1500Kva, 34.5kV-6.6kV transformer.

2.4.2 Overhead Catenary System

A. NEP Tender Document

1) Design Condition.

- Speed
  - Maximum 60 km/hr
- System Voltage
  - Minimal 525 VDC
  - Nominal 750 VDC
  - Maximum 1000 VDC
- Wind Velocities
  - Operating condition 160 km/hr.
  - Under typhoon condition 220 km/hr.
- Temperature Range (ambient) 15 – 40 degrees C
- Trains headway requirements 112 seconds

2) Original OCS and NEP OCS

- Both tracks consist of double contact wire (120 mm2 CuCd), one messenger cable (140 mm2 CuCd, 37 strands), connected to two (2) reinforcing wayside cables (500 mm2) laid inside the concrete ducts.
- However for the new OCS, instead of reinforcing cables, equivalent non insulated auxiliary cables shall be installed aerial along with the messenger cables.
- Portal beam system are used to hold and support the following:
  contact wires, messenger wires, lightning arresters, isolator switches, hangers, supports, insulators, anchoring assemblies, suspension assemblies, feeding facilities, insulated cables, electrical conduit, etc.
- However for the new OCS installation, H-beam poles shall be used on both side of the viaduct in any tangent track while portal beam system shall be installed on curve track and on all anchoring/dead end portions when necessary.

a) Span Lengths

- On Tangent Track 44 m – 56m
- On Curve Track 23 m - 27m

b) Height of contact wire

- Nominal 4600 mm
- Minimum 4300 mm
- Nominal at Support 4750 mm
- Maximum 6000 mm

c) Tensioning Method

Weight tensioning method shall be used for each end of contact wire tension length, but on cross-over and messenger wire, tensioning spring shall be used.

B. LAVALIN F/S Report

1) South Extension OCS in Depot

The depot system will be of trolley type. The catenary system of depot will be of single contact wire, fixed termination design. The depot simple trolley wire construction will use direct suspension.

C. Draft Feasibility Study Report (v0.10) August 2006

1) South Extension OCS

- The OCS will include the overhead conductors, support structures and related items forming die distribution system that will provide 750Vdc power to the trains via the vehicle pantographs. The track running rails will be used as the return current conductors,
- Two types of OCS construction will be used: weight-tensioned catenary, and simple trolley wire. The catenary construction method will be utilized throughout the mainline, and on the transition tracks between the mainline and the Satellite Depot yard storage tracks. Trolley wire construction will be supplied throughout the Satellite Depot storage track area. Both types of OCS shall deliver power to the vehicles at 750 volts dc.
- The physical support system for the OCS will be designed in accordance with the allowable loading, deflection and clearance requirements.
- The E&M systems include provision of the cabling to feed the 750Vdc power from the TPS equipment to the OCS. Feed points will be located in close proximity to each substation with the exact location chosen to minimize section gap arcing during train acceleration.

Source: Study Team

Photo 2-1 Portal beam system of Original OCS

Source: Study Team

Photo 2-2 H beam pole system of NEP OCS

Source: Study Team

Photo 2-3 Trolley type system of Existing DEPOT

2.4.3 Track Works

A. NEP Tender Document

1) Track System of NEP

- The slab track system will be installed on a flat concrete slab. For stray current protection of the structure a suitable grid is installed underneath the track.
- On both sides of the viaduct cast in-situ cable containments will be erected. The upper surface of the cable containments is made available as an emergency detrainment walkway along the line. This concrete structure serves as well as a lateral bearer for the slab track system.
- The track system shall be a slab track with bi-block reinforced sleepers, rubber boots and pads, embedded in track bed concrete. The standard gauge is 1435 mm with rail type EB 50T. The slab track system shall respect the Noise and Vibration criteria.

- The nominal track center distance on the viaduct is 3.20 m. Buffer Stops are installed at the extremity of terminal Station to protect any structure from overshooting full loaded trains entering the station.
- The design speed of the line is 60 kph.
- The turnouts and crossovers shall be installed using the direct fixation method. To ensure compatibility with the Noise and Vibration criteria, they shall be installed on floating slabs.

2) **Track Works Specification of NEP**

a) Rail Profile and Grade

- For main line tracks the running rail profile shall be to the EB 50T profile, specified to UIC Code 860 and EN 13674-1.
- Where check or guard rails are to be installed, the rail profile shall be to the CEN 33 C1 (previously U 69 or UIC 33 profile).
- For turnout switch blades, a matching asymmetrical rail profile to the EB 50Tspecified to EN 13674-2, shall be used. Switch blades are also referred to as switch rails.
- In straight and curved tracks with a radius greater than 600 m, the EB 50T profile running rails shall be of steel quality Grade 900A. In curved track with a radius less than or equal to 600 m, the EB 50T profile running rails shall have a minimum tensile strength of 1100 N/mm².
- The CEN 33 C1 profile for check and guard rails shall be of steel quality Grade 900A.

b) Twin block Concrete Ties

Sleepers are installed on a concrete track bed.

Source: Study Team

Photo 2-4 Twin block Concrete Ties

Table 2-2 Dimension of Twin block Concrete Ties

Dimension	Required
Height of block measured in the axis of seat	189 mm
Distance between rail seat areas	1435 mm
Length of blocks	720 mm
Width of block to receive rubber boot)	290 mm
Height of tie bar with regard to base of sleeper	85 mm
Inclination of the rail seat	1:20

Source: LRTA

c) Sleeper Spacing

The following maximum sleeper spacing shall be respected in ballast less tracks:

- 1428 sleepers per km for radius greater than 1000m,
- 1666 sleepers per km for radius less than or equal to 1000m and greater than 250m, and
- 1818 sleepers per km for radius less than or equal to 250m.

d) Rail Fastening Components

- The rail fastening system shall be of an approved resilient type, appropriate for the operation conditions of the Light Rail system with continuously welded rails.
- The rail fastening shall be of a self-tensioning type, which will give a constant clamping force and rail creep resistance and will maintain the clamping force and rail creep resistance during operation, without any maintenance.

e) Rubber Boots and Micro-Cellular Pad

Rubber boots and the incorporated 12 mm microcellular pads place around and underneath the bi-block concrete sleepers.

f) Rail Welding Materials

Alumino-thermic (thermit) welds of the Continuously Welded Rails (CWR)

g) Buffer Stops

- Fixed or Friction-Hydraulic buffer stops shall be installed at all dead-end tracks of the system.
- For self-propelled trains moving: 25 km/h.

h) Rail Expansion Joints

- The rail expansion joints shall be designed to accommodate full movement in rails to which they are to connect.
- Rail expansion switches (joints) shall be provided at the points where continuously welded tracks meet jointed tracks or where it is considered necessary to ensure track will not be subject to misalignment under extremes of temperature.

i) Noise Barriers

In order to avoid annoyance for the people around the small curve, a noise barrier of 2 m height has to be installed at both sides of the elevated structure. This noise barrier is a light weight metal barrier with noise absorption potential. In order to obtain a transmission loss of at least 20 dB(A) in the frequency range above 500 Hz, the noise barriers should have at least following characteristics:

- Absorption by rockwood panel inside the barrier of at least 50 mm thick and density of 60 kg/m3,
- Metal back panel at least 1.5 mm thick, and
- Perforation rate of front panel: at least 40%.

j) Concreted Track

Rails are fastened to the blocks of twin-block sleepers by means of an elastic fastening system. The required track resilience is obtained in the following track components:

- Elastic fastening system,
- Micro cellular pad, and
- Rubber boot.

k) Floating Slab

- Floating-slab track beds shall be used under the turnouts, designed to control ground borne noise and vibrations.
- The floating slab is constituted of a continuous reinforced concrete slab supported by individual resilient bearings. It covers the complete width of the turnout. The thickness of the floating slab is 330mm.

l) Concrete Ducts and Covers - Walkway

- Cast-in-situ concrete ducts on the viaduct shall be made up of reinforced concrete using steel rebars or steel wire mesh.
- Prefabricated covers shall be made from fiberglass using approved materials and curing procedures.

m) Stray Current Grid Concrete

- The stray current grid layer concrete r is situated underneath the track bed and above the viaduct finished slab.
- This layer includes the placing of stray current grid.

2.5 Technical Considerations and Recommendations for E&M System of L1CEP

The E&M system of the main line in L1CEP section is the government's PPP portion. The theme in this E&M system which should be solved became clear through the technical review. This section points out technical consideration and recommendation for the government's PPP portion.

Now writing the following items.

2.5.1 Signaling System

1) Integration of Signaling System
2) Operations Control Center

2.5.2 Telecommunication System

1) PABX
2) Trunk Radio System
3) Fiber Optic Transmission System

2.5.3 Power Supply System

1) Traction Power Substation
2) Passenger Station Power Supply
3) Traction Power Feeder System
4) UPS System

2.5.4 Overhead Catenary System

1) OCS Pole on both side of the Viaduct
2) Existing Depot Catenary System
3) Satellite Depot Catenary System

2.5.5 Track Works

1) Minimum Radius
2) Noise Barriers
3) Walkway
4) Concreted Track with Elastic Fastening System

3 ROLLING STOCK

3.1 General

There are three types of rolling stocks in Line 1 first generation, second generation and third generation. First generation train was introduced in 1984 when Line 1 is open. Second generation train was introduced in 1999 at Phase 1 of Capacity Expansion Project. Third Generation train is introduced in 2007 for Phase 2 of Capacity Expansion Project. Feature of each generation trains are describe below.

3.1.1 First Generation Train

First generation trains are manufactured by BN (La Brugeoise et Nivelles SA.) of Belgium. Rolling stock arranged from tram car and has three bodies and double articulated. Normally the tram is operated in one car but Line 1 train consists of 2 cars. There is no gangway between two cars. Cab equipments are not installed at intermediate end but passengers' seat is installed. Passengers get on or get off the train through platform therefore there are no step at the door. There are 5 passenger doors in one side of the car. The door is plug door so that side is flat when door is closed. When door is opening door leaf will swing out to outside so the height of platform is limited to 700mm so that door will not hit the platform and the height is about 200mm lower than floor level of the car. There are four bogies in one car and two at both end are motor bogies two at articulation are trailer bogie. Traction motor is DC motor and controlled by chopper controller. One motor is installed in one motor bogie. Resilient wheel are used and rail brake is installed as standard of tram. Air conditioning system is not installed but 12 forced ventilators are installed in one car.

Figure 3-1 First Generation Train (Original)

After Phase 1 of Capacity Expansion Project first generation trains are changed the configuration from 2 cars to 3 cars one by one for expand the capacity of one train.

Air conditioning system was installed and ventilators were removed from first generation train at Phase 2 Package B of Capacity Expansion Project.

Figure 3-2 First Generation Train (Air Conditioned)

3.1.2 Second Generation Train

Second generation trains are manufactured by Adtranz in Sweden and Hyundai in Korea. Adtranz was in charge of electrical and other sub systems and Hyundai was in charge of car body. Train consists of 4 car and one car has 2 body with single articulation. Car body is made of stainless steel and air conditioning system is installed. There are four passengers' doors in one side of the car and door is slide door.

2 bogies are motor bogie and bogie at articulation is trailer bogie. 2 AC induction motors are installed in motor bogie and are controlled by VVVF inverter. Bogie is outer frame while bogie of first generation is inner frame. Wheel base is 2,310 mm. It is quite long for LRV and it restrict to enter some tracks in existing depot.

Body widths are about 95mm bigger than first generation train and distance between bogie is 10m that is 2.5m longer than first generation train. This cause the conflict with platform and platform of some stations had to be grinded.

Figure 3-3 Second Generation Train

3.1.3 Third Generation Train

Third generation train is manufactured by Kinki Sharyo and Nippon Sharyo. Train configuration is same as second generation train.

Track brake is not installed because track brake is normally used for street car to avoid the collision with road vehicles.

Bogie frame is inner type to ease the maintenance. Wheel base is 1,900m and there are no restriction in the depot.

TMS'(Train Management System) is installed for monitoring the condition of major parts to the driver and maintenance personnel.

Figure 3-3 Second Generation Train

3.2 Specification of Existing Rolling Stock

Table 3-1 indicates the specification of the existing rolling stocks.

Table 3-1 Specification of Existing Rolling Stock

			First Generation	Second Generation	Third Generation
Track Gauge			1435mm	1435mm	1435mm
Nominal Voltage of Power Line			750V	750V	750V
Train Configuration			3 car	4 car	4 car
Car type			3 bodies 4 bogies double articulated	2 bodies 3 bogies single articulated	2 bodies 3 bogies single articulated
Body Length			29,280mm	26,500mm	26,500mm
Overall height from top of rail			3,525mm	3,740mm	3,910mm
Pantograph locked down height			3,950mm	3,950mm	3,843mm
Pantograph operating height		Minimum	4,300mm	4,300mm	4,050mm
		Maximum	6,000mm	6,000mm	6,500mm
Train Length			90m	106m	106m
Body width			2,485mm	2,590mm	2,590mm
Vehilcle weight	Mc		41.5t	37.4t	37.4t
	M		-	36.5t	36.5t
Passenger Capacity	Mc	Seated	81	78	66
		Standee	293	252	272
		Total	374	330	338
	M	Seated	-	82	70
		Standee	-	267	286
		Total	-	349	356
	Train	Seated	243	320	272
		Standee	879	1038	1116
		Total	1122	1358	1388
Wheel Diameter			660mm	660mm	660mm
Floor Height from top of rail			900mm	920mm	920mm
Passenger Door	Type		Plug door	Pocket door	Pocket door
	Number/side		5	4	4
	Width		1400mm	1500mm	1500mm
	Height			1900mm	1900mm
Bogie	Type		inner frame	outer frame	inner frame
	Primary suspension		cornical rubber	chevron rubber spring	chevron rubber spring
	Secondary suspension		coil spring	air suspension	air suspension
	Wheel base		1,900mm/1,800mm	2,310mm	1,900mm
Traction Motor	Type		DC motor	AC induction motor	AC induction motor
	Capacity		218kW	125kW	105kW
	Number/bogie		1	2	2
Motor Control			Chopper control	VVVF inverter control	VVVF inverter control
Maximum speed			60km/h	60km/h	60km/h
Maximum acceleration			$1m/s^2$	$1.1m/s^2$	$1.1m/s^2$
Maximum service brake deceleration			$1.3m/s^2$	$1.3m/s^2$	$1.3m/s^2$
Emergency brake deceleration			$2.08m/s^2$	$2.08m/s^2$	$1.3m/s^2$

Appendix B: Others

1 CIVIL

Presentation of the performance indicator and detailed design standard, etc. related to the countermeasure of an earthquake resistant and soft ground

The Cavite extension section of LRT Line 1 is planned along the shoreline of Manila Bay. It is forecast that there is a possibility that magnitude 7 or an earthquake any more occurs in a lot of research investigations because the west valley fault system runs through the Metropolitan Manila. According to this earthquake hazard map, the Cavite extension section is located on Quaternary alluvium and included in a high risk area. Therefore, when the railway structure is constructed, assuming the massive earthquake, introducing the following design standards in which proven earthquake resistant exist in Japan in addition to a past design approach, and designing are necessary and indispensable.

Earthquake Resistant Design

"Design Standards for Railway Structures and Commentary【Seismic Design】 (English digest version) (Railway bureau, Ministry of Land, Infrastructure, Transport and Tourism, Railway Technical Research Institute)"

This earthquake resistant design standard, as a result of the Hyogo Prefecture Hanshin-Awaji (Kobe) Earthquake that occurred in 1995, considers the strong earthquake motion with an inland earthquake and a large scale inter-plate earthquake. It is a content to check the safety of the structure in the method of focusing on a dynamic analysis, and it is correspond to the major earthquakes more than the design standard by an existing seismic coefficient method.

Type of seismic wave	Assumed earthquake	Assumed maximum acceleration of seismic wave
I	Ocean type grade M8 & Inland type under M6.5	max : 458gal
II	Hanshin-Awaji earthquake etc.	max : 975gal

At the Great East Japan Earthquake in 2011, the constructed railway structure by this design method were not damaged such as irreparable large deformation and dismantlement, and the safe train operation was recovered only by a partial restoration. Therefore, it is necessary to do the check that uses this standard in the earthquake resistant design in the Cavite extension section.

As the countermeasure for support parts of the girder, the installation standard for travel limiting device of the girder and a seismic safety device for bridges are established. The accident prevention of train derailment and rollover is conducted to prevent the travelling and falling of the girder.

Pile Foundation of the Ground with Possibility of Soft Ground and Liquidizing

"Design Standards for Railway Structures and Commentary 【Base Structure】 (English version will be published in future) (Railway bureau, Ministry of Land, Infrastructure, Transport and Tourism, Railway Technical Research Institute)"

The low lands of Manila Bay shore is consists of quaternary alluvium and the pile length in the existing section of the Line 1 is approximately 40m, therefore, it is expected that it is necessary to select the foundation similar to it in the Cavite extension section. This design standard describes about the pile foundation, the caisson foundation to which the adoption is scheduled on the inland side of this route, and the standard under specific condition such as the ground with possibility of soft ground and liquidizing, unstable supporting foundation.

As for the railway structure constructed with this design standard, the damage of liquidizing was none at all though the road and ordinary houses had received the great deal of harm by liquefaction in the Great East Japan Earthquake in 2011. Therefore, it is necessary to do the check that uses this standard for the basic design in the Cavite extension section.

Durability of Cracked Concrete

"Design Standards for Railway Structures and Commentary【Concrete Structures】 (English digest version) (Railway bureau, Ministry of Land, Infrastructure, Transport and Tourism, Railway Technical Research Institute)"

In the elevated structures in the existing section of Line 1, the crack occurs a lot in concrete due to the secular distortion. The density of the chloride ion on the surface of concrete is high because it is in a distance short from the shore line, and there is a possibility that is one of the causes of generation of the crack. Finally, the corrosion of the steel material in concrete is promoted, and it comes to cause the decrease in the proof strength of the structure when this crack is left.

Because the plan of the Cavite extension section is adjacent to the coastline further, the influence of the salt damage on concrete structures grows further. The examination of the steel corrosion according to the distance from the coastline is described in this design standard, and it is preferable to decide the cover thickness of reinforcing steel, etc. according to this design standard.

2 ROLLING STOCK

2.1 Design Criteria

Rolling Stocks for Manila LRT line should apply the following design criteria in order to keep compatibility with existing railway system. These criteria shall not be changed in the future unless there is big system change on the line.

Table 2-1 Design Criteria for Rolling Stocks

No.	Item	Criteria
1.	Track Gauge	1,435mm
2.	Dimensions	
(1)	Train Length	Less than 106m
(2)	Body width	Less than 2,600mm
(3)	Overall height	Less than 3,900mm
(4)	Pantograph working height	Less than 4,300mm – more than 6,000mm
(5)	Pantograph lockdown height	Less than 3,950mm
(6)	Floor height	920mm
(7)	Height of anti-climber	750mm
(8)	Wheel diameter	660mm(new) – 600mm(worn)
(9)	Wheel base	Less than 2,100mm
(10)	Distance between bogie center	Less than 10,000mm
(11)	Door height	1,900mm
3.	Traction Power	
(1)	Nominal Voltage	750V
(2)	Working Range	525V – 900V
4.	Train Performance	
(1)	Maximum speed	60km/h
(2)	Maximum acceleration	More than 1.0m/s^2
(3)	Maximum deceleration of service brake	More than 1.3m/s^2
(4)	Deceleration of emergency brake	More than 1.3m/s^2
5.	Running performance	
(1)	Minimum curve radius	Less than 25m
(2)	Maximum gradient	More than 4%
6.	Maximum axle load	Less than 10.5t
7.	Brake system	Emergency brake will be applied in case of train separation
8.	Door system	Door shall not open when train is running
		Train shall not accelerate when door is open
		Doors can be opened manually in case of power failure

2.2 Durability against Salt Air

Route alignment of Cavite Extension runs near the sea and satellite depot is planned not far from the cost. Rolling stocks will be always exposed with salt and it is anticipated that car body or equipments are damaged by salt air and it cause the failure or shortening the lifetime of the rolling stocks. Following items are recommended to for rolling stocks are required to have enough durability against corrosive salt air.

1.	Vehicle Body	Vehicle body include under frame shall be made of stainless steel.
2.	Equipment box	Equipment boxes those are exposed to outside shall be made of stainless steel.
3.	Fastening	All the bolts and nuts those are exposed to outside shall be made of stainless steel
4.	Air intake	Air intake of the equipments shall not face to sea side. *
5.	Equipments	Equipments those are exposed to air for cooling shall have enough durability against salt air.

* New train shall not change direction at existing depot so that same side shall face to the sea.

2.3 Through Operation to Line 3

Despite the criteria in **Table 2-1** trains those will run on the Line 3 should have following criteria

Table 2-2 Design Criteria for Rolling Stock Run through Line 3

1.	**Dimensions**	
(1)	Train Length	95m
(2)	Overall height	3,730mm
(3)	Pantograph working height	3,900mm – 6,000mm
(4)	Pantograph lockdown height	3,660mm
(5)	Distance between bogie center	7,500mm
(6)	Door height	1,900mm
2.	**Train Performance**	
(1)	Maximum speed	65km/h
(2)	Maximum acceleration	1.03m/s^2
(3)	Deceleration of emergency brake	1.58m/s^2
3.	**Running performance**	
(1)	Minimum curve radius	Less than 25m
(2)	Maximum gradient	5%
4.	**Maximum axle load**	**9t**

Those are not conflict with criteria in **Table 2-1** because most of them are stated as “More than” or “Less than” except maximum speed. Criterion of Line 1 cannot be stated as “more than 60km” because when maximum speed exceeds 60 km/s signaling system cannot guarantee to stop the train safely. However in Line 3 maximum speed of 65 km/h is required. Therefore trains should have dual mode “Line 1 mode” and “Line 3 mode” that can be changed manually or automatically. The mode should include maximum speed, acceleration, deceleration, signaling system and communication system.

Appendix C: Demand Forecast for Line 1 Cavite Extension Project

MANILA LRT DEMAND FORECAST FOR LINE 1 CAVITE EXTENSION PROJECT

APPENDIX-C

CONTENTS

Table C.1 Line-1 Average Week Day Station Boarding and Alighting-2015

2-Way Boarding & Alighting		
Station	**Board**	**Alight**
Roosevelt	32,497	22,755
Balintawak	20,488	8,767
Monumento	72,174	59,904
5th Avenue	21,544	18,018
R Papa	7,997	11,481
A Santos	8,856	19,652
Blumentritt	15,979	16,061
Tayuman	22,493	18,347
Bambang	7,734	9,143
D Jose	33,348	32,824
Carriedo	36,090	35,037
Central	20,451	26,198
UN Avenue	36,841	41,052
Pedro Gil	31,990	32,058
Quirino	17,503	23,704
Vito Cruz	18,210	23,655
Gil Puyat	46,858	50,642
Libertad	16,673	19,204
EDSA	75,303	74,829
Baclaran	38,284	36,835
Redemptorist	6,280	6,468
MIA	6,364	6,511
Asia World	1,721	1,807
Ninoy Aquino	6,992	7,572
Dr. Santos	8,572	8,884
Manuyo Uno	549	558
Las Pinas	2,941	3,080
Zapote	10,219	10,770
Talaba	166	176
Niyog	25,583	24,708
Total	**650,700**	**650,700**
Maximum	**75,303**	**74,829**
Average Trip Length (km)		**9.64**

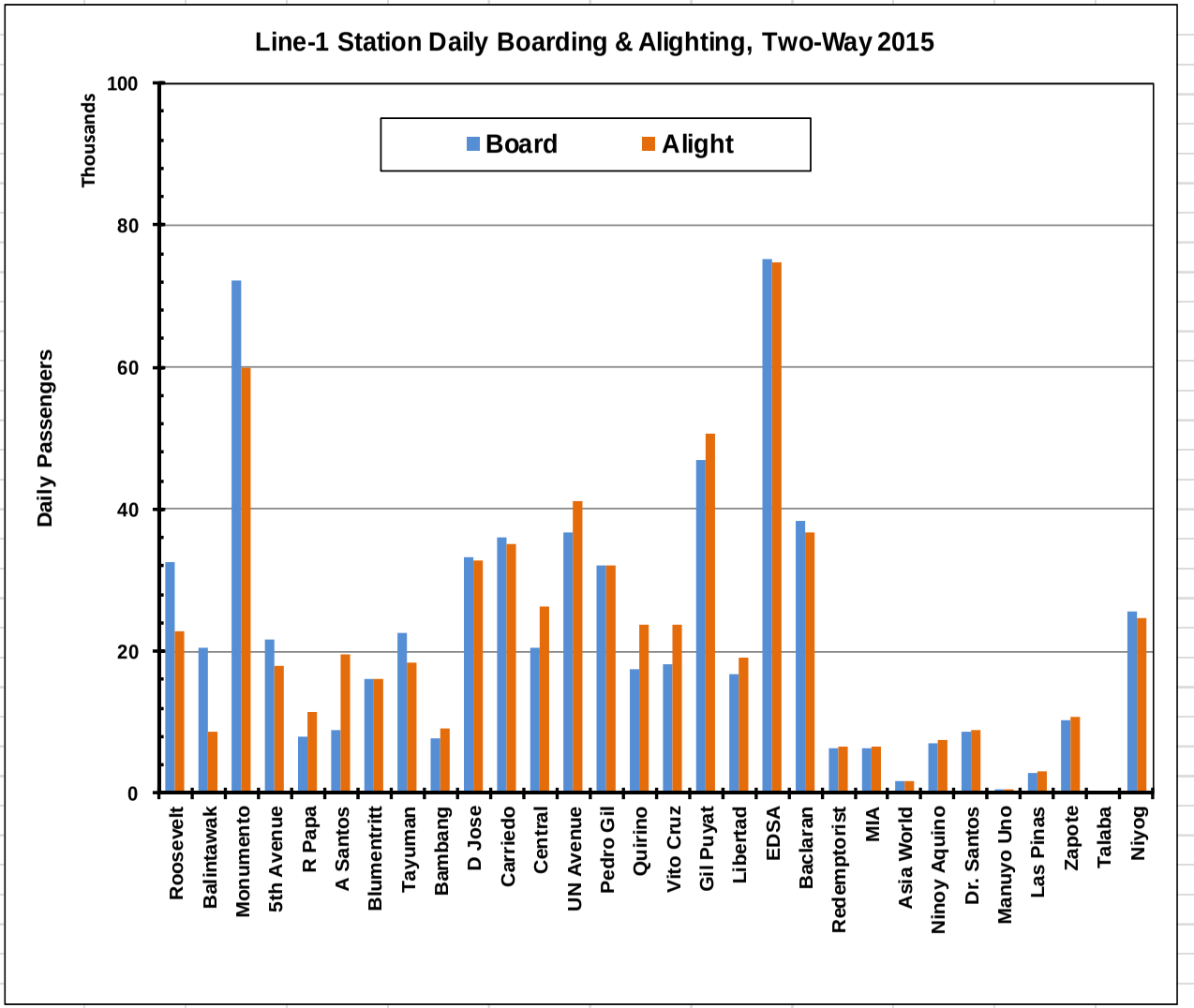
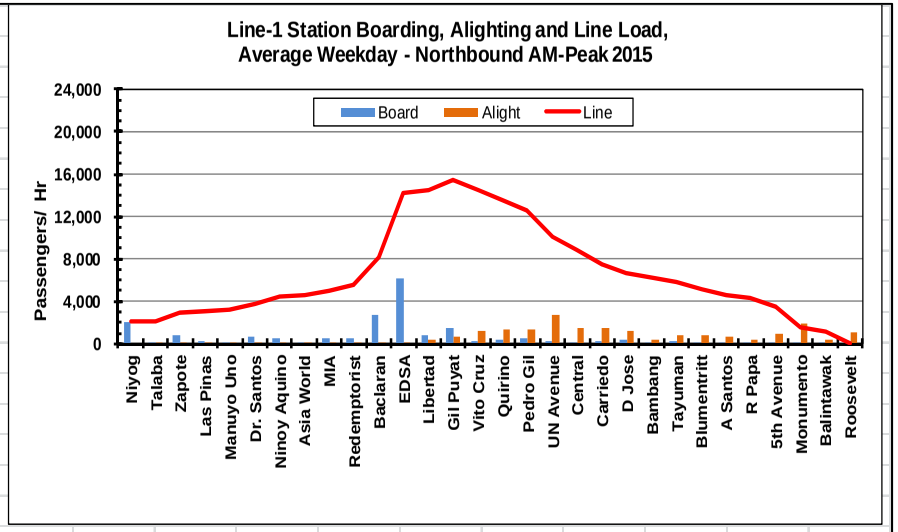


Table C.2 Line-1 AM Peak Hour (07:00-08:00) Station and Line Loading-2015

Northbound Niyog - Roosevelt			
Station	**Board**	**Alight**	**Line**
Niyog	2,040	-	2,040
Talaba	13	0	2,053
Zapote	814	0	2,867
Las Pinas	234	0	3,101
Manuyo Uno	44	0	3,144
Dr. Santos	683	1	3,827
Ninoy Aquino	555	1	4,381
Asia World	137	0	4,518
MIA	502	2	5,018
Redemptorist	490	1	5,507
Baclaran	2,733	86	8,154
EDSA	6,155	127	14,182
Libertad	776	408	14,550
Gil Puyat	1,502	636	15,417
Vito Cruz	304	1,218	14,502
Quirino	377	1,391	13,488
Pedro Gil	475	1,376	12,587
UN Avenue	276	2,716	10,147
Central	85	1,447	8,785
Carriedo	251	1,530	7,506
D Jose	324	1,227	6,602
Bambang	85	401	6,286
Tayuman	275	780	5,781
Blumentritt	159	763	5,177
A Santos	118	672	4,623
R Papa	89	431	4,282
5th Avenue	114	970	3,426
Monumento	65	1,951	1,540
Balintawak	2	418	1,124
Roosevelt	-	1,124	0
Total	19,677	19,677	
Maximum	6,155	2,716	15,417
Average Trip Length (km)			9.09
Two-Way	49,374	49,374	10.18

Southbound Roosevelt - Niyog			
Station	**Board**	**Alight**	**Line**
Roosevelt	3,957	-	3,957
Balintawak	2,877	1	6,834
Monumento	9,105	21	15,917
5th Avenue	2,705	45	18,576
R Papa	780	21	19,335
A Santos	912	43	20,204
Blumentritt	1,277	101	21,380
Tayuman	1,332	294	22,418
Bambang	447	122	22,742
D Jose	1,784	772	23,754
Carriedo	969	1,204	23,518
Central	328	1,077	22,769
UN Avenue	789	2,417	21,141
Pedro Gil	594	1,342	20,392
Quirino	494	1,451	19,435
Vito Cruz	459	1,565	18,330
Gil Puyat	496	5,099	13,727
Libertad	274	1,669	12,332
EDSA	70	5,584	6,818
Baclaran	30	2,159	4,690
Redemptorist	7	431	4,265
MIA	7	433	3,840
Asia World	0	121	3,719
Ninoy Aquino	2	505	3,216
Dr. Santos	0	593	2,623
Manuyo Uno	0	37	2,586
Las Pinas	0	206	2,381
Zapote	0	719	1,662
Talaba	0	12	1,651
Niyog	-	1,651	0
Total	29,696	29,696	
Maximum	9,105	5,584	23,754
Average Trip Length (km)			10.90
AM-PK Hour to Daily			7.59%



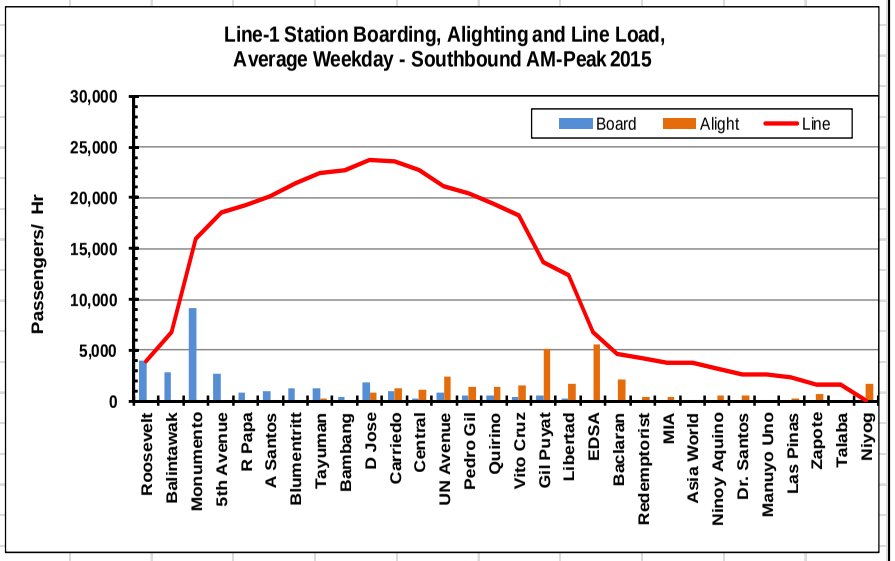


Table C.3 Line-1 Average Week Day Station Boarding and Alighting-2016

2-Way Boarding & Alighting		
Station	**Board**	**Alight**
Roosevelt	34,899	24,415
Balintawak	22,002	9,408
Monumento	77,508	64,277
5th Avenue	23,137	19,333
R Papa	8,588	12,319
A Santos	9,511	21,086
Blumentritt	17,160	17,233
Tayuman	24,155	19,686
Bambang	8,305	9,811
D Jose	35,813	35,221
Carriedo	38,758	37,594
Central	21,963	28,111
UN Avenue	39,563	44,049
Pedro Gil	34,354	34,399
Quirino	18,797	25,436
Vito Cruz	19,556	25,381
Gil Puyat	50,321	54,339
Libertad	17,906	20,606
EDSA	80,868	80,292
Baclaran	41,114	39,524
Redemptorist	11,434	11,747
MIA	11,587	11,824
Asia World	3,134	3,280
Ninoy Aquino	12,729	13,750
Dr. Santos	15,607	16,131
Manuyo Uno	1,002	1,012
Las Pinas	5,354	5,593
Zapote	18,603	19,554
Talaba	297	323
Niyog	46,575	44,866
Total	**750,600**	**750,600**
Maximum	**80,868**	**80,292**
Average Trip Length (km)		**10.72**

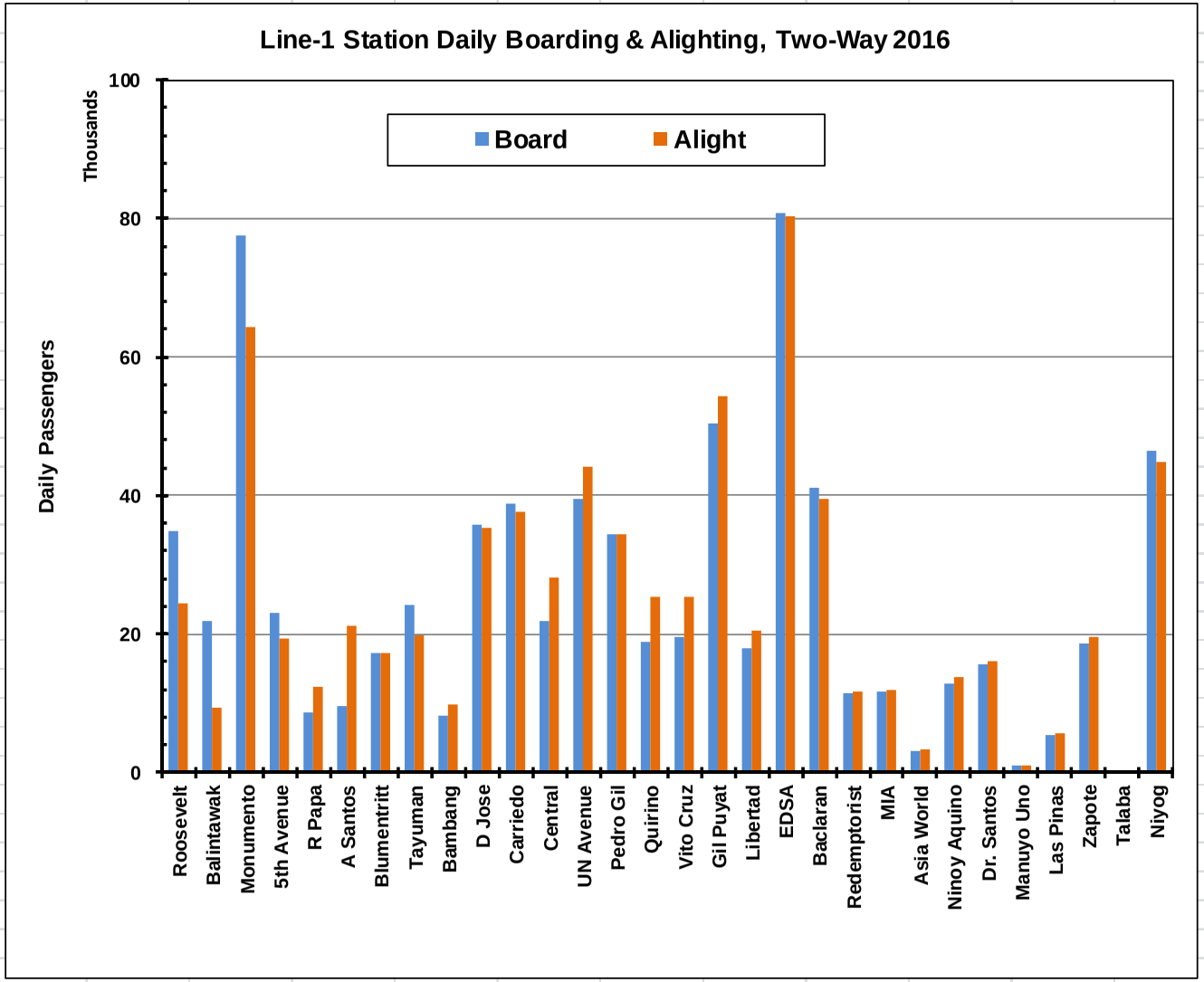
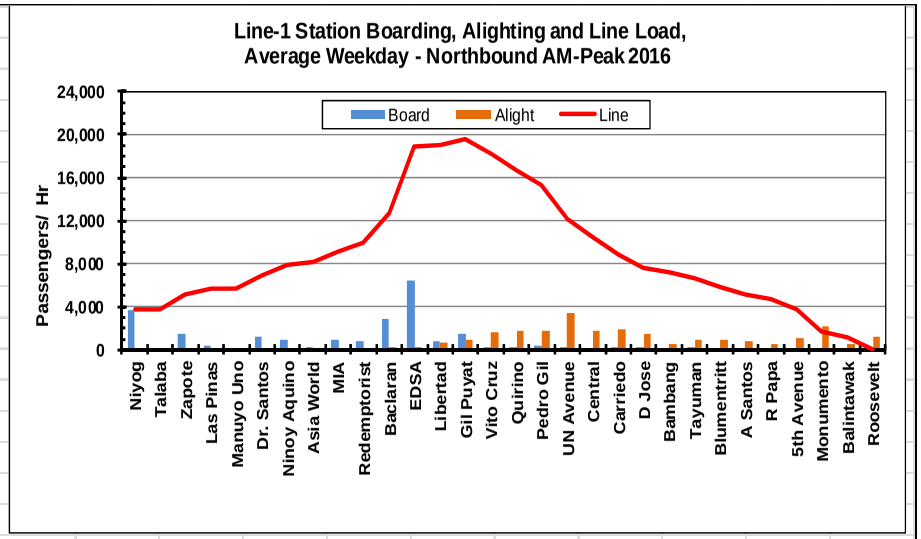


Table C.4 Line-1 AM Peak Hour (07:00-08:00) Station and Line Loading-2016

Northbound Niyog - Roosevelt			
Station	**Board**	**Alight**	**Line**
Niyog	3,701	-	3,701
Talaba	24	0	3,724
Zapote	1,475	2	5,197
Las Pinas	424	0	5,622
Manuyo Uno	79	0	5,701
Dr. Santos	1,240	4	6,937
Ninoy Aquino	1,002	2	7,937
Asia World	248	0	8,184
MIA	900	7	9,077
Redemptorist	868	3	9,942
Baclaran	2,884	186	12,640
EDSA	6,499	190	18,949
Libertad	744	619	19,074
Gil Puyat	1,449	970	19,554
Vito Cruz	253	1,595	18,213
Quirino	317	1,803	16,726
Pedro Gil	401	1,752	15,376
UN Avenue	233	3,407	12,202
Central	74	1,802	10,474
Carriedo	213	1,852	8,835
D Jose	288	1,465	7,658
Bambang	75	471	7,262
Tayuman	244	915	6,590
Blumentritt	142	877	5,856
A Santos	110	775	5,190
R Papa	84	492	4,782
5th Avenue	108	1,100	3,790
Monumento	63	2,187	1,666
Balintawak	2	459	1,209
Roosevelt	-	1,209	-
Total	24,145	24,145	
Maximum	6,499	3,407	19,554
Average Trip Length (km)			10.18
Two-Way	**57,075**	**57,075**	**11.21**

Southbound Roosevelt - Niyog			
Station	**Board**	**Alight**	**Line**
Roosevelt	4,318	-	4,318
Balintawak	3,103	1	7,420
Monumento	9,777	21	17,176
5th Avenue	2,897	43	20,030
R Papa	840	20	20,850
A Santos	985	40	21,795
Blumentritt	1,379	90	23,084
Tayuman	1,456	261	24,278
Bambang	490	108	24,661
D Jose	1,976	700	25,937
Carriedo	1,106	1,043	26,000
Central	382	944	25,438
UN Avenue	923	2,107	24,254
Pedro Gil	721	1,170	23,805
Quirino	611	1,270	23,146
Vito Cruz	574	1,374	22,346
Gil Puyat	742	5,124	17,963
Libertad	416	1,663	16,716
EDSA	106	6,005	10,816
Baclaran	65	2,300	8,582
Redemptorist	25	792	7,814
MIA	27	792	7,049
Asia World	1	222	6,829
Ninoy Aquino	8	929	5,908
Dr. Santos	1	1,089	4,820
Manuyo Uno	0	68	4,752
Las Pinas	0	378	4,375
Zapote	1	1,320	3,057
Talaba	0	22	3,035
Niyog	-	3,035	- 0
Total	32,930	32,930	
Maximum	9,777	6,005	26,000
Average Trip Length (km)			11.96
AM-PK Hour to Daily			**7.60%**



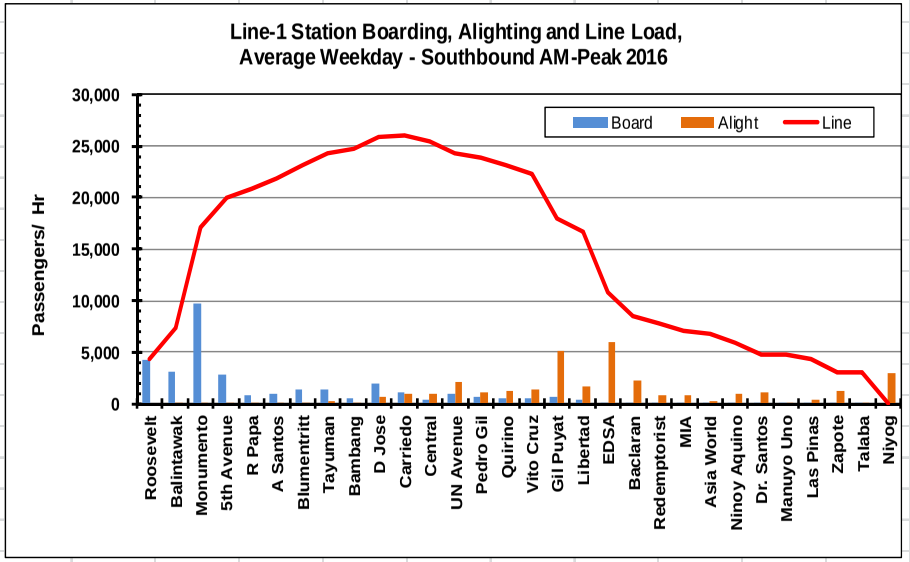


Table C.5 Line-1 Average Week Day Station Boarding and Alighting-2020

2-Way Boarding & Alighting		
Station	**Board**	**Alight**
Roosevelt	37,872	26,489
Balintawak	23,882	10,205
Monumento	84,115	69,737
5th Avenue	25,110	20,977
R Papa	9,319	13,368
A Santos	10,320	22,878
Blumentritt	18,621	18,698
Tayuman	26,213	21,357
Bambang	9,015	10,641
D Jose	38,861	38,214
Carriedo	42,057	40,790
Central	23,831	30,501
UN Avenue	42,930	47,795
Pedro Gil	37,281	37,326
Quirino	20,399	27,592
Vito Cruz	21,226	27,538
Gil Puyat	54,607	58,961
Libertad	19,428	22,356
EDSA	87,755	87,117
Baclaran	44,613	42,886
Redemptorist	13,915	14,286
MIA	14,102	14,380
Asia World	3,814	3,988
Ninoy Aquino	15,492	16,722
Dr. Santos	18,995	19,619
Manuyo Uno	1,218	1,231
Las Pinas	6,516	6,801
Zapote	22,642	23,783
Talaba	364	396
Niyog	56,687	54,568
Total	**831,200**	**831,200**
Maximum	**87,755**	**87,117**
Average Trip Length (km)		**11.00**

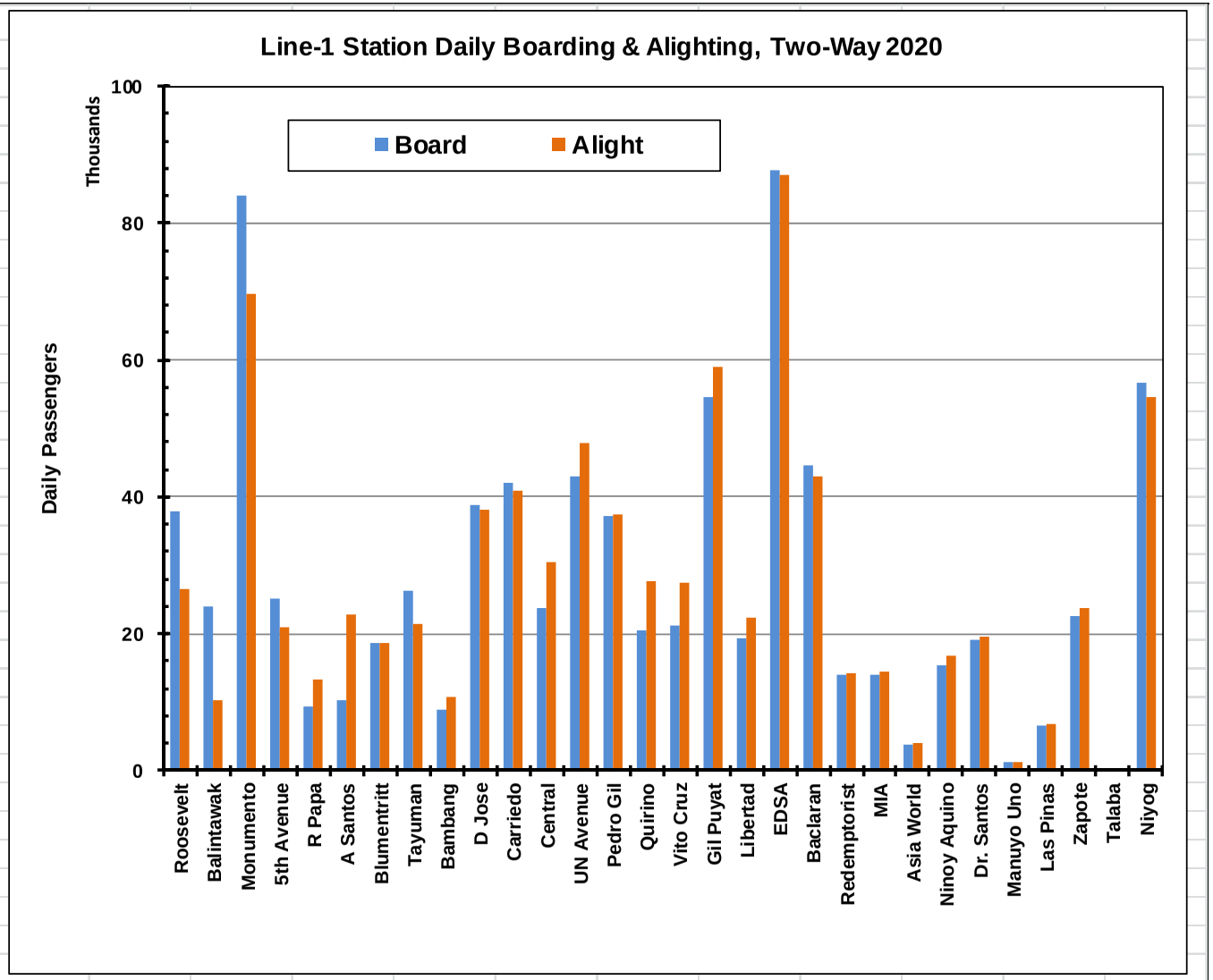
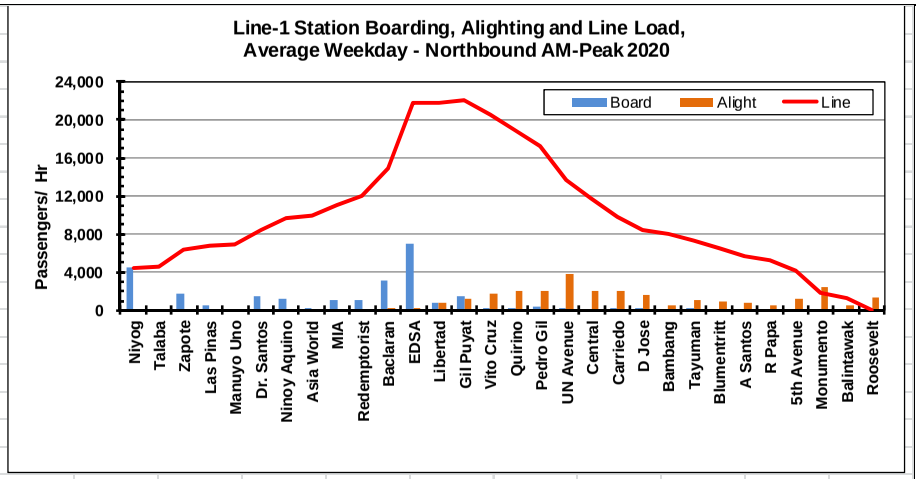


Table C.6 Line-1 AM Peak Hour (07:00-08:00) Station and Line Loading-2020

Northbound Niyog - Roosevelt			
Station	**Board**	**Alight**	**Line**
Niyog	4,500	-	4,500
Talaba	29	0	4,529
Zapote	1,793	2	6,319
Las Pinas	516	0	6,834
Manuyo Uno	97	0	6,931
Dr. Santos	1,507	5	8,433
Ninoy Aquino	1,217	3	9,646
Asia World	301	1	9,946
MIA	1,090	10	11,025
Redemptorist	1,046	5	12,067
Baclaran	3,111	238	14,939
EDSA	**7,011**	227	21,723
Libertad	776	736	21,764
Gil Puyat	1,516	1,156	**22,123**
Vito Cruz	254	1,817	20,561
Quirino	318	2,049	18,830
Pedro Gil	404	1,983	17,251
UN Avenue	234	**3,844**	13,641
Central	75	2,031	11,685
Carriedo	215	2,072	9,828
D Jose	294	1,636	8,486
Bambang	76	523	8,039
Tayuman	249	1,016	7,271
Blumentritt	145	969	6,448
A Santos	113	858	5,703
R Papa	87	544	5,247
5th Avenue	112	1,211	4,148
Monumento	66	2,402	1,812
Balintawak	2	502	1,312
Roosevelt	-	1,312	- 0
Total	27,154	27,154	
Maximum	**7,011**	**3,844**	**22,123**
Average Trip Length (km)			**10.44**
Two-Way	**63,226**	**63,226**	**11.47**

Southbound Roosevelt - Niyog			
Station	**Board**	**Alight**	**Line**
Roosevelt	4,707	-	4,707
Balintawak	3,372	1	8,077
Monumento	**10,606**	22	18,662
5th Avenue	3,140	44	21,758
R Papa	912	21	22,649
A Santos	1,070	41	23,679
Blumentritt	1,499	92	25,085
Tayuman	1,588	267	26,406
Bambang	535	110	26,832
D Jose	2,162	718	28,276
Carriedo	1,219	1,057	**28,439**
Central	424	961	27,902
UN Avenue	1,023	2,140	26,785
Pedro Gil	807	1,187	26,405
Quirino	687	1,290	25,801
Vito Cruz	646	1,398	25,049
Gil Puyat	879	5,427	20,501
Libertad	493	1,756	19,238
EDSA	127	**6,511**	12,853
Baclaran	83	2,485	10,451
Redemptorist	36	966	9,521
MIA	40	965	8,596
Asia World	2	270	8,327
Ninoy Aquino	11	1,133	7,206
Dr. Santos	2	1,328	5,880
Manuyo Uno	0	83	5,797
Las Pinas	1	460	5,337
Zapote	2	1,610	3,729
Talaba	0	27	3,702
Niyog	-	3,702	0
Total	36,072	36,072	
Maximum	**10,606**	**6,511**	**28,439**
Average Trip Length (km)			**12.25**
AM-PK Hour to Daily			**7.61%**



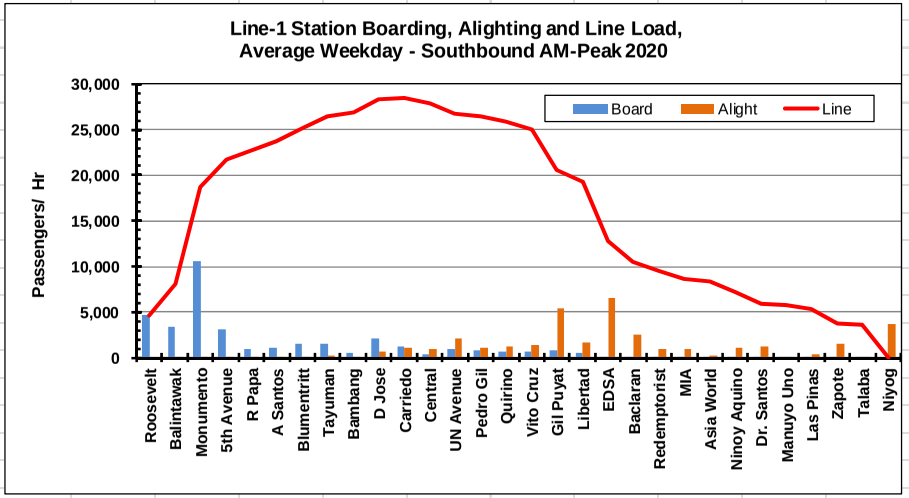


Table C.7 Line-1 Average Week Day Station Boarding and Alighting-2025

2-Way Boarding & Alighting		
Station	**Board**	**Alight**
Roosevelt	40,341	28,211
Balintawak	25,435	10,868
Monumento	89,597	74,276
5th Avenue	26,743	22,343
R Papa	9,925	14,237
A Santos	10,995	24,364
Blumentritt	19,838	19,915
Tayuman	27,924	22,747
Bambang	9,602	11,336
D Jose	41,398	40,703
Carriedo	44,799	43,445
Central	25,384	32,485
UN Avenue	45,734	50,904
Pedro Gil	39,712	39,751
Quirino	21,729	29,391
Vito Cruz	22,608	29,332
Gil Puyat	58,167	62,794
Libertad	20,697	23,808
EDSA	93,477	92,784
Baclaran	47,525	45,677
Redemptorist	16,136	16,557
MIA	16,351	16,664
Asia World	4,422	4,623
Ninoy Aquino	17,963	19,380
Dr. Santos	22,025	22,737
Manuyo Uno	1,412	1,427
Las Pinas	7,556	7,883
Zapote	26,254	27,563
Talaba	422	458
Niyog	65,729	63,237
Total	**899,900**	**899,900**
Maximum	**93,477**	**92,784**
Average Trip Length (km)		**11.22**

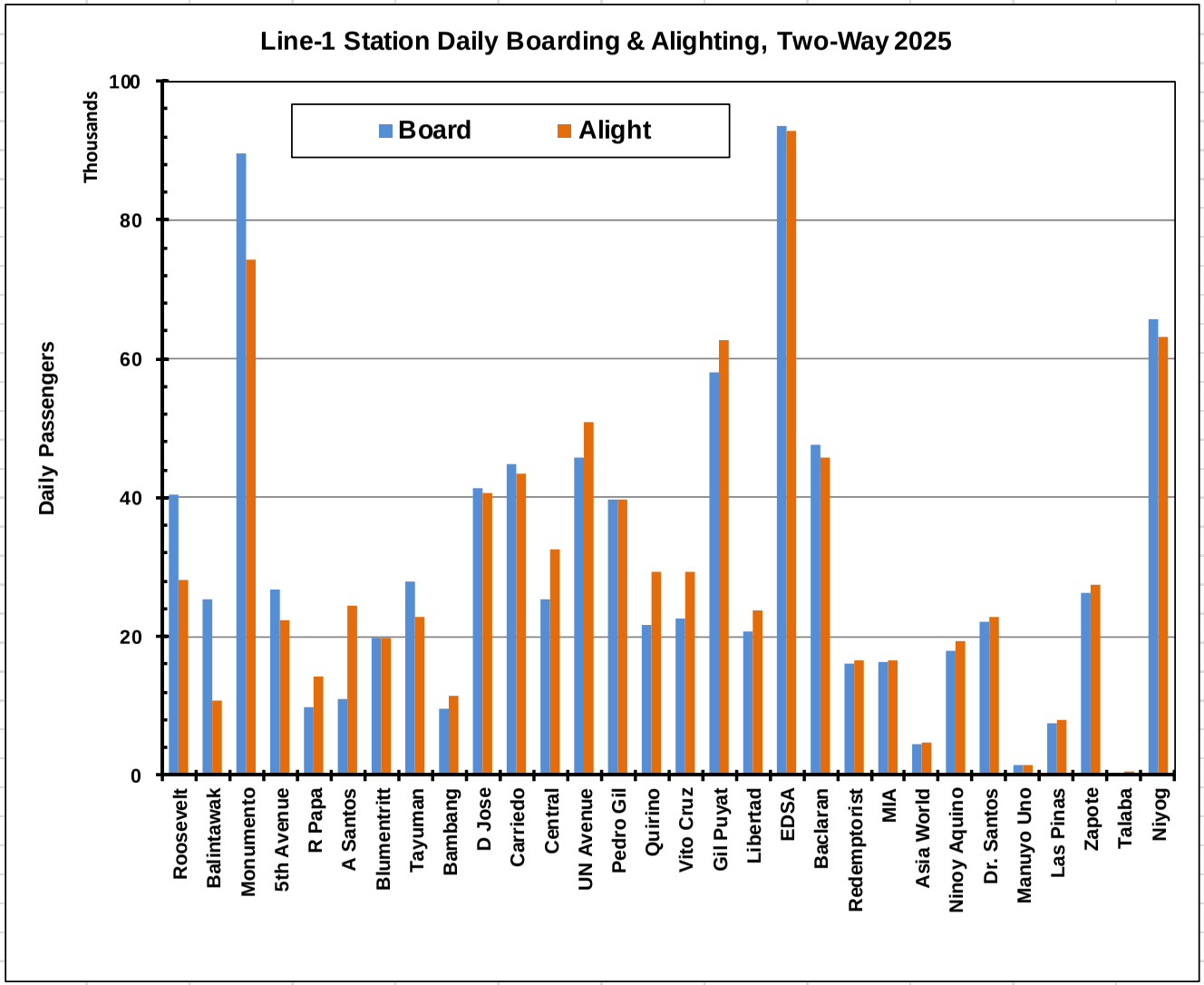
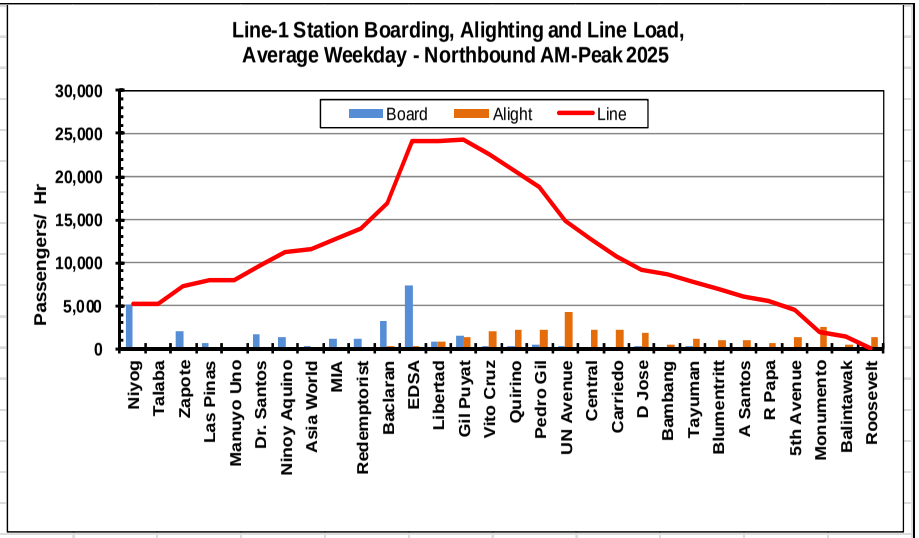


Table C.8 Line-1 AM Peak Hour (07:00-08:00) Station and Line Loading-2025

Northbound Niyog - Roosevelt			
Station	**Board**	**Alight**	**Line**
Niyog	5,214	-	5,214
Talaba	33	0	5,247
Zapote	2,076	3	7,320
Las Pinas	597	0	7,917
Manuyo Uno	112	0	8,029
Dr. Santos	1,746	7	9,768
Ninoy Aquino	1,407	5	11,171
Asia World	348	1	11,518
MIA	1,258	14	12,762
Redemptorist	1,203	6	13,959
Baclaran	3,296	288	16,966
EDSA	7,430	262	24,134
Libertad	799	842	24,092
Gil Puyat	1,564	1,326	24,330
Vito Cruz	253	2,008	22,575
Quirino	318	2,261	20,631
Pedro Gil	404	2,181	18,855
UN Avenue	234	4,219	14,870
Central	75	2,226	12,719
Carriedo	216	2,259	10,675
D Jose	297	1,783	9,189
Bambang	77	567	8,699
Tayuman	252	1,102	7,848
Blumentritt	147	1,047	6,948
A Santos	116	928	6,136
R Papa	89	587	5,639
5th Avenue	115	1,306	4,448
Monumento	68	2,584	1,933
Balintawak	2	537	1,398
Roosevelt	-	1,398	0
Total	29,748	29,748	
Maximum	7,430	4,219	24,330
Average Trip Length (km)			10.64
Two-Way	**68,464**	**68,464**	**11.68**

Southbound Roosevelt - Niyog			
Station	**Board**	**Alight**	**Line**
Roosevelt	5,032	-	5,032
Balintawak	3,593	1	8,624
Monumento	11,293	22	19,895
5th Avenue	3,341	45	23,191
R Papa	972	21	24,141
A Santos	1,142	42	25,241
Blumentritt	1,598	93	26,746
Tayuman	1,698	270	28,175
Bambang	573	111	28,637
D Jose	2,319	729	30,227
Carriedo	1,314	1,063	30,478
Central	459	969	29,968
UN Avenue	1,108	2,155	28,921
Pedro Gil	879	1,195	28,605
Quirino	751	1,300	28,056
Vito Cruz	707	1,409	27,354
Gil Puyat	1,002	5,657	22,699
Libertad	564	1,826	21,437
EDSA	146	6,927	14,656
Baclaran	101	2,636	12,120
Redemptorist	47	1,121	11,046
MIA	53	1,119	9,980
Asia World	3	314	9,668
Ninoy Aquino	15	1,315	8,368
Dr. Santos	2	1,542	6,828
Manuyo Uno	0	97	6,732
Las Pinas	1	535	6,198
Zapote	3	1,869	4,331
Talaba	0	31	4,300
Niyog	-	4,300	-
Total	38,716	38,716	
Maximum	11,293	6,927	30,478
Average Trip Length (km)			12.49
AM-PK Hour to Daily			**7.61%**



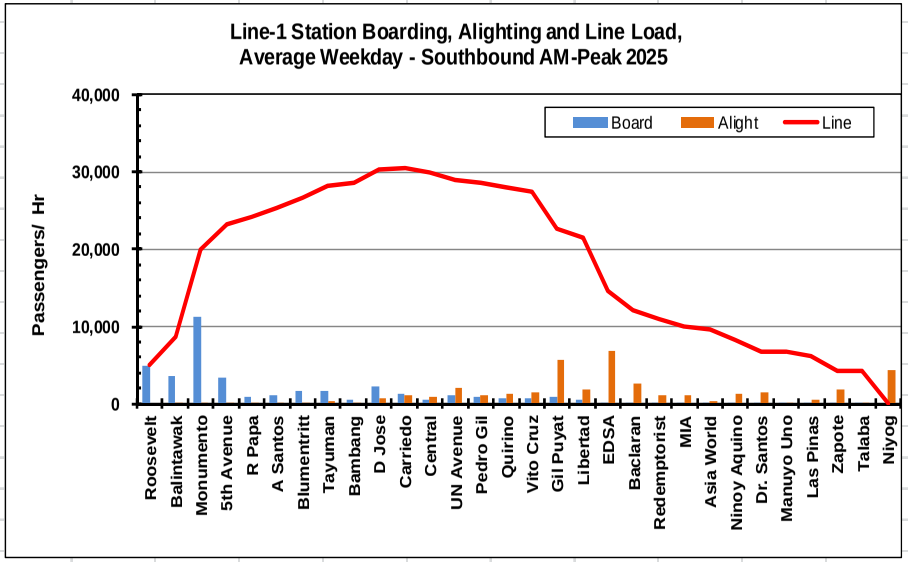


Table C.9 Line-1 Average Week Day Station Boarding and Alighting-2030

2-Way Boarding & Alighting		
Station	**Board**	**Alight**
Roosevelt	42,120	29,452
Balintawak	26,556	11,344
Monumento	93,549	77,545
5th Avenue	27,920	23,326
R Papa	10,364	14,866
A Santos	11,478	25,438
Blumentritt	20,709	20,789
Tayuman	29,155	23,746
Bambang	10,027	11,830
D Jose	43,219	42,491
Carriedo	46,773	45,356
Central	26,504	33,914
UN Avenue	47,749	53,140
Pedro Gil	41,460	41,503
Quirino	22,686	30,681
Vito Cruz	23,600	30,622
Gil Puyat	60,734	65,557
Libertad	21,609	24,855
EDSA	97,598	96,867
Baclaran	49,618	47,686
Redemptorist	17,819	18,277
MIA	18,057	18,397
Asia World	4,883	5,104
Ninoy Aquino	19,838	21,394
Dr. Santos	24,324	25,100
Manuyo Uno	1,560	1,575
Las Pinas	8,345	8,703
Zapote	28,994	30,427
Talaba	465	505
Niyog	72,587	69,810
Total	**950,300**	**950,300**
Maximum	**97,598**	**96,867**
Average Trip Length (km)		**11.37**

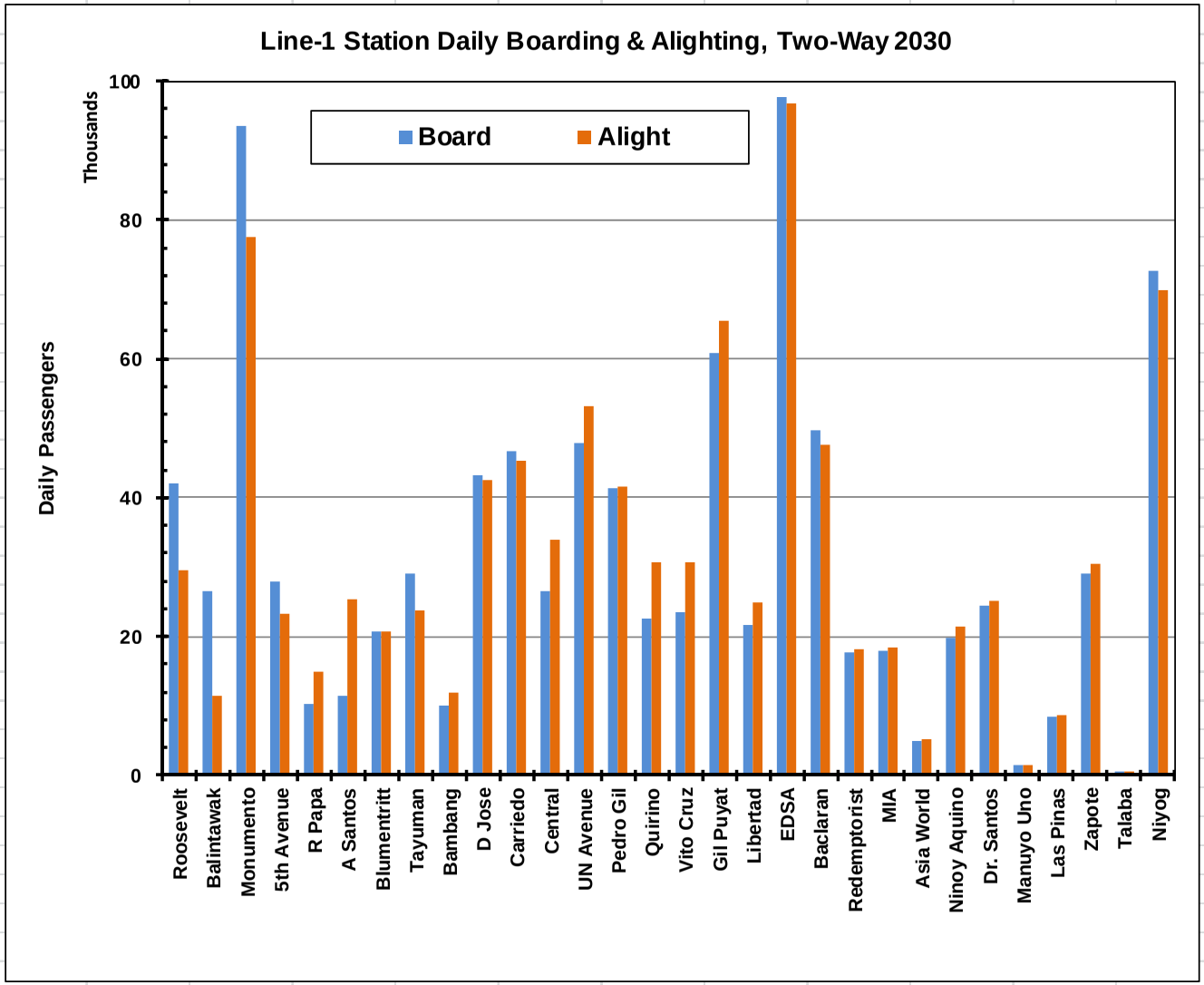
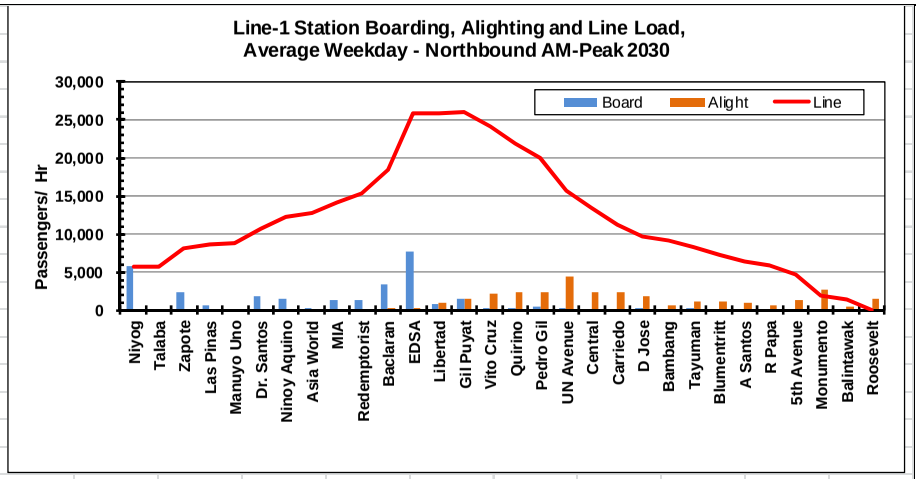


Table C.10 Line-1 AM Peak Hour (07:00-08:00) Station and Line Loading-2030

Northbound Niyog - Roosevelt			
Station	**Board**	**Alight**	**Line**
Niyog	5,755	-	5,755
Talaba	37	0	5,791
Zapote	2,291	4	8,079
Las Pinas	659	1	8,737
Manuyo Uno	123	0	8,861
Dr. Santos	1,928	9	10,779
Ninoy Aquino	1,552	6	12,325
Asia World	384	1	12,709
MIA	1,384	17	14,076
Redemptorist	1,320	8	15,388
Baclaran	3,427	328	18,487
EDSA	**7,728**	290	25,925
Libertad	814	923	25,816
Gil Puyat	1,594	1,457	**25,953**
Vito Cruz	252	2,149	24,056
Quirino	316	2,417	21,956
Pedro Gil	403	2,327	20,032
UN Avenue	234	**4,494**	15,771
Central	75	2,370	13,476
Carriedo	215	2,397	11,295
D Jose	299	1,890	9,704
Bambang	77	599	9,181
Tayuman	253	1,165	8,269
Blumentritt	148	1,103	7,314
A Santos	117	979	6,452
R Papa	91	619	5,924
5th Avenue	117	1,375	4,666
Monumento	69	2,716	2,020
Balintawak	3	563	1,460
Roosevelt	-	1,460	-
Total	31,664	31,664	
Maximum	**7,728**	**4,494**	**25,953**
Average Trip Length (km)			**10.77**
Two-Way	**72,304**	**72,304**	**11.82**

Southbound Roosevelt - Niyog			
Station	**Board**	**Alight**	**Line**
Roosevelt	5,268	-	5,268
Balintawak	3,753	1	9,020
Monumento	**11,787**	23	20,784
5th Avenue	3,486	46	24,224
R Papa	1,015	22	25,217
A Santos	1,193	43	26,367
Blumentritt	1,670	94	27,944
Tayuman	1,778	272	29,450
Bambang	600	111	29,939
D Jose	2,433	735	31,636
Carriedo	1,384	1,065	**31,955**
Central	484	972	31,467
UN Avenue	1,169	2,160	30,477
Pedro Gil	933	1,198	30,211
Quirino	798	1,303	29,705
Vito Cruz	752	1,414	29,043
Gil Puyat	1,097	5,810	24,330
Libertad	618	1,872	23,076
EDSA	161	**7,225**	16,012
Baclaran	115	2,743	13,384
Redemptorist	57	1,239	12,202
MIA	64	1,236	11,030
Asia World	3	347	10,686
Ninoy Aquino	18	1,454	9,250
Dr. Santos	3	1,704	7,548
Manuyo Uno	0	107	7,442
Las Pinas	1	591	6,852
Zapote	3	2,066	4,789
Talaba	0	34	4,755
Niyog	-	4,755	- 0
Total	40,640	40,640	
Maximum	**11,787**	**7,225**	**31,955**
Average Trip Length (km)			**12.65**
AM-PK Hour to Daily			**7.61%**



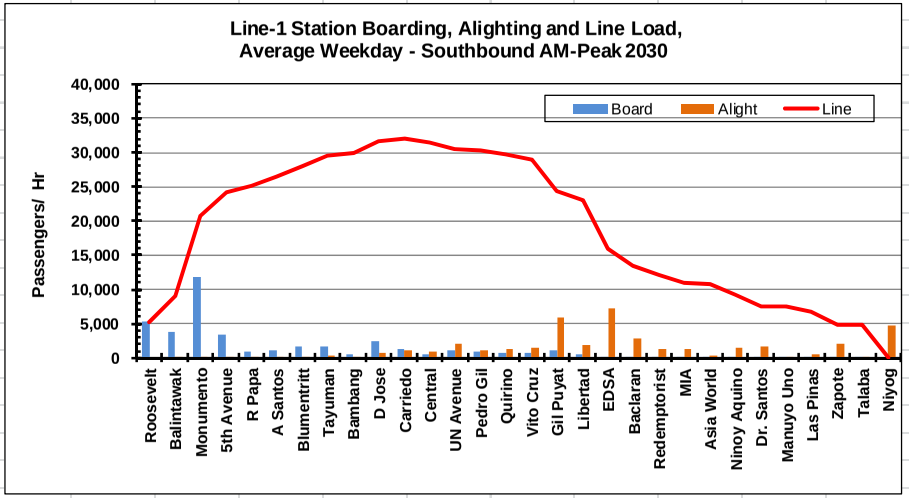


Table C.11 Line-1 Average Week Day Station Boarding and Alighting-2035

2-Way Boarding & Alighting		
Station	**Board**	**Alight**
Roosevelt	43,527	30,436
Balintawak	27,443	11,722
Monumento	96,674	80,128
5th Avenue	28,856	24,106
R Papa	10,710	15,361
A Santos	11,860	26,287
Blumentritt	21,404	21,485
Tayuman	30,124	24,539
Bambang	10,360	12,226
D Jose	44,665	43,908
Carriedo	48,334	46,871
Central	27,387	35,042
UN Avenue	49,340	54,912
Pedro Gil	42,846	42,883
Quirino	23,444	31,706
Vito Cruz	24,393	31,641
Gil Puyat	62,758	67,739
Libertad	22,332	25,686
EDSA	100,855	100,097
Baclaran	51,277	49,272
Redemptorist	19,200	19,686
MIA	19,456	19,815
Asia World	5,263	5,497
Ninoy Aquino	21,373	23,042
Dr. Santos	26,204	27,034
Manuyo Uno	1,681	1,696
Las Pinas	8,991	9,374
Zapote	31,238	32,773
Talaba	500	545
Niyog	78,205	75,191
Total	**990,700**	**990,700**
Maximum	**100,855**	**100,097**
Average Trip Length (km)		**11.48**

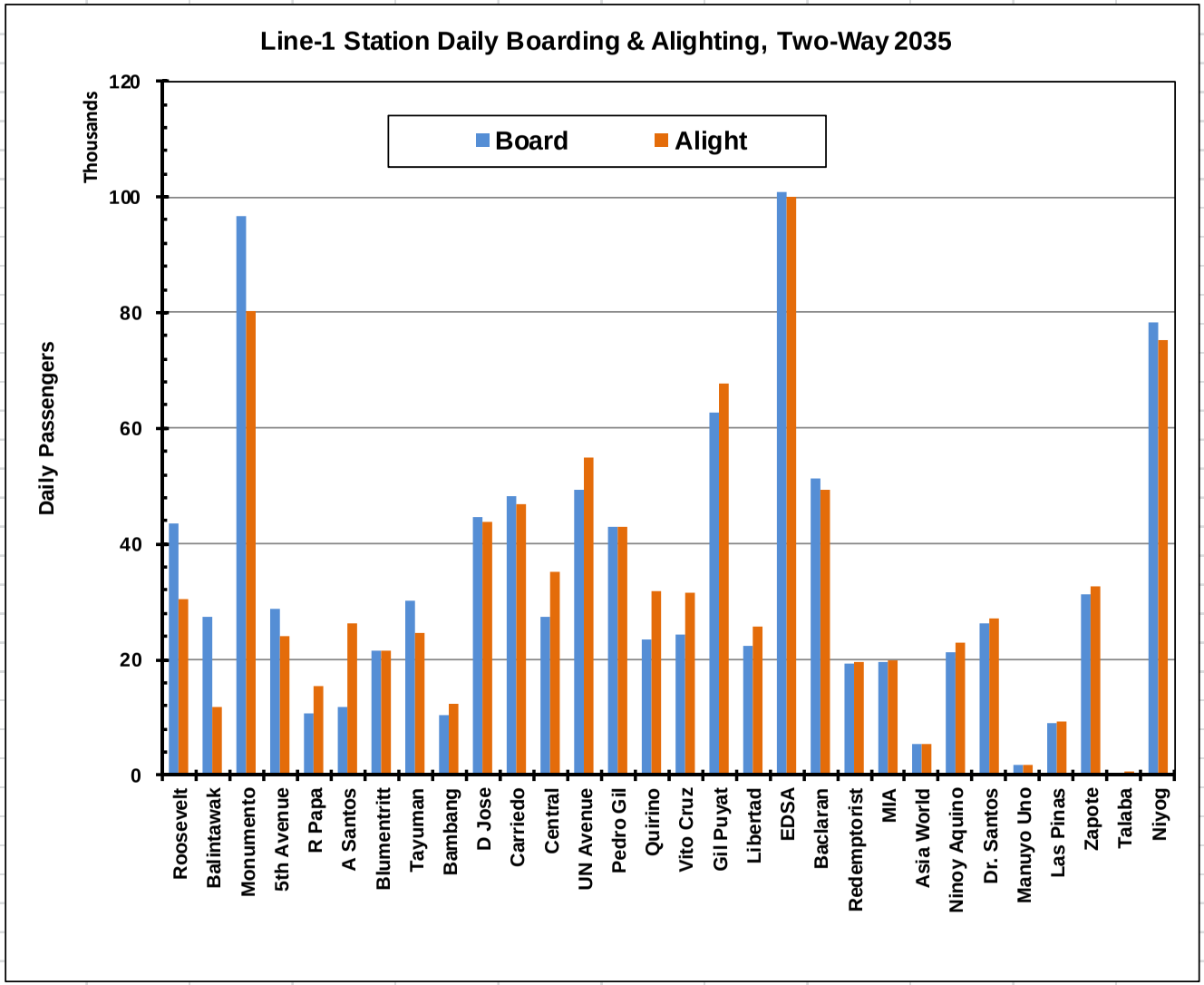
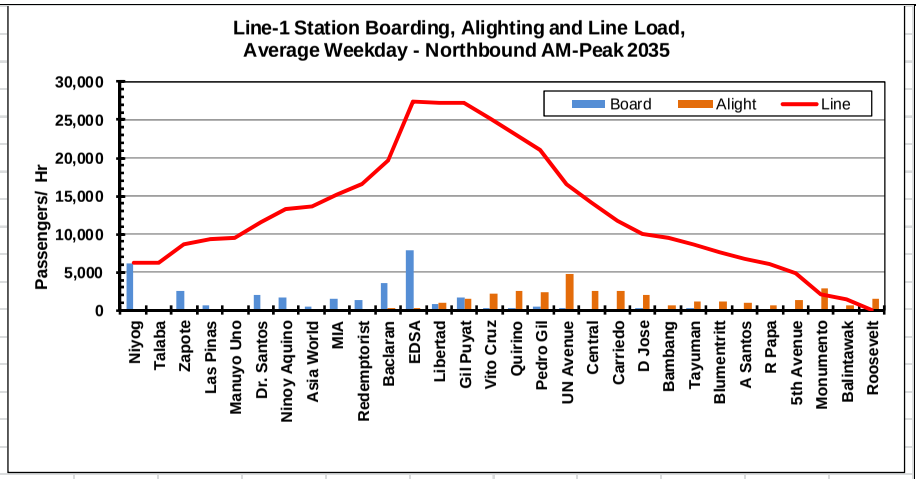


Table C.12 Line-1 AM Peak Hour (07:00-08:00) Station and Line Loading-2035

Northbound Niyog - Roosevelt			
Station	**Board**	**Alight**	**Line**
Niyog	6,197	-	6,197
Talaba	39	0	6,237
Zapote	2,467	4	8,700
Las Pinas	710	1	9,409
Manuyo Uno	133	0	9,541
Dr. Santos	2,076	10	11,607
Ninoy Aquino	1,669	7	13,270
Asia World	414	1	13,682
MIA	1,487	19	15,150
Redemptorist	1,414	9	16,556
Baclaran	3,530	362	19,724
EDSA	**7,961**	313	**27,371**
Libertad	824	990	27,205
Gil Puyat	1,616	1,565	27,256
Vito Cruz	251	2,262	25,245
Quirino	315	2,542	23,018
Pedro Gil	402	2,444	20,976
UN Avenue	233	**4,715**	16,494
Central	75	2,486	14,083
Carriedo	215	2,507	11,792
D Jose	300	1,977	10,115
Bambang	77	625	9,567
Tayuman	254	1,216	8,605
Blumentritt	149	1,149	7,605
A Santos	118	1,020	6,703
R Papa	92	644	6,151
5th Avenue	118	1,430	4,839
Monumento	70	2,821	2,089
Balintawak	3	583	1,508
Roosevelt	-	1,508	-
Total	**33,208**	**33,208**	
Maximum	**7,961**	**4,715**	**27,371**
Average Trip Length (km)			**10.87**
Two-Way	**75,381**	**75,381**	**11.93**

Southbound Roosevelt - Niyog			
Station	**Board**	**Alight**	**Line**
Roosevelt	5,455	-	5,455
Balintawak	3,879	1	9,333
Monumento	**12,177**	23	21,486
5th Avenue	3,601	46	25,041
R Papa	1,049	22	26,068
A Santos	1,234	43	27,258
Blumentritt	1,727	94	28,891
Tayuman	1,841	272	30,460
Bambang	621	111	30,969
D Jose	2,523	739	32,753
Carriedo	1,439	1,065	**33,127**
Central	505	973	32,659
UN Avenue	1,218	2,162	31,715
Pedro Gil	975	1,198	31,492
Quirino	835	1,304	31,022
Vito Cruz	788	1,415	30,395
Gil Puyat	1,174	5,924	25,645
Libertad	662	1,906	24,401
EDSA	174	**7,458**	17,117
Baclaran	127	2,826	14,418
Redemptorist	66	1,336	13,148
MIA	73	1,331	11,890
Asia World	4	374	11,519
Ninoy Aquino	21	1,567	9,972
Dr. Santos	3	1,837	8,138
Manuyo Uno	0	115	8,023
Las Pinas	1	637	7,387
Zapote	4	2,227	5,164
Talaba	0	37	5,127
Niyog	-	5,127	-
Total	**42,173**	**42,173**	
Maximum	**12,177**	**7,458**	**33,127**
Average Trip Length (km)			**12.77**
AM-PK Hour to Daily			**7.61%**



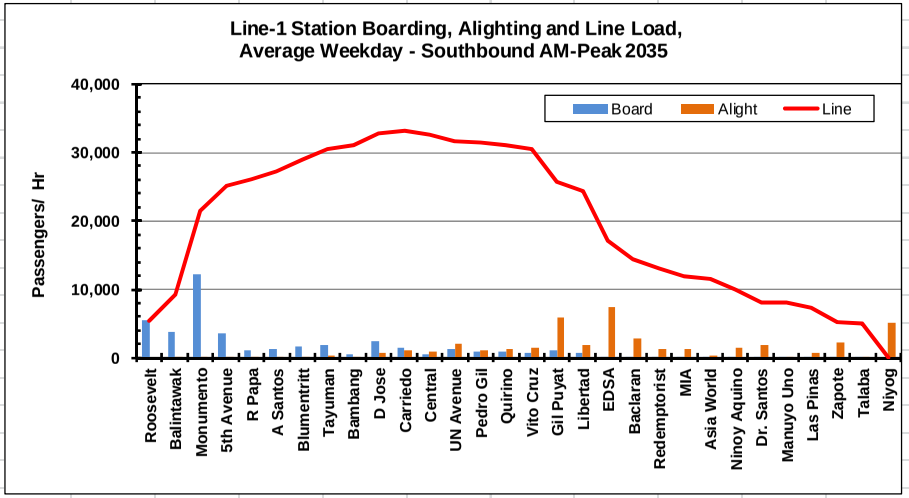


Table C.13 Line-1 Average Week Day Station Boarding and Alighting-2040

2-Way Boarding & Alighting		
Station	**Board**	**Alight**
Roosevelt	44,502	31,116
Balintawak	28,059	11,988
Monumento	98,837	81,923
5th Avenue	29,503	24,643
R Papa	10,953	15,703
A Santos	12,124	26,875
Blumentritt	21,880	21,963
Tayuman	30,802	25,087
Bambang	10,595	12,500
D Jose	45,667	44,892
Carriedo	49,421	47,917
Central	28,002	35,827
UN Avenue	50,449	56,143
Pedro Gil	43,807	43,846
Quirino	23,970	32,419
Vito Cruz	24,937	32,349
Gil Puyat	64,169	69,258
Libertad	22,832	26,258
EDSA	103,119	102,334
Baclaran	52,422	50,377
Redemptorist	20,180	20,689
MIA	20,450	20,824
Asia World	5,531	5,777
Ninoy Aquino	22,466	24,216
Dr. Santos	27,546	28,411
Manuyo Uno	1,767	1,783
Las Pinas	9,451	9,852
Zapote	32,832	34,439
Talaba	524	572
Niyog	82,203	79,019
Total	**1,019,000**	**1,019,000**
Maximum	**103,119**	**102,334**
Average Trip Length (km)		**11.56**

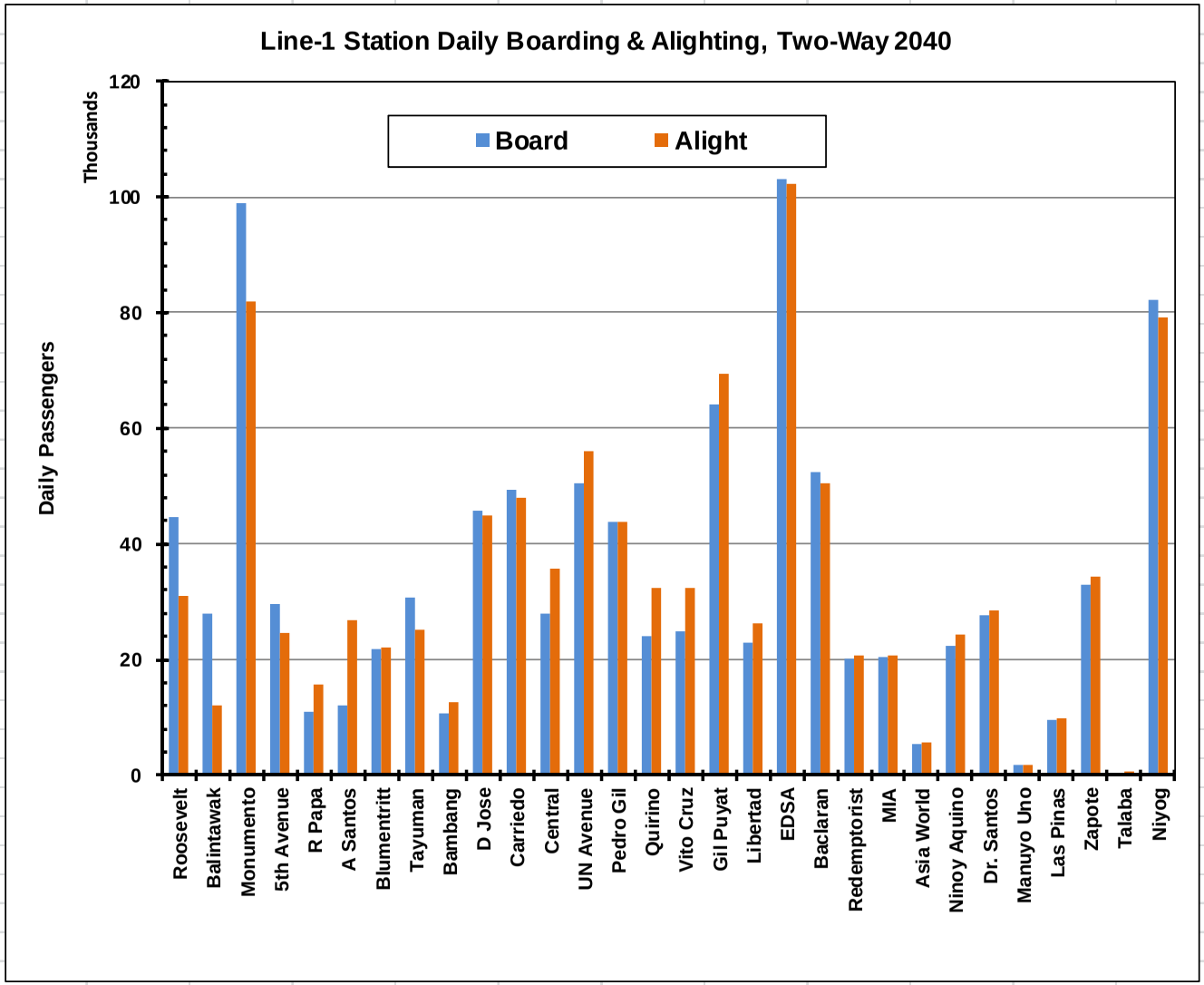
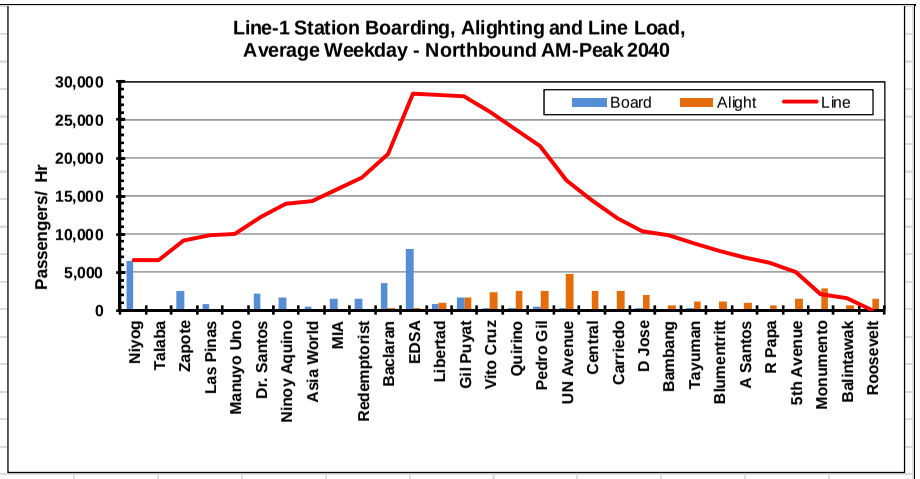


Table C.14 Line-1 AM Peak Hour (07:00-08:00) Station and Line Loading-2040

Northbound Niyog - Roosevelt			
Station	**Board**	**Alight**	**Line**
Niyog	6,512	-	6,512
Talaba	41	0	6,554
Zapote	2,592	5	9,141
Las Pinas	746	1	9,886
Manuyo Uno	140	0	10,025
Dr. Santos	2,181	11	12,195
Ninoy Aquino	1,753	7	13,941
Asia World	435	1	14,374
MIA	1,560	21	15,913
Redemptorist	1,481	10	17,385
Baclaran	3,600	386	20,598
EDSA	8,121	330	28,389
Libertad	831	1,038	28,182
Gil Puyat	1,630	1,643	28,169
Vito Cruz	250	2,341	26,078
Quirino	314	2,630	23,761
Pedro Gil	401	2,526	21,636
UN Avenue	232	4,870	16,999
Central	75	2,567	14,507
Carriedo	214	2,583	12,139
D Jose	300	2,037	10,402
Bambang	77	643	9,836
Tayuman	254	1,251	8,839
Blumentritt	149	1,180	7,808
A Santos	118	1,049	6,878
R Papa	92	661	6,309
5th Avenue	119	1,468	4,960
Monumento	71	2,894	2,137
Balintawak	3	597	1,542
Roosevelt	-	1,542	- 0
Total	**34,292**	**34,292**	
Maximum	8,121	4,870	28,389
Average Trip Length (km)			**10.94**
Two-Way	**77,534**	**77,534**	**12.01**

Southbound Roosevelt - Niyog			
Station	**Board**	**Alight**	**Line**
Roosevelt	5,584	-	5,584
Balintawak	3,967	1	9,550
Monumento	12,446	23	21,973
5th Avenue	3,680	47	25,606
R Papa	1,073	22	26,657
A Santos	1,262	43	27,876
Blumentritt	1,766	94	29,547
Tayuman	1,885	273	31,159
Bambang	636	112	31,684
D Jose	2,586	741	33,529
Carriedo	1,477	1,064	33,942
Central	519	973	33,488
UN Avenue	1,252	2,161	32,579
Pedro Gil	1,005	1,198	32,385
Quirino	861	1,304	31,942
Vito Cruz	813	1,415	31,339
Gil Puyat	1,230	5,999	26,570
Libertad	693	1,928	25,336
EDSA	183	7,619	17,900
Baclaran	135	2,884	15,152
Redemptorist	72	1,405	13,820
MIA	81	1,399	12,501
Asia World	4	394	12,112
Ninoy Aquino	23	1,648	10,486
Dr. Santos	3	1,932	8,558
Manuyo Uno	0	121	8,437
Las Pinas	1	670	7,768
Zapote	4	2,342	5,430
Talaba	0	39	5,392
Niyog	-	5,392	-
Total	**43,242**	**43,242**	
Maximum	12,446	7,619	33,942
Average Trip Length (km)			**12.85**
AM-PK Hour to Daily			**7.61%**



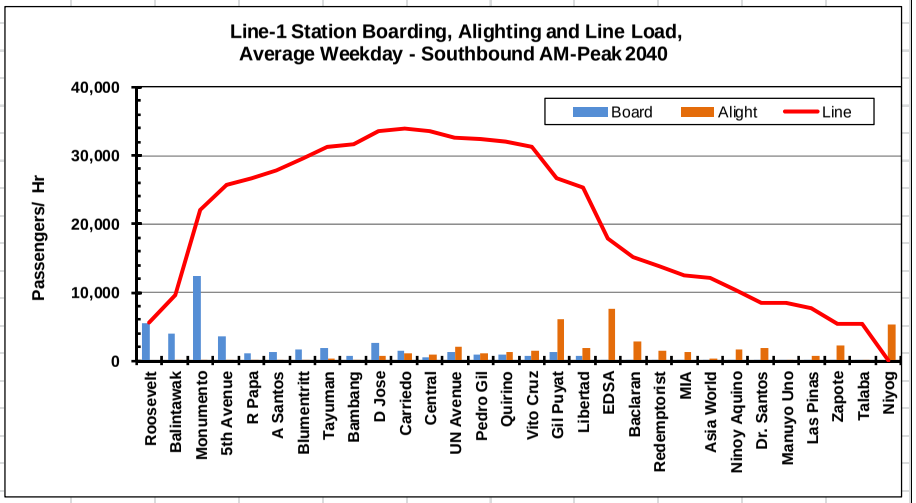


Table C.15 Line-1 Average Week Day Station Boarding and Alighting-2045

2-Way Boarding & Alighting		
Station	**Board**	**Alight**
Roosevelt	45,189	31,594
Balintawak	28,495	12,169
Monumento	100,362	83,186
5th Avenue	29,957	25,023
R Papa	11,121	15,944
A Santos	12,315	27,289
Blumentritt	22,216	22,306
Tayuman	31,278	25,473
Bambang	10,757	12,692
D Jose	46,369	45,580
Carriedo	50,182	48,657
Central	28,436	36,382
UN Avenue	51,227	57,011
Pedro Gil	44,485	44,522
Quirino	24,339	32,916
Vito Cruz	25,322	32,848
Gil Puyat	65,158	70,325
Libertad	23,186	26,663
EDSA	104,713	103,916
Baclaran	53,235	51,153
Redemptorist	20,951	21,474
MIA	21,230	21,615
Asia World	5,741	5,997
Ninoy Aquino	23,322	25,136
Dr. Santos	28,596	29,491
Manuyo Uno	1,835	1,851
Las Pinas	9,811	10,224
Zapote	34,087	35,750
Talaba	546	593
Niyog	85,339	82,020
Total	**1,039,800**	**1,039,800**
Maximum	**104,713**	**103,916**
Average Trip Length (km)		**11.62**

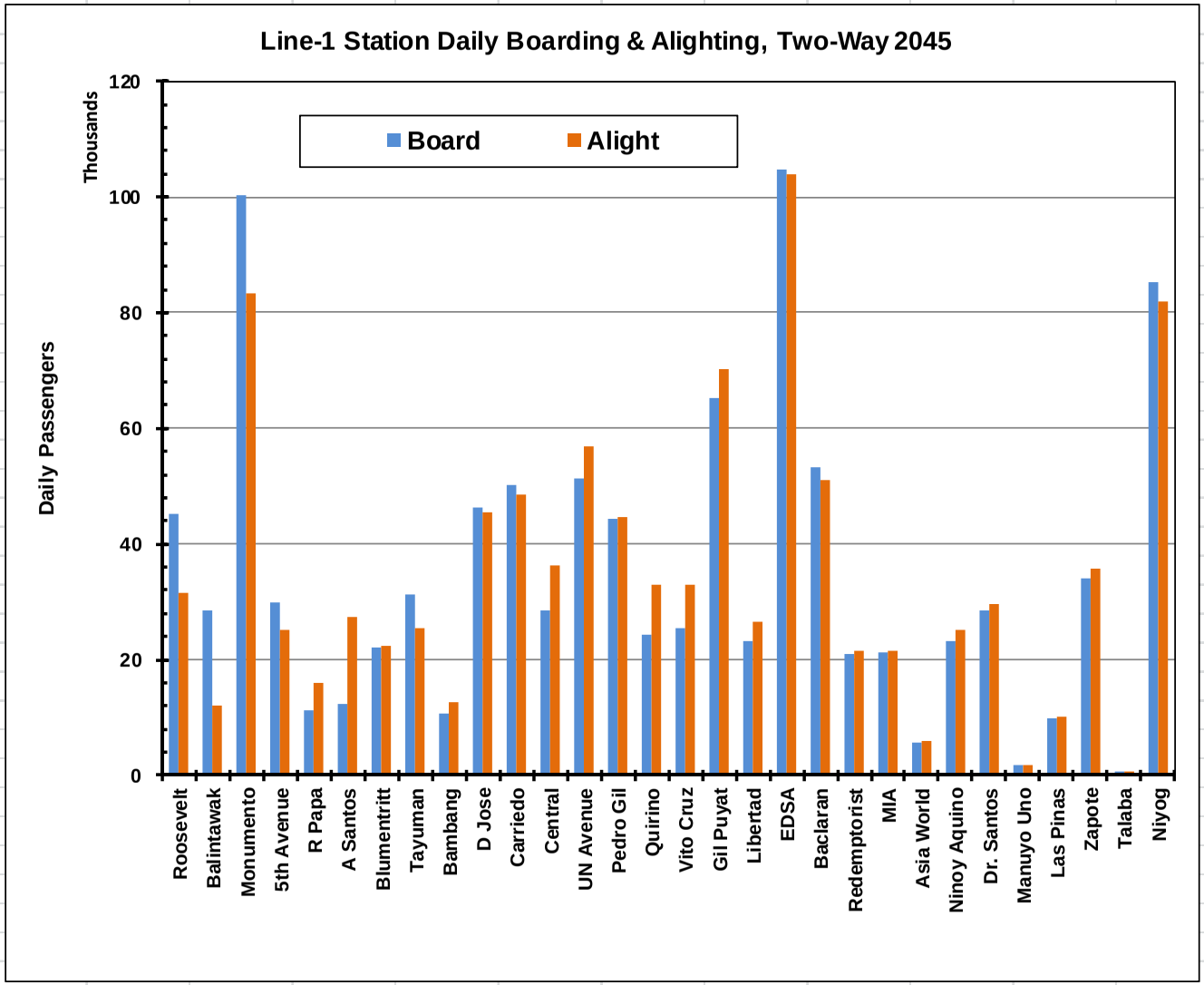
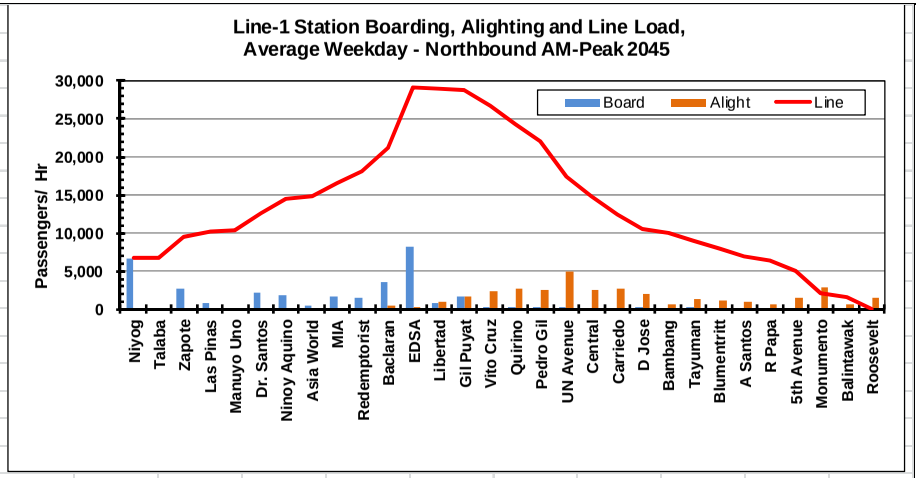
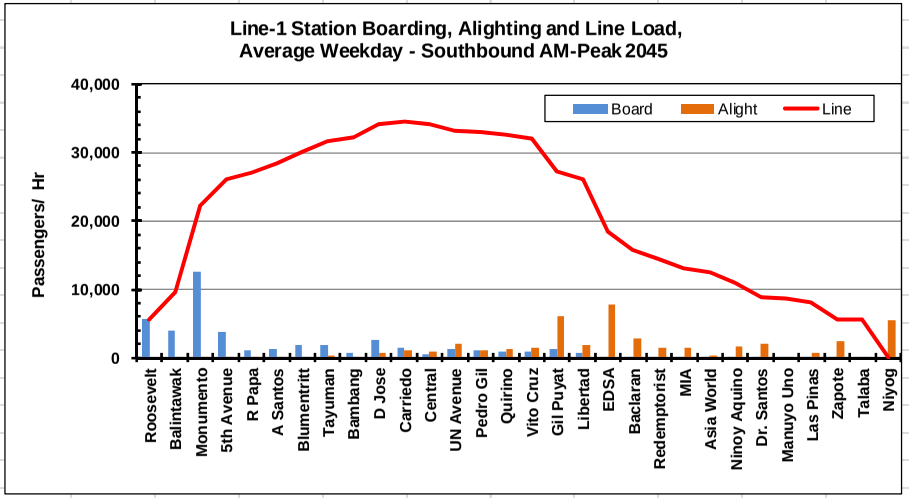


Table C.16 Line-1 AM Peak Hour (07:00-08:00) Station and Line Loading-2045

Northbound Niyog - Roosevelt			
Station	**Board**	**Alight**	**Line**
Niyog	6,759	-	6,759
Talaba	43	0	6,802
Zapote	2,690	5	9,487
Las Pinas	774	1	10,260
Manuyo Uno	145	1	10,405
Dr. Santos	2,264	12	12,657
Ninoy Aquino	1,818	8	14,467
Asia World	451	1	14,917
MIA	1,616	23	16,510
Redemptorist	1,533	10	18,033
Baclaran	3,648	407	21,275
EDSA	8,231	343	29,163
Libertad	834	1,076	28,920
Gil Puyat	1,637	1,704	28,853
Vito Cruz	248	2,401	26,700
Quirino	312	2,696	24,316
Pedro Gil	399	2,587	22,127
UN Avenue	231	4,985	17,373
Central	75	2,627	14,821
Carriedo	213	2,640	12,395
D Jose	300	2,082	10,613
Bambang	77	657	10,033
Tayuman	253	1,277	9,010
Blumentritt	149	1,203	7,956
A Santos	119	1,069	7,005
R Papa	92	674	6,423
5th Avenue	119	1,496	5,047
Monumento	71	2,947	2,171
Balintawak	3	607	1,566
Roosevelt	-	1,566	- 0
Total	**35,104**	**35,104**	
Maximum	8,231	4,985	29,163
Average Trip Length (km)			**10.99**
Two-Way	**79,116**	**79,116**	**12.06**

Southbound Roosevelt - Niyog			
Station	**Board**	**Alight**	**Line**
Roosevelt	5,677	-	5,677
Balintawak	4,029	1	9,704
Monumento	12,636	23	22,317
5th Avenue	3,735	47	26,005
R Papa	1,090	22	27,073
A Santos	1,282	43	28,312
Blumentritt	1,793	94	30,011
Tayuman	1,916	272	31,655
Bambang	647	111	32,191
D Jose	2,630	740	34,081
Carriedo	1,505	1,060	34,525
Central	529	971	34,084
UN Avenue	1,277	2,154	33,207
Pedro Gil	1,026	1,194	33,039
Quirino	880	1,300	32,620
Vito Cruz	831	1,411	32,040
Gil Puyat	1,273	6,043	27,270
Libertad	718	1,940	26,048
EDSA	191	7,732	18,507
Baclaran	143	2,923	15,727
Redemptorist	78	1,458	14,346
MIA	87	1,452	12,981
Asia World	4	409	12,577
Ninoy Aquino	24	1,711	10,890
Dr. Santos	4	2,006	8,887
Manuyo Uno	0	126	8,762
Las Pinas	1	696	8,068
Zapote	5	2,432	5,640
Talaba	0	40	5,600
Niyog	-	5,600	-
Total	**44,012**	**44,012**	
Maximum	12,636	7,732	34,525
Average Trip Length (km)			**12.92**
AM-PK Hour to Daily			**7.61%**





Appendix D: Traffic Survey

APPENDIX D - TRAFFIC SURVEY

1 Introduction

A high-investment project such as a railway line needs a project preparation study in order to establish its viability. One important input to the study is an estimate of the possible passenger transport demand that will use the service. Such estimate needs information on current passenger demand trends as well as vehicle traffic volumes along the proposed alignment of the service.

This report describes the methodology used in the survey conducted, data processing procedure and summary of general findings of the summary.

2 Survey Approach and Methodology

2.1 The Survey Area

The survey area covers a wide portion of Metro Manila and adjacent areas where existing LRT lines are operating and those corridors where proposed extensions of LRT Line 1 and LRT Line 2 will be put up.

a. Objectives of the Surveys

The main objectives of the surveys are as follows:

- To determine current vehicle traffic and passenger volumes along major corridors where LRT1 and LRT 2 are operating and those with their proposed extensions; and
- To determine current origin-destination patterns, socio-economic profiles of passengers using motor vehicles and those using LRT lines along the concerned corridors.

b. Description of Survey Methodology

Three (3) types of surveys were undertaken, namely:

- Traffic count survey;
- Vehicle occupancy survey; and
- Origin-Destination survey: Roadside interview of motor vehicle passengers and interview of LRT passengers at selected stations.

1) Traffic Count Survey

This is a roadside survey conducted in twelve (12) stations, as enumerated in **Table** 1.

Table 1 Traffic Count and Vehicles Occupancy Survey Locations

No.	Location Description
1	Marcos Highway (West of Sumulong Highway Junction) – Also O/D Site H-1
2	Marcos Highway (Between F. Mariano Av. & A. Rodriguez)
3	Marcos Highway (West of Santalon LRT Station on Footbridge)
4	Rizal Avenue (Between Tayuman Rd and Francis P Yuseco Rd)
5	Taft Ave (Between Vito Cruz and Sen. Gil Puyat Avenue)
6	Roxas Blvd (Between Airport Rd and NAIA Rd – Opposite Aseana Av.)
7	Cavite Expressway South of South Toll Plaza or River Crossing
8	Quririno Avenue Bridge
9	Ninoy Aquino at Imelda Bridge
10	Evangelista St. Just west of Niog Rd Junction
11	Aguinaldo Highway (Between Niog St and Molino Blvd) – Also O/D Site H-2
12	Molino Blvd – North of Ilang-Ilang

The counts were made by vehicle type, by direction for a 16-hour duration (6:00am - 10:00pm) on a weekday. The vehicle types considered in the counts are shown in **Table 2**.

Table 2 Vehicle Classification

No.	Vehicle Type Description	Vehicle Occupancy
1	Cyclo/Motorcycle/Tricycle	All Occupants including driver
2	Private Car/Sedan	All Occupants including driver
3	Public Taxi	All Occupants including driver
4	SUV/Van	All Occupants including driver
5	AUV . Public FX	All Occupants including driver
6	Jeepney	All Occupants including driver
7	Mini Bus	All Occupants including driver
8	Local Public Bus (Aircon, Ordinary)	All Occupants including driver
9	Long Distance (Provincial) Bus	All Occupants including driver
10	Delivery vehicles, 2 axle trucks, other 2 axle vehicle (no occupancy)	
11	Trucks or other goods vehicles with 3 or more axles No Occupancy	

The survey dates are shown in **Table 3.**

Table 3 Schedule of Surveys: Classified Vehicle Traffic Count

Dates	Survey Stations
26 June 2012 (Tuesday)	Station 5: Taft Ave (Between Vito Cruz and Sen Gil Puyat Ave)
	Station 6: Roxas Blvd (Between Airport Rd & NAIA Rd . Opposite Aseana Av)
	Station 8: Quirino Avenue Bridge
	Station 9: Ninoy Aquino at Imelda Bridge
27 June 2012 (Wednesday)	Station 1: Marcos Highway (West of Sumulong Highway Junction)
	Station 2: Marcos Highway (Between F. Mariano Ave & A Rodriguez)
	Station 3: Marcos Highway (West of Santolan LRT Station on Footbridge)
	Station 4: Rizal Avenue (Between Tayuman Rd and Francis P Yuseco Rd)
28 June 2012 (Thursday)	Station 7: Cavite Expressway South of South Toll Plaza or River Crossing
	Station 10: Evangelista St (West of Niog Rd Junction)
	Station 11: Aguinaldo Highway (Between Niog St & Molino Blvd)
	Station 12: Molino Blvd (North of Ilang-Ilang)

To ensure more accuracy in the data gathered, the following measures were followed in the conduct of the survey:

- Manual counting of vehicles was done using the form shown in **Figure 1**. Each vehicle passing through the station was marked by crossing a number listed consecutively in the form. The last number crossed indicated the total vehicle count for a given period. Vehicle counts were recorded every 30 minutes.
- All vehicles, i.e., 100% passing the station were counted.
- Each surveyor was assigned not more than two vehicle types to be counted.
- Relievers were provided to replace a surveyor who took time out to rest or to do personal necessities. and
- No surveyor worked for more than one (1) eight-hour shift in a survey day.

Field Survey Form	TRAFFIC COUNT SURVEY	TTPI

Station Code:	Direction	Recorder: .....
Station Name:	From:	Supervisor: .....
Date:	To:	Checker: .....
Weather:		Encoder:

Time Period: From: _____ To: _____

Vehicle Type: ( ) _____

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165
166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195
196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225
226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255
256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
271	272	273	274	275	276	277	278	279	280	281	282	283	284	285
286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315
316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
331	332	333	334	335	336	337	338	339	340	341	342	343	344	345
346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375
376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
391	392	393	394	395	396	397	398	399	400	401	402	403	404	405
406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435
436	437	438	439	440	441	442	443	444	445	446	447	448	449	450
451	452	453	454	455	456	457	458	459	460	461	462	463	464	465
466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495
496	497	498	499	500	501	502	503	504	505	506	507	508	509	510
511	512	513	514	515	516	517	518	519	520	521	522	523	524	525
526	527	528	529	530	531	532	533	534	535	536	537	538	539	540

30 mins. Total: _____

Vehicle Type: ( ) _____

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165
166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195
196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225
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256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
271	272	273	274	275	276	277	278	279	280	281	282	283	284	285
286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315
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331	332	333	334	335	336	337	338	339	340	341	342	343	344	345
346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375
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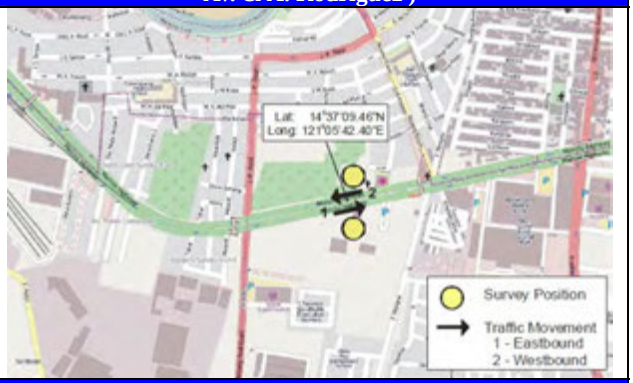
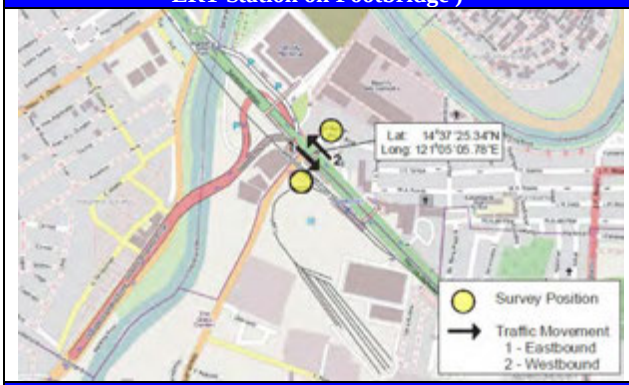
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435
436	437	438	439	440	441	442	443	444	445	446	447	448	449	450
451	452	453	454	455	456	457	458	459	460	461	462	463	464	465
466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495
496	497	498	499	500	501	502	503	504	505	506	507	508	509	510
511	512	513	514	515	516	517	518	519	520	521	522	523	524	525
526	527	528	529	530	531	532	533	534	535	536	537	538	539	540

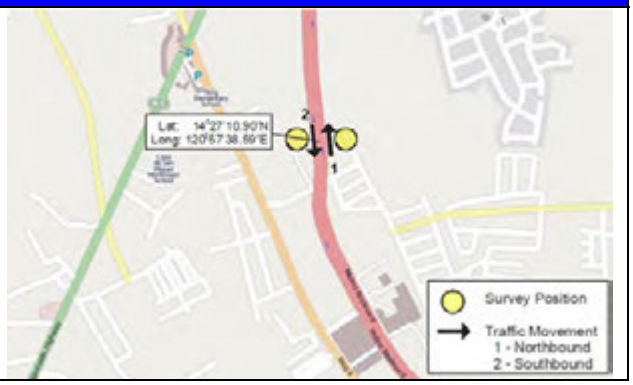
30 mins. Total: _____

Figure 1 Traffic Count Survey Form

Table 4 shows the location maps of all survey stations.

Table 4 Survey Location

Survey Location 1, Marcos Highway (West of Sumulong Highway Junction)	Survey Location 2, Marcos Highway (Between F. Mariano Av. & A. Rodriguez)
	
Survey Location 3, Marcos Highway (West of Santalon LRT Station on Footbridge)	**Survey Location 4, Rizal Avenue (Between Tayuman Rd and Francis P Yuseco Rd)**
	
Survey Location 5, Taft Ave (Between Vito Cruz and Sen. Gil Puyat Avenue)	**Survey Location 6, Roxas Blvd (Between Airport Rd and NAIA Rd – Opposite Aseana Av.)**
	

Survey Location 7, Cavite Expressway (South of South Toll Plaza or River Crossing)	Survey Location 8, Quririno Avenue Bridge
	
Survey Location 9, Ninoy Aquino at Imelda Bridge	**Survey Location 10, Evangelista St. Just west of Niog Rd Junction**
	
Survey Location 11, Aguinaldo Highway (Between Niog St and Molino Blvd)	**Survey Location 12, Molino Blvd: North of Ilang-Ilang**
	

2) Vehicle Occupancy Survey

This survey was conducted simultaneously with the classified vehicle traffic counts at the same survey stations shown in **Table 3**. This determined the volume of passengers inside an observed vehicle passing a given station. In as much as the observed vehicles were moving, the best way the surveyors did was to determine the best estimate of passenger volume of each observed vehicle.

In the case of buses, the estimated occupancy rate was recorded in terms of percent (%) occupancy in relation to vehicle seating capacity i.e., 100% full means all seats were occupied, 50% full means half of the sets were occupied. For buses with standing passengers, occupancy was recorded as 100% full plus number of standing passengers.

Passenger volumes were computed later by multiplying the occupancy rate with seating capacity. For vehicles with dark windows, the surveyor recorded the passenger volume of a vehicle with similar size,

with clear window.

The survey was conducted at random for all passing vehicles, for each vehicle type shown in **Table 2**. Vehicle occupancy determination was made for at least 20% of all passing vehicles, by direction, by vehicle type. Data recording was made for every 30-minute interval during a 16-hr period (6:00am to 10:00pm). One surveyor was assigned to one vehicle type.

To ensure data accuracy for this survey, relievers were fielded to substitute the surveyors when they had to attend to important personal matters. Furthermore, no surveyor worked for more than one 8-hour shift. The survey locations are same with that of traffic counting survey.

Figure 2 Vehicle Occupancy Survey Form (Bus) show the survey form used for other mode and bus, respectively.

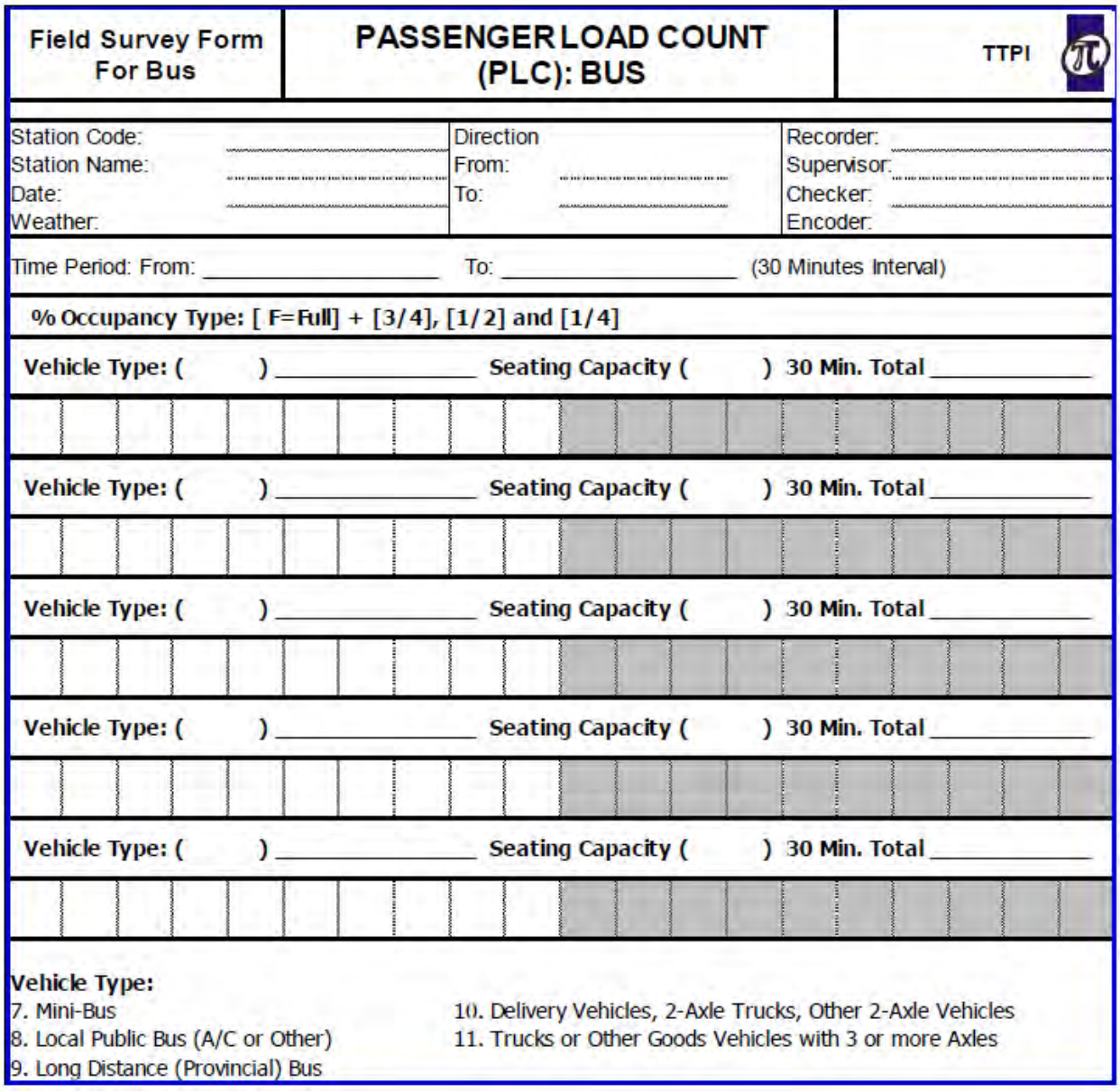


Figure 2 Vehicle Occupancy Survey Form (Bus)

3) Origin and Destination (O/D) Surveys

This is an interview type survey of public transport passengers. The survey locations are shown in **Table 5**.

Table 5 OD Survey Locations

No.	Location Description
H-1	Marcos Highway (West of Sumulong Highway Junction)
H-2	Aguinaldo Highway (Between Niog St and Molino Blvd)
S-1	Roosevelt Station (Entry & Exit 100 Sample Each of Entering and Existing Passengers) Total of 200 samples
S-2	EDSA Station (Entry & Exit 100 Sample Each of Entering and Existing Passengers) Total of 200 samples
S-3	Baclaran Station (Entry & Exit 200 Sample Each of Entering and Existing Passengers) Total of 400 samples
S-4	Santolan Station (Entry & Exit 200 Sample Each of Entering and Existing Passengers) Total of 400 samples
S-5	Taft Station (Entry & Exit 100 Sample Each of Entering and Existing Passengers) Total of 200 samples

a. Roadside Interview

As shown in the above table, two (2) of the stations were located at road sections, namely, Marcos Highway (west of Sumulong Junction) and Aguinaldo Highway (Between Niyog St. and Molino Blvd). The survey technique used was the Roadside Interview Survey (RSI), where randomly selected vehicles were stopped at the roadside (per direction) and randomly selected passengers in the selected vehicle were interviewed. Survey duration was for 16-hours per station (6:00am to 10:00pm). The surveys were conducted simultaneously with the traffic count and vehicle occupancy surveys at the said stations.

Sampling size was targeted at not less than 5% of all passing vehicles in the station per direction. Inasmuch as the survey involved stopping of vehicles at the roadside, the survey team was assisted by local policemen in stopping selected vehicles. The vehicles subjected to the survey were: private cars, jeepneys, AUVs or FX and Buses.

For each vehicle sample, the number of passengers interviewed (randomly selected) were: one (1) for private car (usually the driver), minimum of two (2) passengers for each FX and jeepney vehicle and 2 to 3 passengers of bus passengers. Car drivers, jeepney and FX passengers were interviewed from the outside, i.e., interviewers stayed outside the vehicles. However, bus passengers were interviewed inside buses. Data were recorded in 30-minute intervals. The questionnaires to be used in the survey are shown **Figure 3** to **Figure 5**.

To ensure better accuracy of the survey, one surveyor was assigned to one vehicle type only, relievers were fielded to substitute surveyors who had to take a break due to personal matter, and no surveyor worked for more one 8-hour shift. **Table 6** shows the survey locations of the two stations.

Roadside Interview Survey **Passenger Interview** Form 1 - Private Mode	JICA Study for Enhancement of Railway Network System in Metro Manila	

Control No:

Station Name : _____ Date : _____

Interviewer : _____ Direction : _____

Weather : _____

Survey Data (For Office Use)			
Time:	____ : ____	____ : ____	____ : ____
1.Mode of Travel 1. Cyclo/Motorcycle 2. Private Car/ Sedan/ SUV/ Open Back	☐	☐	☐
2.Origin Barangay/City - Municipality / Province	_____ _____ (H/A) ☐ ☐☐☐	_____ _____ (H/A) ☐ ☐☐☐	_____ _____ (H/A) ☐ ☐☐☐
3. Destination Street / Barangay City / Municipality / Province	_____ _____ (H/A) ☐ ☐☐☐	_____ _____ (H/A) ☐ ☐☐☐	_____ _____ (H/A) ☐ ☐☐☐
4. Trip Purpose 1. To Home 2. To Work 3. Education 4. Business 5. Others	☐	☐	☐
5. No. of Passengers (Including Driver)	☐☐	☐☐	☐☐
6. Seating Capacity	☐☐	☐☐	☐☐
7. Home Address: _____ Street/Barangay _____ City/Municipality _____ Province			☐☐☐

Figure 3 Origin-Destination Form 1 (Private Mode – Passenger)

Roadside Interview Survey **Passenger's Interview** Form 2 - Public Mode	JICA Study for Enhancement of Railway Network System in Metro Manila	

Control No:

Station Name : _____ Date : _____

Interviewer : _____ Direction : _____

Weather : _____

Survey Data: (For Office Use)			
Time:	____ : ____	____ : ____	____ : ____
1. Vehicle Type 1. Tricycle 2. Public Taxi 3. AUV/Public FX 4. Jeepney 5. Mini-Bus 6. Local Public Bus (Air Con or Other) 7. Long Distance Bus (Provincial Bus)	☐	☐	☐
2. Origin Barangay/City - Municipality / Province	_____ _____ (H/A) ☐ ☐☐☐	_____ _____ (H/A) ☐ ☐☐☐	_____ _____ (H/A) ☐ ☐☐☐
3. Destination Barangay/City - Municipality / Province	_____ _____ (H/A) ☐ ☐☐☐	_____ _____ (H/A) ☐ ☐☐☐	_____ _____ (H/A) ☐ ☐☐☐
4. Trip Purpose 1. To Home 2. To Work 8. Education 4. Business 5. Others	☐	☐	☐
7. Home Address: _____ Street/Barangay _____ City/Municipality _____ Province			☐☐☐

Figure 4 Origin-Destination Form 2 (Public Mode - Passenger)

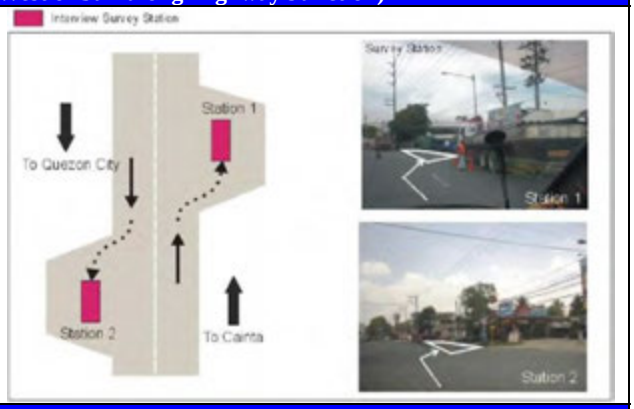
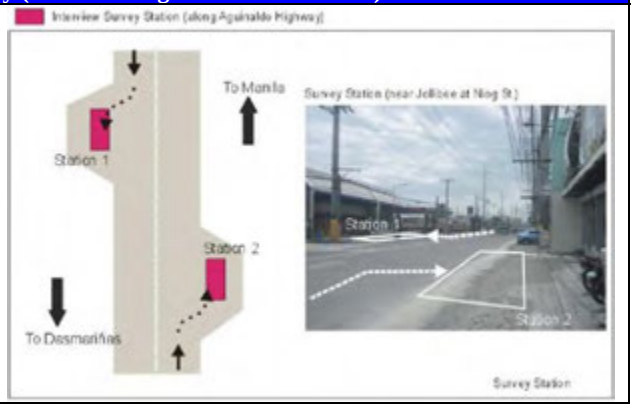
Roadside Interview Survey **Driver's Interview** Form 3 - Public Mode	JICA Study for Enhancement of Railway Network System in Metro Manila	

Control No:
Station Name : _____ Date : _____ Interviewer : _____ Direction : _____ Weather : _____

Survey Data: (For Office Use)	☐☐☐☐☐
1. PT Routes Details: From: _____ ☐☐☐ To: _____ ☐☐☐	
2. No. of Passengers (Including Driver)	☐☐
3. Seating Capacity	☐☐

Figure 5 Origin-Destination Form 3 (Public Mode - Driver)

Table 6 Survey Location of O/D Interview Survey

Survey Location 1, Marcos Highway (West of Sumulong Highway Junction)	
	
Survey Location 2, Aguinaldo Highway (Between Niog St and Molino Blvd)	
	

b. O/D Interview at LRT/MRT Stations

As shown in **Table 7** passenger interviews were conducted at five (5) LRT stations, namely:

- Roosevelt Station (LRT1)
- EDSA Station (LRT1)
- Baclaran Station (LRT1)
- Santolan Station (LRT2)
- Taft Station (MRT)

The survey durations for all stations are: 7:00 to 9:00 am (covering the morning peak hours) and 5:00 to 7:00pm (covering the evening peak hours). The interviews were undertaken on a random sampling basis for both entering and exiting passengers in the stations. The target sample sizes are specified in **Table 7.**

To ensure better accuracy of the survey, separate staff was assigned for each entry and exit interviews per station and relievers were fielded as surveyor substitute.

Table 7 Sample Size per LRT Station

Name of Station	No. of Samples 7:00 to 9:00 am (2hrs)			No. of Samples 5:00 to 7:00 pm (2hrs)		
	Entry	Exit	Total	Entry	Exit	Total
LRT1: Roosevelt Station 200 samples)	50	50	100	50	50	100
LRT1: EDSA Station (200 samples)	50	50	100	50	50	100
LRT1: Baclaran Station (400 samples)	100	100	200	100	100	200
LRT2: Santolan Station (400 samples)	100	100	200	100	100	200
MRT: Taft Station (200 samples)	50	50	100	50	50	100
Total (1,400 samples)	350	350	700	350	350	700

The questionnaire to be used in the survey is shown in **Figure 6**.

Department of Transportation and Communications

JICA Study for Enhancement of Railway Network System in Metro Manila

RAIL PASSENGER O-D SURVEY

Sequential No.: ☐☐☐☐ *(for office use only)*

Surveyor: _____ ☐☐

Questionnaire for LRT users

Date: _____ ☐☐☐☐

Time: _____ : _____ ☐☐ : ☐☐

Direction: LRT 1- 1. Northbound 2. Southbound ☐
Direction: LRT 2- 3. Eastbound 4. Westbound
Direction: MRT3- 5. Northbound 6. Southbound

Mode: 1. LRT 1 2. LRT 2 3. MRT3 ☐

Socio-Economic Profile

Age: _____ ☐☐

Gender: 1. Male 2. Female ☐

Income: (Personal Monthly Income) ☐

1. No Income
2. Below 5,000
3. 5,000 - 9,999
4. 10,000 - 14,999
5. 15,000 - 19,999
6. 20,000 - 24,999
7. 25,000 - 29,999
8. 30,000 - 39,999
9. 40,000 - 49,999
10. 50,000 - 59,999
11. 60,000 - 69,999
12. Above ₱70,000

Occupation: ☐

1. Student
2. Employed/Worker
3. Unemployed
4. Businessman/Self –Employ
5. Professional/Executive

Trip Details

Boarding Location/Sta (B): _____ ☐☐☐

Origin (O): _____ ☐☐☐
Brgy City/Municipality
(H/A) ☐

Main mode to Boarding (O-B): _____ ☐☐

Fare Paid for Main mode: ₱ _____ ☐☐☐

Trip Purpose: ☐

1. To Home
2. To Work
3. Education
4. Business
5. Others

Alighting (A): _____ ☐☐☐

Destination (D): _____ ☐☐☐
Brgy City/Municipality
(H/A) ☐

Other mode to Destination (A-D): _____ ☐☐

Fare Paid for Other Mode ₱ _____ ☐☐☐

Total Travel Time(Estimation):Min _____ ☐☐☐

Mode Type: *(reference for other modes used)*

1. Cyclo/Motorcycle/Tricycle
2. Private Car/ Sedan/ SUV/ Open Back
3. Delivery Vehicles, 2-Axle Truck and Other 2-Axle Veh.
4. Trucks and Other Delivery Vehicles (3 or more Axle)
5. Public Taxi
6. AUV/Public FX
7. Jeepney
8. Mini-Bus
9. Local Public Bus (Air Con or Other)
10. Long Distance Bus (Provincial Bus)
11. LRT/MRT
12. Others _____

7. Home Address:

_____ _____ _____ ☐☐☐
Street/Barangay City/Municipality Province

Figure 6 Railway Passenger's Origin-Destination Form

3 Data Processing

3.1 Data Processing Activities

Data processing involved three (3) main stages, namely:

- Data checking - consists of validation and logical checking,
- Data coding - consists of marking codes to each data item for entry into the database system, and
- Data encoding - consists of entry of coded data into the computer, using the data base system.

The general process is shown in **Figure 7**.

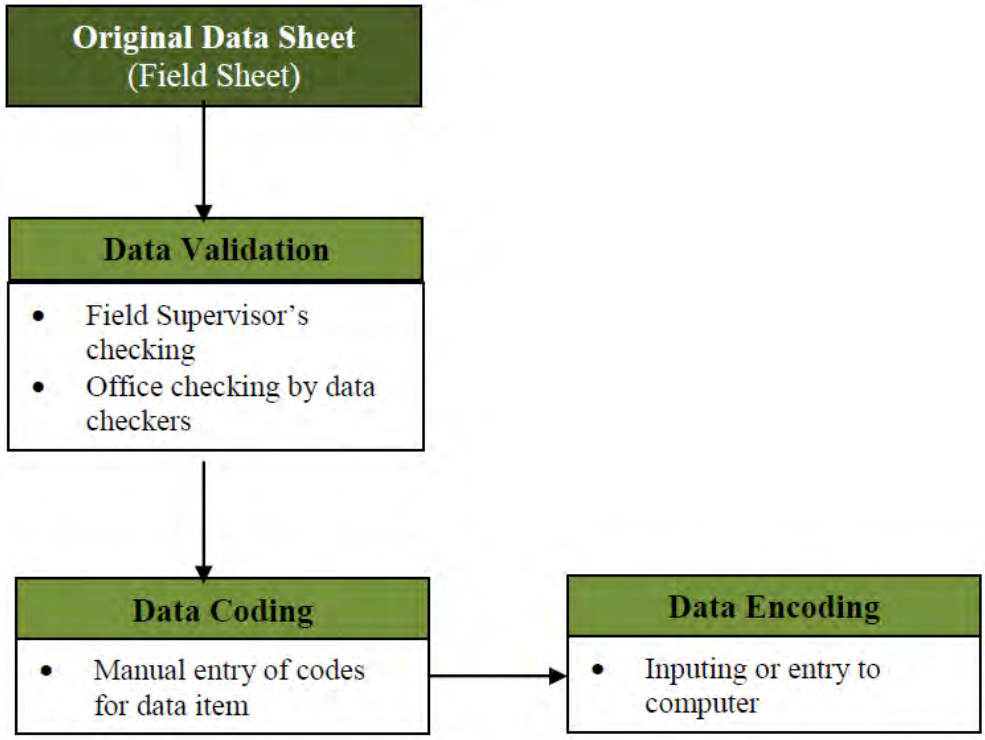


Figure 7 Data Processing Activities

Prior to data validation, the data processing team had already designed the database system.

The software used is Microsoft Office Access. Microsoft Office Access, previously known as Microsoft Access, is a relational database management system from Microsoft that combines the relational Microsoft Jet Database Engine with a graphical user interface and software development tools. It is a member of the Microsoft Office suite of applications included in the Professional and higher released editions.

Access stores data in its own format based on the Access Jet Database Engine. It can also import or link directly to data stored in other Access databases, Excel, SharePoint lists, text, XML, Outlook, HTML, dBase, Paradox, Lotus 1-2-3 software.

"Microsoft Access is used to create simple database solutions. Access tables support a variety of standard field types, indices, and referential integrity. Access also includes a query interface, forms to display and enter data, and reports for printing. The underlying Jet database, which contains these objects, is multiuser-aware and handles record-locking and referential integrity including cascading updates and deletes. Simple tasks can be automated through macros with point-and-click options".

3.2 Data Validation

To minimize errors in data generated from the field survey, field survey sheets shall be checked as to accuracy and reliability. This involved a two-stage process, to wit:

a) Upon completion of the survey, i.e., when surveyors accomplished the forms, the surveyors ascertained that all needed information were correct and complete, e.g., location, date of survey, direction and other identification parameters. The surveyors submitted the accomplished form to the supervisor. The supervisor, upon receipt of the accomplished form from the surveyors examined each data sheet and the corresponding data entries for consistency, believability, in other words the "logic" of the data. Following methodology was applied for data validation per survey:

For traffic count data:

- Excessive deviation from realistic volumes e.g., a total hourly volume in a 3-lane section of say, 3,000 vehicles during an off-peak hour or an unbelievably low volume in the same section of say 300 vehicles during a peak hour. Cases like this had to be corrected.
- Unusual rise or drop of hourly traffic volume from a one-hour period to the next one hour period. For example, for a given road section, the 9:00am to 10:am volume is 650 vehicles, then from 10:00am to 11:00am the counted volume is 2500 vehicles, and from 11:00am to 12:00 noon, the counted volume drops to 400 vehicles. Cases like this had to be checked carefully.

For passenger load data:

- Unusual occupancy load of jeepneys such as 35 or 42, of buses such as 300 or 500. These show excessive unbelievable data as against seating capacities of said vehicles. These cases have to be checked.

For OD survey data:

After the surveyor had completed an interview, he/she checked the accomplished form for completion of data, such as location, date, etc. as well as completion of all OD data entries. Accomplished forms were submitted to the OD survey supervisor. The OD survey supervisor reviewed all accomplished forms, in accordance with the following general principles:

- Completeness of information (i.e., all required data should be written in the forms);
- (ii) Correctness and consistency of information, such as:
  - ✧ total household income versus the sum of individual incomes of household members;
  - ✧ income versus occupation, i.e., indicated income should be consistent with the salary range for a given occupation;
  - ✧ origin, destination, and transfer points (a reference map of the survey area should be available);
  - ✧ origin, destination, and transfer points in relation to modes used and routes taken;
  - ✧ travel time and transportation cost versus origin-destination patterns;
  - ✧ number of household members versus number of accomplished individual forms;
  - ✧ and others.

b) All accomplished/checked/validated data from the survey supervisors were submitted to the data checking group. The validated data were reviewed by office data checkers in accordance with the same general principles explained above. In effect, data validation was done twice, first by supervisors, then by office data checkers. This is based on a "check-and-balance" principle.

3.3 Data Coding

Double-checked data were be "coded" by data coders. The database system includes a coding system, assigning preferably numerical codes to each data item. In the checked survey forms are code boxes

where numerical codes per data item have specified ranges. For example:

Trip Purpose	Code
Home	1
Work	2
School	3
Business	4
Private	5
Others	6

Coding of Trip Purpose therefore, would have valid codes of 1 to 6. Coders took extra care in writing the numerical codes and the allowable range. All other data items have their corresponding numerical codes and ranges, and coding was done in the same manner as explained above.

3.4 Data Encoding

The coded data on the checked and coded data forms were turned over to the data encoders. This group manually entered into the computer the codes for all data items in each survey sheet. The use of numerical codes facilitated data encoding because encoders focused on “number keys” to be pressed.

The database system was designed in such a way that entry or encoding errors can be detected right away, such as non-acceptance by the computer of invalid codes, i.e., those outside the specified ranges for each data item.

Data processing activity involved an “inquiry system” among surveyors, supervisors, data checkers, data coders and data encoders. This” inquiry system” flow is shown in the chart below:

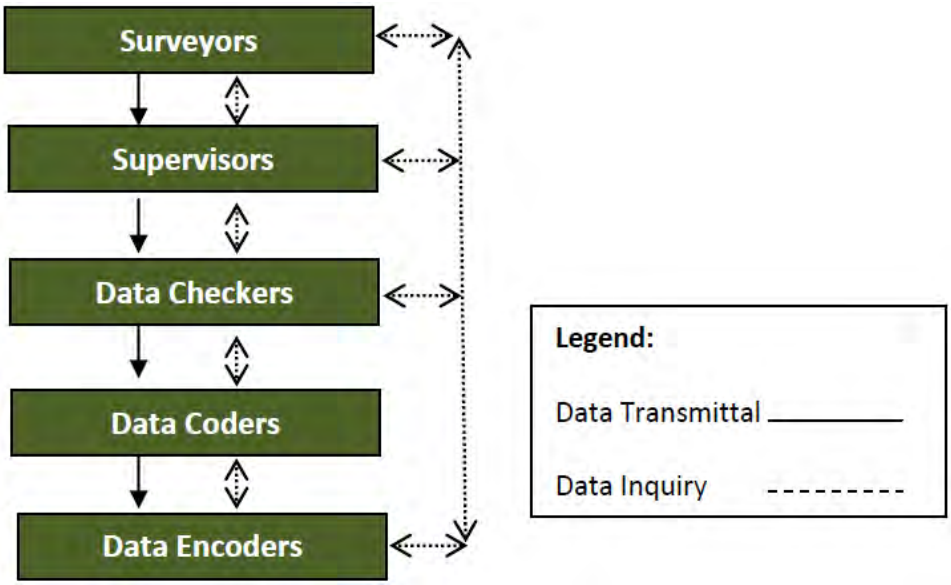


Figure 8 Data Processing Inquiry System Flow

3.5 Data Acceptance Sampling

The encoded data in the data base system are all valid data because the data checking process has corrected errors in the data gathered. Furthermore, there are no invalid records because incomplete replies by respondents who refused to be further interviewed on most questions were automatically discarded and were not included in the data checking. The data checking procedure is described below. The table below shows the procedure done for OD survey data checking.

4 Survey Results

Summary tables of all surveys conducted are presented here.

5 Traffic Count Survey

Table 8 shows the total 16-hour traffic volume by direction, by vehicle type for all stations.

Table 8 Summary of 16-Hour Vehicle Traffic Count Volume (All Stations)

Station	Direction	Cyclo/Motor-cycle/Tricycle	Pvt. Car	SUV/Van	Public Taxi	AUV/ Public FX	Jeepney	Mini-bus	Local Public Bus	Long Dist. Provincial Bus	Delivery Veh. (2-axle Truck)	Trucks (3 or more axles)	Total
1. Marcos Highway	EB	10,072	15,048	5,578	1,476	1,258	6,097	0	18	8	1,762	2,066	41,317
	WB	11,401	16,187	3,383	1,951	1,139	6,190	0	67	12	2,957	2,856	43,287
	Bothways	**21,473**	**31,235**	**8,961**	**3,427**	**2,397**	**12,287**	**0**	**85**	**20**	**4,719**	**4,922**	**84,604**
2. Marcos Highway	EB	9,085	15,847	5,421	3,496	2,130	5,229	0	28	10	2,802	1,178	44,048
	WB	7,905	18,749	2,956	3,234	2,039	5,537	10	49	5	2,343	1,640	42,827
	Bothways	**16,990**	**34,596**	**8,377**	**6,730**	**4,169**	**10,766**	**10**	**77**	**15**	**5,145**	**2,818**	**86,875**
3. Marcos Highway	EB	8,465	20,472	4,155	4,353	2,401	5,174	0	50	9	2,074	1,830	47,153
	WB	7,291	14,504	3,361	3,819	2,099	5,327	0	31	18	2,528	2,010	38,978
	Bothways	**15,756**	**34,976**	**7,516**	**8,172**	**4,500**	**10,501**	**0**	**81**	**27**	**4,602**	**3,840**	**86,131**
4. Rizal Avenue	NB	3,270	913	333	146	17	5,168	2	0	0	189	0	10,038
	SB	4,536	1,427	411	302	12	4,940	1	0	1	345	10	11,975
	Bothways	**7,806**	**2,340**	**744**	**448**	**29**	**10,108**	**3**	**0**	**1**	**534**	**10**	**22,013**
5. Taft Avenue	NB	959	1,073	644	1,103	342	2,459	3	824	387	291	59	8,085
	SB	1,322	1,346	455	547	927	2,639	0	711	214	134	31	8,295
	Bothways	**2,281**	**2,419**	**1,099**	**1,650**	**1,269**	**5,098**	**3**	**1,535**	**601**	**425**	**90**	**16,380**
6. Roxas Boulevard	NB	6,693	10,944	6,599	3,821	1,710	4,689	0	2,244	1,906	1,745	1,027	40,351
	SB	5,967	7,033	2,032	2,800	2,016	3,010	224	1,018	1,031	599	376	25,730
	Bothways	**12,660**	**17,977**	**8,631**	**6,621**	**3,726**	**7,699**	**224**	**3,262**	**2,937**	**2,344**	**1,403**	**66,081**
7. Cavitex	NB	104	14,921	3,040	692	1,161	1,641	50	788	1,122	1,317	1,111	24,836
	SB	19	13,294	3,308	688	1,134	1,618	53	710	1,089	1,368	411	23,281
	Bothways	**123**	**28,215**	**6,348**	**1,380**	**2,295**	**3,259**	**103**	**1,498**	**2,211**	**2,685**	**1,522**	**48,117**
8. Quirino Avenue	NB	8,682	1,065	631	334	48	2,221	0	5	0	188	72	13,174
	SB	8,829	1,411	406	191	123	3,073	0	7	0	154	39	14,194
	Bothways	**17,511**	**2,476**	**1,037**	**525**	**171**	**5,294**	**0**	**12**	**0**	**342**	**111**	**27,368**
9. Ninoy Aquino Avenue	NB	7,921	6,668	3,775	2,307	1,791	2,726	0	13	20	1,528	927	26,749
	SB	11,633	9,400	2,912	2,411	2,102	3,357	0	26	1	2,364	2,084	34,206
	Bothways	**19,554**	**16,068**	**6,687**	**4,718**	**3,893**	**6,083**	**0**	**39**	**21**	**3,892**	**3,011**	**60,955**
10. Evangelista	EB	3,482	2,735	690	62	51	1,559	0	1	1	363	5	8,944
	WB	3,652	2,487	519	71	31	1,642	0	5	1	417	7	8,825
	Bothways	**7,134**	**5,222**	**1,209**	**133**	**82**	**3,201**	**0**	**6**	**2**	**780**	**12**	**17,769**
11. Aguinaldo Highway	NB	4,985	5,101	1,233	271	473	2,393	841	4	1,280	941	558	17,522
	SB	4,278	6,309	1,973	423	192	2,431	779	74	1,314	941	1,239	18,714
	Bothways	**9,263**	**11,410**	**3,206**	**694**	**665**	**4,824**	**1,620**	**78**	**2,594**	**1,882**	**1,797**	**36,236**
12. Molino Blvd.	NB	3,085	5,696	1,811	168	662	777	0	2	2	600	431	12,803
	SB	3,444	6,197	2,398	171	484	1,038	0	2	0	626	384	14,360
	Bothways	**6,529**	**11,893**	**4,209**	**339**	**1,146**	**1,815**	**0**	**4**	**2**	**1,226**	**815**	**27,163**

Table 9 Summary of Average Daily Passenger Load per Vehicle (All Stations)

Station	Direction	Cyclo/Motor-cycle/Tricycle	Pvt. Car	SUV/Van	Public Taxi	AUV/ Public FX	Jeepney	Mini-bus	Local Public Bus	Long Dist. Provincial Bus	Delivery Veh. (2-axle Truck)	Trucks (3 or more axles)
1. Marcos Highway	EB	1.52	1.83	3.92	2.22	5.31	15.79	2.00	9.45	11.27	2.33	2.49
	WB	1.38	2.13	3.48	2.06	6.64	14.28	4.80	4.92	3.20	2.34	2.35
	Bothways	**1.45**	**1.98**	**3.69**	**2.14**	**5.97**	**15.04**	**4.73**	**5.92**	**7.43**	**2.33**	**2.42**
2. Marcos Highway	EB	1.33	1.99	4.61	2.31	7.66	18.72	4.33	6.32	4.11	2.29	2.13
	WB	1.22	1.76	3.97	2.18	4.84	18.15	10.11	12.12	3.00	2.34	2.39
	Bothways	**1.27**	**1.87**	**4.29**	**2.24**	**6.15**	**18.43**	**8.67**	**10.32**	**3.71**	**2.32**	**2.27**
3. Marcos Highway	EB	1.27	1.53	2.39	1.49	3.40	12.20	0.00	13.90	37.33	2.27	2.16
	WB	1.23	1.53	1.85	1.54	3.86	12.50	0.00	18.21	20.45	2.43	2.19
	Bothways	**1.25**	**1.53**	**2.07**	**1.52**	**3.67**	**12.35**	**0.00**	**15.09**	**28.05**	**2.35**	**2.18**
4. Rizal Avenue	NB	1.48	1.45	1.54	1.71	1.71	11.18	1.00	0.00	0.00	2.02	0.00
	SB	1.76	1.77	2.43	2.10	1.50	11.04	3.00	0.00	0.00	2.37	3.33
	Bothways	**1.62**	**1.65**	**2.25**	**2.03**	**1.62**	**11.11**	**2.00**	**0.00**	**0.00**	**2.27**	**3.33**
5. Taft Avenue	NB	1.34	2.02	2.89	1.95	5.32	12.23	17.00	36.42	28.83	2.17	2.26
	SB	1.44	1.86	1.93	2.07	3.60	10.87	0.00	26.43	6.51	2.47	1.84
	Bothways	**1.38**	**1.94**	**2.49**	**1.99**	**4.45**	**11.54**	**17.00**	**33.30**	**20.76**	**2.21**	**2.14**
6. Roxas Boulevard	NB	1.25	1.85	6.50	2.02	7.68	32.75	36.08	2.39	2.25	0.00	0.00
	SB	1.23	1.47	1.98	2.09	6.85	24.16	33.57	2.35	2.33	0.00	0.00
	Bothways	**1.24**	**1.64**	**4.15**	**2.05**	**7.25**	**28.53**	**34.84**	**2.37**	**2.27**	**0.00**	**0.00**
7. Cavitex	NB	1.09	1.84	6.79	2.27	5.43	14.04	16.24	47.32	48.55	2.27	2.16
	SB	1.29	1.57	4.10	2.31	6.91	13.37	28.78	54.68	56.36	2.36	2.33
	Bothways	**1.27**	**1.70**	**5.40**	**2.29**	**6.34**	**13.70**	**23.80**	**51.33**	**52.46**	**2.32**	**2.27**
8. Quirino Avenue	NB	1.70	1.55	1.86	1.57	1.71	5.85	0.00	30.75	0.00	2.43	2.63
	SB	1.65	1.64	2.02	1.84	2.61	6.82	0.00	12.50	60.00	2.29	3.78
	Bothways	**1.68**	**1.60**	**1.95**	**1.66**	**2.32**	**6.38**	**0.00**	**24.67**	**60.00**	**2.36**	**3.32**
9. Ninoy Aquino Avenue	NB	2.02	1.80	5.93	2.03	4.91	6.27	13.33	2.10	2.20	0.00	0.00
	SB	1.44	1.99	4.16	2.09	6.52	2.64	2.67	2.33	2.28	0.00	0.00
	Bothways	**1.74**	**1.89**	**5.21**	**2.06**	**5.57**	**3.91**	**8.00**	**2.21**	**2.23**	**0.00**	**0.00**
10. Evangelista	EB	1.47	1.66	2.45	1.69	3.11	9.48	0.00	2.00	2.00	2.24	2.75
	WB	1.63	1.98	2.86	1.61	1.33	10.16	0.00	4.67	2.00	2.26	3.40
	Bothways	**1.55**	**1.82**	**2.71**	**1.64**	**2.35**	**9.82**	**0.00**	**4.00**	**2.00**	**2.26**	**3.11**
11. Aguinaldo Highway	SB	1.30	1.72	2.39	1.61	5.22	9.50	12.24	29.35	52.12	2.32	2.13
	NB	1.32	1.53	1.89	2.01	4.92	8.62	10.81	36.36	50.17	2.22	2.15
	Bothways	**1.31**	**1.63**	**2.14**	**1.79**	**5.01**	**9.06**	**11.60**	**34.58**	**51.27**	**2.27**	**2.14**
12. Molino Blvd.	NB	1.29	2.02	3.30	1.70	7.98	15.56	3.22	2.00	4.00	2.39	2.69
	SB	1.40	1.74	7.39	2.25	4.36	15.46	10.00	2.00	2.00	2.13	2.49
	Bothways	**1.34**	**1.88**	**5.22**	**1.98**	**7.39**	**15.51**	**3.90**	**2.00**	**3.33**	**2.28**	**2.53**

6 Origin-Destination (OD) Survey

6.1 Roadside Interview

The roadside interview survey was conducted at two stations, namely MB-2: Marcos Highway and MB-11: Aguinaldo Highway.

a. Public Transport Passenger Interview

Sample distribution by survey station is shown in **Table 10** and **Figure 9**.

Table 10 Sample Distribution by Station: Public Transport Passengers' Interview

Station	Location	Direction	Total	Share (%)
MB-2	Marcos Highway	EB	507	24.8%
		WB	488	23.8%
		Both Ways	995	48.6%
MB-11	Aguinaldo Highway	NB	581	28.4%
		SB	471	23.0%
		Both Ways	1,052	51.4%
Total		-	2,047	100.0%
Share (%)		-	100.0%	-

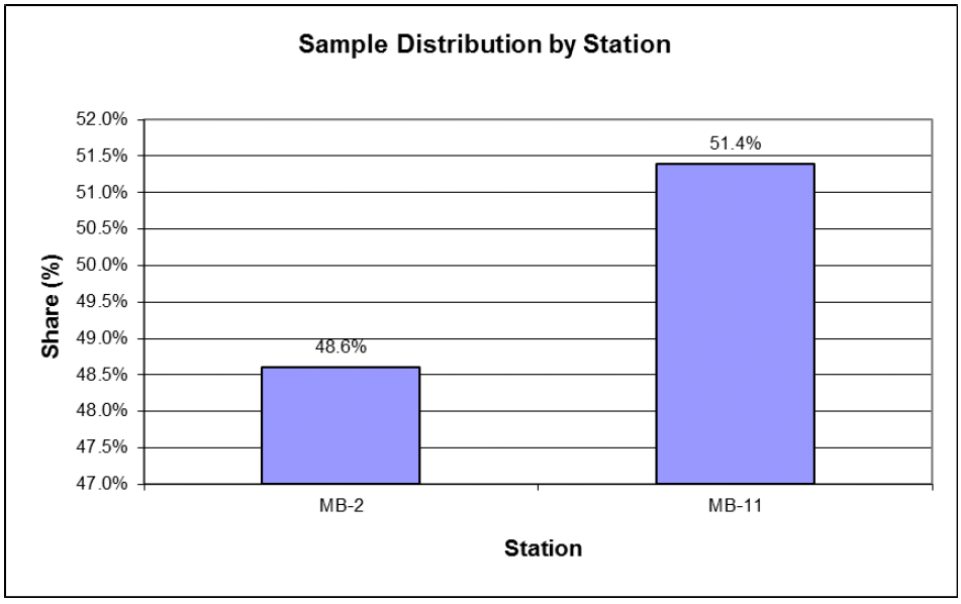


Figure 9 Sample Distribution by Station – Public Transport Passenger's Interview

Sample distribution by public transport mode is shown in **Table 11** and **Figure 10**.

Table 11 Sample Distribution by Station by Mode: Public Transport Passengers' Interview

Station	Location	AUV/FX	Jeepney	Mini-Bus	Local Public Bus	Provincial Bus	Total	Share (%)
MB-2	Marcos Highway	22	973	0	0	0	995	48.6%
MB-11	Aguinaldo Highway	0	604	151	0	297	1,052	51.4%
Total		22	1,577	151	0	297	2,047	100.0%
Share (%)		1.1%	77.0%	7.4%	0.0%	14.5%	100.0%	-

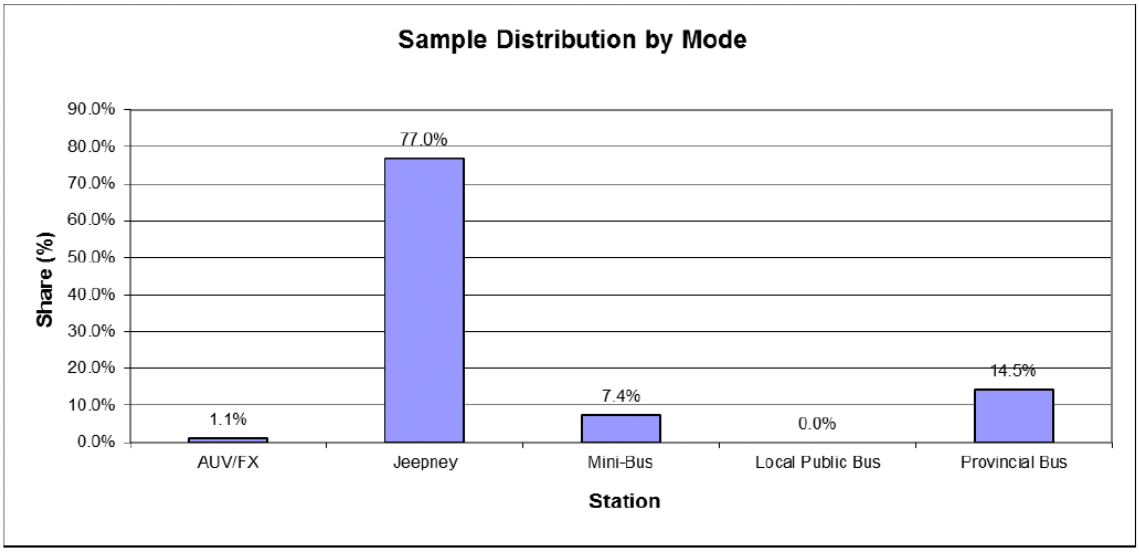


Figure 10 Sample Distribution by Station by Mode: Public Transport Passengers' Interview

Trip purpose distribution for all modes of public transportation is shown in **Table 12** and **Figure 11**. More detailed distribution of trip purpose by public transport mode can be extracted from the encoded OD data.

Table 12 Trip Purpose Distribution for All Public Transport Passengers

Station	Purpose					Total
	1	2	3	4	5	
MB-2	434	235	53	47	224	993
MB-11	488	163	57	41	283	1,032
Total	922	398	110	88	507	2,025
Share (%)	45.5%	19.7%	5.4%	4.3%	25.0%	100.0%

Notes: 22 respondents have no reply.
Purpose 1 – To Home
Purpose 2 – To Work
Purpose 3 – Education
Purpose 4 – Business
Purpose 5 – Others

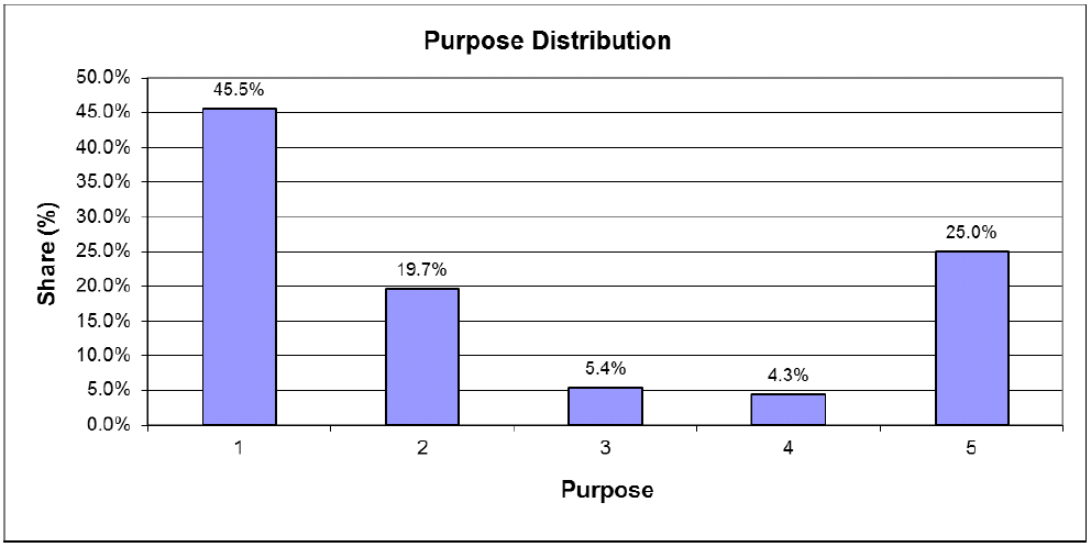


Figure 11 Trip Purpose Distribution for All Public Transport Passengers

Public transport passengers' OD pattern based on the interview at Station MB-2, aggregated into intercity/municipality flows is shown in **Table 13**.

Table 13 Intercity/Municipality Passenger OD Table: Station MB-2

O/D	Antipolo	Binangonan	Cainta	Caloocan City	Cavite City	Dona Remedios Trinidad	Makati City	Mandaluyong City	Manila	Marikina City	Muntinlupa City	Pasay City	Pasig City	Pateros	Quezon City	Rodriguez	San Mateo	San Pedro	Tanay	Taytay	Valenzuela City	Total	Share (%)
Antipolo	85	1	36	2	0	3	6	8	14	79	1	1	133	1	128	11	2	2	0	5	0	518	52.6%
Bacoor	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Baras	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0.2%
Binangonan	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Cainta	28	0	1	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	32	3.2%
Caloocan City	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Dasmarinas	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Makati City	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0.7%
Mandaluyong City	4	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	6	0.6%
Manila	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0.8%
Marikina City	108	0	5	0	0	0	0	1	1	1	0	0	7	0	3	0	1	0	1	0	0	128	13.0%
Navotas City	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Paranaque City	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.2%
Pasig City	106	0	3	0	0	0	1	0	0	1	0	0	2	0	1	0	0	0	0	0	0	114	11.6%
Quezon City	148	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	151	15.3%
Rodriguez	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	4	0.4%
San Juan	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.2%
Taguig City	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.2%
Tanay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0.1%
Taytay	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.2%
Valenzuela City	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Total	508	1	49	2	1	3	7	9	15	85	1	1	145	1	133	12	3	2	1	5	1	985	100.0%
Share (%)	51.6%	0.1%	5.0%	0.2%	0.1%	0.3%	0.7%	0.9%	1.5%	8.6%	0.1%	0.1%	14.7%	0.1%	13.5%	1.2%	0.3%	0.2%	0.1%	0.5%	0.1%	100.0%	

For station MB-11, public transport passengers' OD pattern is shown in **Table 14**, aggregated into inter-city/municipality flows.

Table 14 Intercity/Municipality Passenger OD Table: Station MB-11

O/D	Alfonso	Bacoor	Caloocan City	Cavite City	Dasmarinas	Dona Remedios Trinidad	Gen_ Mariano Alvarez	General Trias	Imus	Kawit	Las Pinas City	Makati City	Malabon City	Manila	Maragondon	Muntinlupa City	Naic	Noveleta	Paranaque City	Pasay City	Quezon City	Rosario	San Pedro	Silang	Tagaytay	Tanza	Ternate	Trece Martires	Total	Share (%)
Bacoor	0	286	0	15	8	0	2	2	39	9	64	1	0	4	1	9	3	3	21	23	2	7	1	1	2	1	0	0	504	48.5%
Cavite City	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	8	0.8%
Dasmarinas	0	13	0	0	0	1	0	0	1	0	9	1	1	3	0	2	0	0	3	13	0	0	0	0	0	0	1	0	48	4.6%
Alvarez	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	3	0.3%
General Trias	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.3%
Imus	0	69	0	0	0	0	0	0	6	0	40	1	0	5	0	4	0	0	15	20	1	0	0	0	0	0	0	0	161	15.5%
Indang	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0.2%
Kawit	0	11	0	0	0	0	0	0	0	0	7	0	0	0	0	3	0	1	1	2	0	0	0	0	0	0	0	0	25	2.4%
Las Pinas City	0	53	0	2	7	0	2	0	19	4	3	0	0	0	0	0	2	1	0	0	0	3	0	0	0	2	0	1	99	9.5%
Makati City	0	7	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0.9%
City	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0.2%
Manila	0	8	0	0	1	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	19	1.8%
Maragondon	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Muntinlupa City	0	10	0	2	2	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	21	2.0%
Naic	0	3	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0.7%
Navotas City	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Noveleta	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0.3%
Paranaque City	0	11	0	0	2	0	1	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	26	2.5%
Pasay City	1	16	0	1	5	0	1	0	22	1	1	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	1	0	54	5.2%
Quezon City	0	3	1	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	8	0.8%
Rosario	0	3	0	0	1	0	0	0	0	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	9	0.9%
San Pedro	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Silang	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	0.4%
Tagaytay	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	2	0	0	0	0	0	0	0	0	4	0.4%
Tanza	0	6	0	0	0	0	0	0	0	0	6	0	0	0	0	1	0	0	0	3	1	0	0	0	0	0	0	0	17	1.6%
Trece Martires	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0.1%
Total	1	510	1	20	29	1	7	2	115	17	140	3	1	15	1	23	5	5	44	65	6	11	1	4	5	5	2	1	1040	100.0%
Share (%)	0.1%	49.0%	0.1%	1.9%	2.8%	0.1%	0.7%	0.2%	11.1%	1.6%	13.5%	0.3%	0.1%	1.4%	0.1%	2.2%	0.5%	0.5%	4.2%	6.3%	0.6%	1.1%	0.1%	0.4%	0.5%	0.5%	0.2%	0.1%	100.0%	

b. Public Transport (PT) Drivers' Interview Data

Sample distribution by PT mode is shown in **Table 15** and **Figure 12**.

Table 15 Sample Distribution by PT Drivers' Interview

Station	Location	AUV/FX	Jeepney	Mini-Bus	Local Public Bus	Provincial Bus	Total	Share (%)
MB-2	Marcos Highway	142	492	0	0	0	634	50.8%
MB-11	Aguinaldo Highway	10	324	194	11	75	614	49.2%
Total		152	816	194	11	75	1,248	100.0%
Share (%)		12.2%	65.4%	15.5%	0.9%	6.0%	100.0%	-

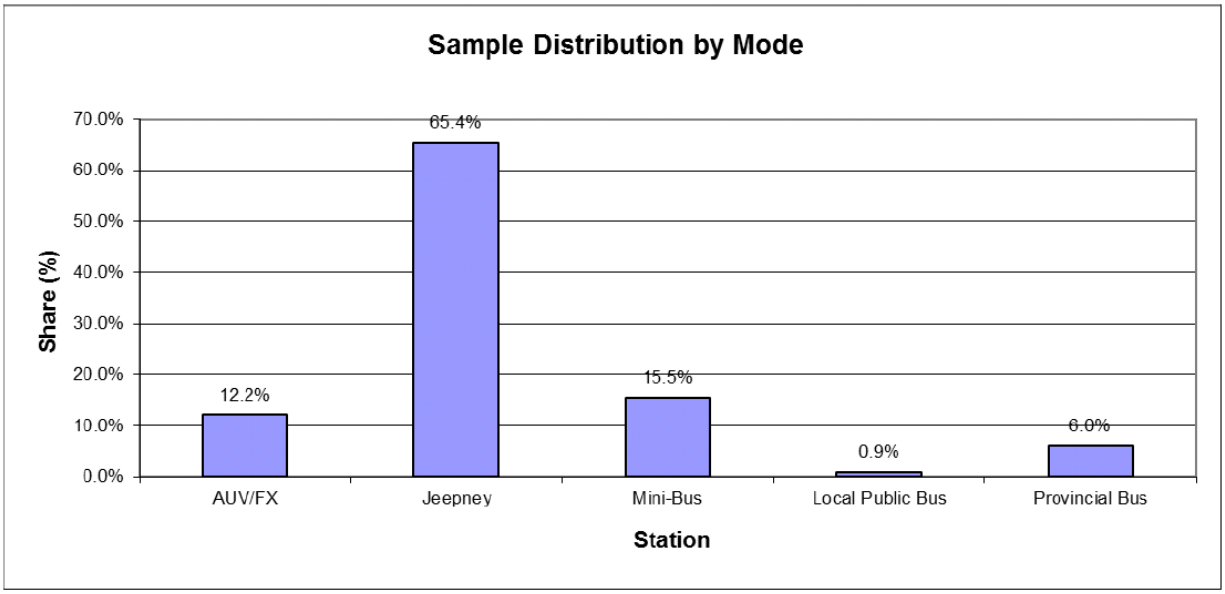


Figure 12 Sample Distribution by PT Drivers' Interview

Passenger Load occupancies and vehicle capacities surveyed are shown in **Table 16** and **Table 17**.

Table 16 Passenger Load Occupancy – PT Vehicles Surveyed

Station	Mode	Sample	Sum of Occupancy	Average Occupancy
MB-2	AUV/FX	142	1,011	7.12
	Jeepney	486	7,409	15.24
	Mini-Bus	0	0	0.00
	Local Public Bus	0	0	0.00
	Provincial Bus	0	0	0.00
MB-11	AUV/FX	10	108	10.80
	Jeepney	324	3,177	9.81
	Mini-Bus	194	1,998	10.30
	Local Public Bus	11	405	36.82
	Provincial Bus	75	2,150	28.67

Table 17 Capacities of PT Vehicles Surveyed

Station	Mode	Sample	Sum of Capacity	Average Capacity
MB-2	AUV/FX	142	1,504	10.59
	Jeepney	487	10,707	21.99
	Mini-Bus	0	0	0.00
	Local Public Bus	0	0	0.00
	Provincial Bus	0	0	0.00
MB-11	AUV/FX	10	159	15.90
	Jeepney	324	6,554	20.23
	Mini-Bus	194	6,415	33.07
	Local Public Bus	11	604	54.91
	Provincial Bus	75	4,154	55.39

PT routes' distributions are shown in **Table 18** and **Table 19**.

Table 18 PT Routes Distribution: Station MB-2

O/D	Antipolo	Baras	Cainta	Makati City	Manila	Marikina City	Pasig City	Quezon City	San Mateo	Total	Share (%)
Antipolo	7	0	0	1	0	49	14	172	0	243	38.3%
Baras	0	0	0	0	0	1	0	0	0	1	0.2%
Cainta	1	0	0	0	0	2	0	0	0	3	0.5%
Makati City	3	0	1	0	0	6	0	0	0	10	1.6%
Mandaluyong City	0	0	0	0	0	3	0	0	0	3	0.5%
Marikina City	135	12	0	0	8	1	1	6	1	164	25.9%
Pasig City	53	0	0	0	0	0	1	0	0	54	8.5%
Quezon City	151	0	0	0	0	1	1	3	0	156	24.6%
Total	350	12	1	1	8	63	17	181	1	634	100.0%
Share (%)	55.2%	1.9%	0.2%	0.2%	1.3%	9.9%	2.7%	28.5%	0.2%	100.0%	

Table 19 PT Routes Distribution: Station MB-11

O/D	Alfonso	Bacoor	Caloocan City	Cavite City	Dasmarinas	Gen_ Mariano Alvarez	General Trias	Imus	Indang	Las Pinas City	Makati City	Manila	Mendez	Naic	Noveleta	Parana que City	Pasay City	Quezon City	Rosario	Silang	Tagaytay	Tanza	Trece Martires	Total	Share (%)
Alfonso	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	7	2.2%
Bacoor	0	26	0	30	21	2	1	6	1	1	0	0	0	13	0	0	6	0	3	14	1	0	0	125	38.7%
Cavite City	0	16	0	1	0	0	0	0	0	17	0	1	0	1	0	0	0	0	0	0	0	0	0	36	11.1%
Dasmarinas	0	31	1	0	0	0	0	0	1	25	1	2	0	0	1	0	33	0	0	0	0	0	0	95	29.4%
Alvarez	0	1	0	0	0	0	0	2	0	10	0	0	0	0	0	0	3	0	0	0	0	0	0	16	5.0%
General Trias	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3%
Imus	0	16	0	0	0	0	0	0	0	13	0	3	0	0	0	2	53	0	0	0	0	0	0	87	26.9%
Indang	0	1	0	0	0	0	0	0	1	0	0	1	0	1	0	0	14	0	0	0	0	0	0	18	5.6%
Kawit	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	5	1.5%
Las Pinas City	0	0	0	3	0	0	0	2	0	2	0	0	0	0	0	1	0	0	0	0	1	0	0	9	2.8%
Makati City	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	3	0.9%
Malabon City	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3%
Manila	0	0	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	7	2.2%
Maragondon	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.9%
Mendez	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3%
Naic	0	40	0	3	0	0	0	0	0	26	0	0	0	0	0	0	2	0	0	0	0	0	0	71	22.0%
Noveleta	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	4	1.2%
Paranaque City	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3%
Pasay City	5	7	0	1	13	1	0	22	6	1	0	1	1	0	0	0	3	0	0	0	1	0	2	64	19.8%
Quezon City	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	5	1.5%
Rosario	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.9%
Silang	0	5	0	0	0	0	0	0	0	9	0	0	0	0	0	0	1	0	0	0	0	0	0	15	4.6%
Tagaytay	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0.9%
Tanza	0	12	0	0	0	0	0	0	0	5	0	0	0	0	0	0	1	0	1	0	0	1	0	20	6.2%
Ternate	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3%
Trece Martires	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3%
Valenzuela City	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3%
Total	5	91	0	8	21	1	0	26	7	63	1	5	2	1	0	3	78	1	1	2	4	1	2	323	100.0%
Share (%)	1.5%	28.2%	0.0%	2.5%	6.5%	0.3%	0.0%	8.0%	2.2%	19.5%	0.3%	1.5%	0.6%	0.3%	0.0%	0.9%	24.1%	0.3%	0.3%	0.6%	1.2%	0.3%	0.6%	100.0%	0.3%

c. Private Car Owners'/Drivers' Interview

Sample distribution by survey station is shown in **Table 20** and **Figure 13.**

Table 20 Sample Distribution by Station: Private Car Owners'/Drivers' Interview

Station	Location	Direction	Total	Share (%)
MB-2	Marcos Highway	EB	112	22.3%
		WB	191	38.0%
		Both Ways	303	60.4%
MB-11	Aguinaldo Highway	NB	41	8.2%
		SB	158	31.5%
		Both Ways	199	39.6%
Total		-	502	100.0%
Share (%)		-	100.0%	-

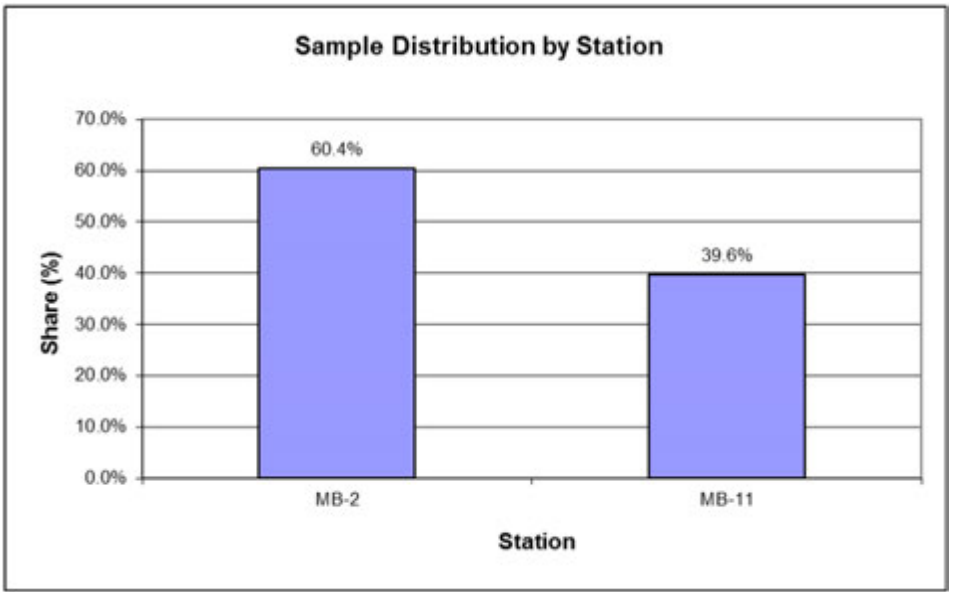


Figure 13 Sample Distribution by Station: Private Car Owners'/Drivers' Interview

Sample distribution by private vehicle mode is shown in **Table 21** and **Figure 14**.

Table 21 Sample Distribution by Station: Private Vehicle Mode: Private Car Owners'/Drivers Interview

Station	Location	Private Car	SUV/Van	Public Taxi	Total	Share (%)
MB-2	Marcos Highway	152	103	48	303	60.4%
MB-11	Aguinaldo Highway	129	67	3	199	39.6%
Total		281	170	51	502	100.0%
Share (%)		56.0%	33.9%	10.2%	100.0%	-

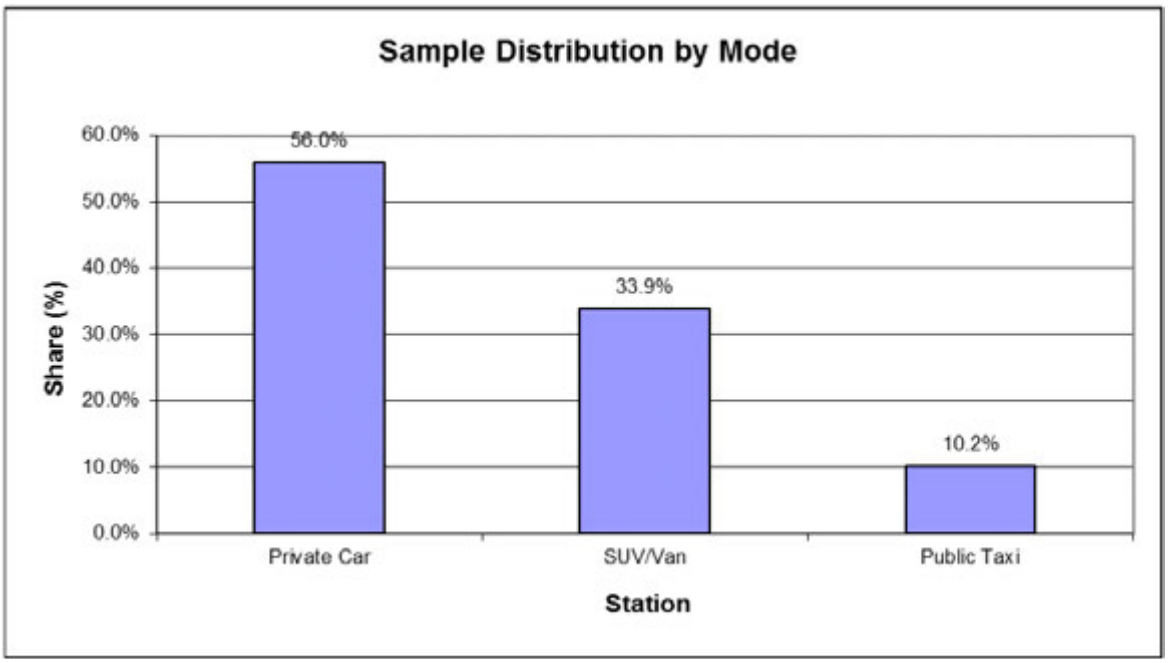


Figure 14 Sample Distribution by Station: Private Vehicle Mode: Private Car Owners'/Drivers Interview

Trip purpose distribution of private motorists is shown in **Table 22** and **Figure 15**.

Table 22 Trip Purpose Distribution (Private Motorist)

Station	Purpose					Total
	1	2	3	4	5	
MB-2	115	54	15	17	99	300
MB-11	90	37	4	16	51	198
Total	205	91	19	33	150	498
Share (%)	41.2%	18.3%	3.8%	6.6%	30.1%	100.0%

Legend:
Purpose 1 – To Home
Purpose 2 – To Work
Purpose 3 – Education
Purpose 4 – Business
Purpose 5 – Others

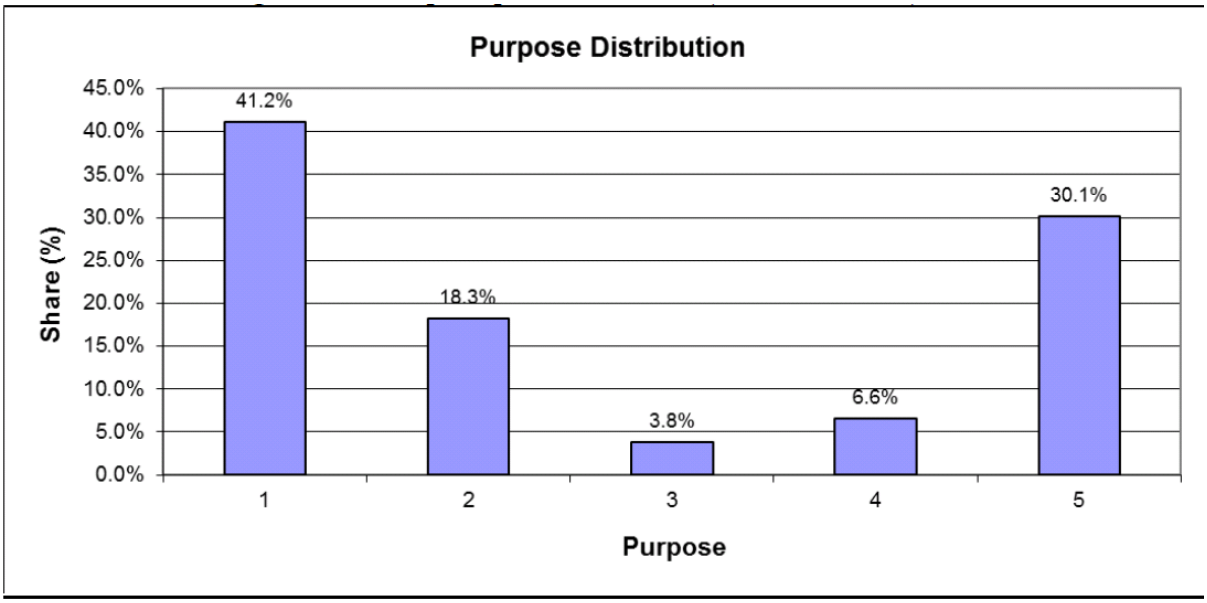


Figure 15 Trip Purpose Distribution (Private Motorist)

Average passenger occupancy and capacity of private vehicles surveyed by private vehicle mode are shown in **Table 23** and **Table 24**.

Table 23 Passenger Occupancy Data of Private Vehicles Surveyed

Station	Mode	Sample	Sum of Occupancy	Average Occupancy
MB-2	Private Car	150	326	2.17
	SUV/Van	102	312	3.06
	Public Taxi	45	100	2.22
MB-11	Private Car	127	253	1.99
	SUV/Van	67	191	2.85
	Public Taxi	3	7	2.33

Table 24 Private Vehicle Capacity of Private Vehicles Surveyed

Station	Mode	Sample	Sum of Capacity	Average Capacity
MB-2	Private Car	150	827	5.51
	SUV/Van	103	1213	11.78
	Public Taxi	46	253	5.50
MB-11	Private Car	127	695	5.47
	SUV/Van	67	783	11.69
	Public Taxi	3	21	7.00

Private vehicle passengers' OD pattern per OD data gathered at stations MB-2 and MB-11 aggregated to intercity/municipality flows are shown in **Table 25** and **Table 26**.

Table 25 Private Motorists' OD Pattern: Station MB-2

O/D	Angono	Antipolo	Baras	Cainta	Makati City	Mandaluyong City	Manila	Marikina City	Morong	Paranaque City	Pasay City	Pasig City	Quezon City	San Juan	San Mateo	Taytay	Teresa	Total	Share (%)
Antipolo	0	37	1	22	1	3	2	23	0	1	1	19	45	1	1	0	0	157	52.5%
Binangonan	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3%
Cainta	0	19	0	4	2	1	1	10	0	0	0	3	9	0	0	0	0	49	16.4%
Dona Remedios Trinidad	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3%
Makati City	0	2	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	4	1.3%
Mandaluyong City	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1.0%
Manila	1	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	1.3%
Marikina City	0	13	0	0	1	0	0	1	0	0	0	3	1	0	0	0	1	20	6.7%
Muntinlupa City	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3%
Paranaque City	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3%
Pasig City	0	12	0	0	0	0	0	1	1	0	0	2	0	0	0	0	0	16	5.4%
Quezon City	0	32	0	2	0	0	0	2	0	0	0	1	1	0	0	1	1	40	13.4%
San Pedro	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3%
Tanay	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.3%
Total	1	122	1	31	4	5	3	39	1	1	1	29	56	1	1	1	2	299	100.0%
Share (%)	0.3%	40.8%	0.3%	10.4%	1.3%	1.7%	1.0%	13.0%	0.3%	0.3%	0.3%	9.7%	18.7%	0.3%	0.3%	0.3%	0.7%	100.0%	

Table 26 Private Motorists' OD Pattern: Station MB-11

O/D	Bacoor	Dasmarinas	General Trias	Imus	Kawit	Las Pinas City	Makati City	Manila	Muntinlupa City	Naic	Noveleta	Parañaque City	Pasay City	Quezon City	Rosario	Silang	Tagaytay	Tanza	Ternate	Trece Martires	Total	Share (%)
Bacoor	25	2	1	11	1	3	3	0	2	0	1	1	3	3	0	0	1	1	1	0	59	29.9%
Caloocan City	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1.0%
Cavite City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0.5%
Dasmarinas	1	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	5	2.5%
Imus	3	0	0	2	0	3	2	1	2	0	0	2	3	1	0	0	0	0	0	0	19	9.6%
Las Pinas City	16	3	0	10	2	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	34	17.3%
Makati City	5	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	4.6%
Mandaluyong City	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1.0%
Manila	11	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	8.6%
Muntinlupa City	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1.5%
Paranaque City	12	1	1	5	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	21	10.7%
Pasay City	5	1	1	5	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	15	7.6%
Pasig City	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1.0%
Quezon City	2	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	3.0%
San Juan	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.5%
San Pedro	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.5%
Total	87	12	3	45	3	7	5	1	4	1	1	4	9	4	1	2	4	2	1	1	197	100.0%
Share (%)	44.2%	6.1%	1.5%	22.8%	1.5%	3.6%	2.5%	0.5%	2.0%	0.5%	0.5%	2.0%	4.6%	2.0%	0.5%	1.0%	2.0%	1.0%	0.5%	0.5%	100.0%	

d. LRT Passengers' Interview

Summary tables of OD and related data of LRT passengers are presented here. Sample distribution by survey station and direction is shown in **Table 27**.

Table 27 Sample Distribution by Station and Direction

Station Code	Station_Name	Northbound	Southbound	Eastbound	Westbound	Northbound	Southbound	Total	Share (%)
1017	LRT 1 - EDSA/Taft	100	100	0	0	0	0	200	14.1%
1018	LRT 1 - Baclaran	203	203	0	0	0	0	406	28.5%
1020	LRT 1 - Roosevelt	97	103	0	0	0	0	200	14.1%
2001	LRT 2 - Santolan	0	0	200	201	0	0	401	28.2%
3013	MRT 3 - Taft Avenue	0	0	0	0	108	108	216	15.2%
Total	-	400	406	200	201	108	108	1,423	100.0%
Share (%)	-	28.1%	28.5%	14.1%	14.1%	7.6%	7.6%	100.0%	-

Age distribution of respondents by station is shown in **Table 28**.

Table 28 Age Distribution of LRT Passengers Interviewed

Age Bracket	LRT1	LRT2	MRT	Total	% Share
12-20	218	147	61	426	30.0
21-29	253	117	104	474	33.3
30-39	138	70	30	238	16.7
40-49	95	34	10	139	9.7
50-59	63	22	10	95	6.7
60 & above	39	11	1	51	3.6
Total	806	401	216	1,423	100.0

Sex distribution of respondents by station is shown in **Table 29**.

Table 29 Sex Distribution of Respondents

Sex	LRT 1	LRT 2	MRT 3	Total	Share (%)
Male	450	216	148	814	57.2%
Female	356	185	68	609	42.8%
Total	806	401	216	1,423	100.0%
Share (%)	56.6%	28.2%	15.2%	100.0%	-

Occupation distribution of respondents is shown in **Table 30**.

Table 30 Occupation Distribution of Respondents

Occupation	LRT 1	LRT 2	MRT 3	Total	Share (%)
1. Student	207	154	54	415	29.2%
2. Employed/Worker	390	176	116	682	47.9%
3. Unemployed	123	30	38	191	13.4%
4. Businessman/Self Employ	44	14	1	59	4.1%
5. Professional/Executive	42	27	7	76	5.3%
Total	806	401	216	1,423	100.0%
Share (%)	56.6%	28.2%	15.2%	100.0%	-

Personal monthly income distribution of respondents is shown in **Table 31**.

Table 31 Personal Monthly Income Distribution of Respondents

Income	LRT 1	LRT 2	MRT 3	Total	Share (%)
No reply	16	19	12	47	3.3%
1. None	331	184	92	607	42.7%
2. Below P5,000	34	19	2	55	3.9%
3. 5,000 - 9,999	93	23	19	135	9.5%
4. 10,000 - 14,999	157	59	37	253	17.8%
5. 15,000 - 19,999	81	53	29	163	11.5%
6. 20,000 - 24,999	41	22	8	71	5.0%
7. 25,000 - 29,999	11	3	7	21	1.5%
8. 30,000 - 39,999	12	8	7	27	1.9%
9. 40,000 - 49,999	9	1	0	10	0.7%
10. 50,000 - 59,999	7	4	1	12	0.8%
11. 60,000 - 69,999	3	2	0	5	0.4%
12. Above P70,000	11	4	2	17	1.2%
Total	806	401	216	1,423	100.0%
Share (%)	56.6%	28.2%	15.2%	100.0%	-

Trip purpose distribution of respondents is shown in **Table 32**.

Table 32 Trip Purpose Distribution of Respondents

Trip Purpose	LRT 1	LRT 2	MRT 3	Total	Share (%)
1. To Home	207	154	54	415	29.2%
2. To Work	390	176	116	682	47.9%
3. Education	123	30	38	191	13.4%
4. Business	44	14	1	59	4.1%
5. Others	42	27	7	76	5.3%
Total	806	401	216	1,423	100.0%
Share (%)	56.6%	28.2%	15.2%	100.0%	-

Station to station flow of respondents is shown in **Table 33**.

Table 33 Station to Station Flow of Respondents

Boarding Station		Alighting Station		Sample	Share (%)
Code	Station Name	Code	Station Name		
1001	LRT 1 - Monumento	1017	LRT 1 - EDSA/Taft	12	0.8%
1001	LRT 1 - Monumento	1018	LRT 1 - Baclaran	30	2.1%
1001	LRT 1 - Monumento	1020	LRT 1 - Roosevelt	6	0.4%
1002	LRT 1 - 5th Avenue	1017	LRT 1 - EDSA/Taft	3	0.2%
1002	LRT 1 - 5th Avenue	1018	LRT 1 - Baclaran	11	0.8%
1003	LRT 1 - R. Papa	1017	LRT 1 - EDSA/Taft	6	0.4%
1003	LRT 1 - R. Papa	1018	LRT 1 - Baclaran	3	0.2%
1003	LRT 1 - R. Papa	1020	LRT 1 - Roosevelt	2	0.1%
1004	LRT 1 - Abad Santos	1017	LRT 1 - EDSA/Taft	1	0.1%
1004	LRT 1 - Abad Santos	1018	LRT 1 - Baclaran	7	0.5%
1004	LRT 1 - Abad Santos	1020	LRT 1 - Roosevelt	2	0.1%
1005	LRT 1 - Blumentritt	1017	LRT 1 - EDSA/Taft	3	0.2%
1005	LRT 1 - Blumentritt	1018	LRT 1 - Baclaran	7	0.5%
1006	LRT 1 - Tayuman	1017	LRT 1 - EDSA/Taft	6	0.4%
1006	LRT 1 - Tayuman	1018	LRT 1 - Baclaran	3	0.2%
1006	LRT 1 - Tayuman	1020	LRT 1 - Roosevelt	7	0.5%
1007	LRT 1 - Bambang	1017	LRT 1 - EDSA/Taft	1	0.1%
1007	LRT 1 - Bambang	1018	LRT 1 - Baclaran	3	0.2%
1007	LRT 1 - Bambang	1020	LRT 1 - Roosevelt	3	0.2%
1008	LRT 1 - D. Jose	1017	LRT 1 - EDSA/Taft	5	0.4%
1008	LRT 1 - D. Jose	1018	LRT 1 - Baclaran	24	1.7%
1008	LRT 1 - D. Jose	1020	LRT 1 - Roosevelt	6	0.4%
1009	LRT 1 - Carriedo	1017	LRT 1 - EDSA/Taft	9	0.6%
1009	LRT 1 - Carriedo	1018	LRT 1 - Baclaran	23	1.6%
1009	LRT 1 - Carriedo	1020	LRT 1 - Roosevelt	9	0.6%
1010	LRT 1 - Central Station	1017	LRT 1 - EDSA/Taft	7	0.5%
1010	LRT 1 - Central Station	1018	LRT 1 - Baclaran	16	1.1%
1010	LRT 1 - Central Station	1020	LRT 1 - Roosevelt	9	0.6%
1011	LRT 1 - U.N. Avenue	1017	LRT 1 - EDSA/Taft	22	1.5%
1011	LRT 1 - U.N. Avenue	1018	LRT 1 - Baclaran	27	1.9%
1011	LRT 1 - U.N. Avenue	1020	LRT 1 - Roosevelt	7	0.5%
1012	LRT 1 - Pedro Gil	1017	LRT 1 - EDSA/Taft	6	0.4%
1012	LRT 1 - Pedro Gil	1018	LRT 1 - Baclaran	14	1.0%
1012	LRT 1 - Pedro Gil	1020	LRT 1 - Roosevelt	7	0.5%
1013	LRT 1 - Quirino Avenue	1017	LRT 1 - EDSA/Taft	4	0.3%
1013	LRT 1 - Quirino Avenue	1018	LRT 1 - Baclaran	10	0.7%
1013	LRT 1 - Quirino Avenue	1020	LRT 1 - Roosevelt	4	0.3%
1014	LRT 1 - Vito Cruz	1017	LRT 1 - EDSA/Taft	4	0.3%
1014	LRT 1 - Vito Cruz	1018	LRT 1 - Baclaran	4	0.3%
1014	LRT 1 - Vito Cruz	1020	LRT 1 - Roosevelt	10	0.7%
1015	LRT 1 - Gil Puyat	1017	LRT 1 - EDSA/Taft	1	0.1%
1015	LRT 1 - Gil Puyat	1018	LRT 1 - Baclaran	4	0.3%
1015	LRT 1 - Gil Puyat	1020	LRT 1 - Roosevelt	6	0.4%
1016	LRT 1 - Libertad	1018	LRT 1 - Baclaran	2	0.1%
1016	LRT 1 - Libertad	1020	LRT 1 - Roosevelt	4	0.3%

Boarding Station		Alighting Station		Sample	Share (%)
Code	Station Name	Code	Station Name		
1017	LRT 1 - EDSA/Taft	1001	LRT 1 - Monumento	9	0.6%
1017	LRT 1 - EDSA/Taft	1002	LRT 1 - 5th Avenue	9	0.6%
1017	LRT 1 - EDSA/Taft	1003	LRT 1 - R. Papa	1	0.1%
1017	LRT 1 - EDSA/Taft	1005	LRT 1 - Blumentritt	8	0.6%
1017	LRT 1 - EDSA/Taft	1006	LRT 1 - Tayuman	10	0.7%
1017	LRT 1 - EDSA/Taft	1007	LRT 1 - Bambang	1	0.1%
1017	LRT 1 - EDSA/Taft	1008	LRT 1 - D. Jose	9	0.6%
1017	LRT 1 - EDSA/Taft	1009	LRT 1 - Carriedo	5	0.4%
1017	LRT 1 - EDSA/Taft	1010	LRT 1 - Central Station	8	0.6%
1017	LRT 1 - EDSA/Taft	1011	LRT 1 - U.N. Avenue	8	0.6%
1017	LRT 1 - EDSA/Taft	1012	LRT 1 - Pedro Gil	14	1.0%
1017	LRT 1 - EDSA/Taft	1013	LRT 1 - Quirino Avenue	4	0.3%
1017	LRT 1 - EDSA/Taft	1014	LRT 1 - Vito Cruz	9	0.6%
1017	LRT 1 - EDSA/Taft	1015	LRT 1 - Gil Puyat	1	0.1%
1017	LRT 1 - EDSA/Taft	1018	LRT 1 - Baclaran	4	0.3%
1017	LRT 1 - EDSA/Taft	1019	LRT 1 - Balintawak	2	0.1%
1017	LRT 1 - EDSA/Taft	1020	LRT 1 - Roosevelt	13	0.9%
1018	LRT 1 - Baclaran	1001	LRT 1 - Monumento	31	2.2%
1018	LRT 1 - Baclaran	1002	LRT 1 - 5th Avenue	12	0.8%
1018	LRT 1 - Baclaran	1003	LRT 1 - R. Papa	9	0.6%
1018	LRT 1 - Baclaran	1004	LRT 1 - Abad Santos	5	0.4%
1018	LRT 1 - Baclaran	1005	LRT 1 - Blumentritt	10	0.7%
1018	LRT 1 - Baclaran	1006	LRT 1 - Tayuman	13	0.9%
1018	LRT 1 - Baclaran	1007	LRT 1 - Bambang	1	0.1%
1018	LRT 1 - Baclaran	1008	LRT 1 - D. Jose	27	1.9%
1018	LRT 1 - Baclaran	1009	LRT 1 - Carriedo	19	1.3%
1018	LRT 1 - Baclaran	1010	LRT 1 - Central Station	13	0.9%
1018	LRT 1 - Baclaran	1011	LRT 1 - U.N. Avenue	12	0.8%
1018	LRT 1 - Baclaran	1012	LRT 1 - Pedro Gil	11	0.8%
1018	LRT 1 - Baclaran	1013	LRT 1 - Quirino Avenue	9	0.6%
1018	LRT 1 - Baclaran	1014	LRT 1 - Vito Cruz	3	0.2%
1018	LRT 1 - Baclaran	1015	LRT 1 - Gil Puyat	7	0.5%
1018	LRT 1 - Baclaran	1016	LRT 1 - Libertad	5	0.4%
1018	LRT 1 - Baclaran	1017	LRT 1 - EDSA/Taft	4	0.3%
1018	LRT 1 - Baclaran	1018	LRT 1 - Baclaran	3	0.2%
1018	LRT 1 - Baclaran	1019	LRT 1 - Balintawak	5	0.4%
1018	LRT 1 - Baclaran	1020	LRT 1 - Roosevelt	10	0.7%
1019	LRT 1 - Balintawak	1017	LRT 1 - EDSA/Taft	6	0.4%
1019	LRT 1 - Balintawak	1018	LRT 1 - Baclaran	5	0.4%
1020	LRT 1 - Roosevelt	1001	LRT 1 - Monumento	2	0.1%
1020	LRT 1 - Roosevelt	1002	LRT 1 - 5th Avenue	4	0.3%
1020	LRT 1 - Roosevelt	1003	LRT 1 - R. Papa	3	0.2%
1020	LRT 1 - Roosevelt	1004	LRT 1 - Abad Santos	5	0.4%
1020	LRT 1 - Roosevelt	1005	LRT 1 - Blumentritt	6	0.4%
1020	LRT 1 - Roosevelt	1006	LRT 1 - Tayuman	6	0.4%
1020	LRT 1 - Roosevelt	1007	LRT 1 - Bambang	2	0.1%
1020	LRT 1 - Roosevelt	1008	LRT 1 - D. Jose	9	0.6%
1020	LRT 1 - Roosevelt	1009	LRT 1 - Carriedo	6	0.4%
1020	LRT 1 - Roosevelt	1010	LRT 1 - Central Station	6	0.4%
1020	LRT 1 - Roosevelt	1011	LRT 1 - U.N. Avenue	13	0.9%
1020	LRT 1 - Roosevelt	1012	LRT 1 - Pedro Gil	6	0.4%
1020	LRT 1 - Roosevelt	1013	LRT 1 - Quirino Avenue	6	0.4%
1020	LRT 1 - Roosevelt	1014	LRT 1 - Vito Cruz	9	0.6%
1020	LRT 1 - Roosevelt	1015	LRT 1 - Gil Puyat	6	0.4%
1020	LRT 1 - Roosevelt	1016	LRT 1 - Libertad	4	0.3%
1020	LRT 1 - Roosevelt	1017	LRT 1 - EDSA/Taft	9	0.6%
1020	LRT 1 - Roosevelt	1018	LRT 1 - Baclaran	8	0.6%

Boarding Station		Alighting Station		Sample	Share (%)
Code	Station Name	Code	Station Name		
2001	LRT 2 - Santolan	2003	LRT 2 - Anonas	1	0.1%
2001	LRT 2 - Santolan	2004	LRT 2 - Cubao/Araneta	44	3.1%
2001	LRT 2 - Santolan	2005	LRT 2 - Betty Go Belmonte	2	0.1%
2001	LRT 2 - Santolan	2006	LRT 2 - Gilmore	5	0.4%
2001	LRT 2 - Santolan	2007	LRT 2 - J. Ruiz	3	0.2%
2001	LRT 2 - Santolan	2008	LRT 2 - V. Mapa	16	1.1%
2001	LRT 2 - Santolan	2009	LRT 2 - Pureza	25	1.8%
2001	LRT 2 - Santolan	2010	LRT 2 - Legarda	37	2.6%
2001	LRT 2 - Santolan	2011	LRT 2 - Recto	68	4.8%
2002	LRT 2 - Katipunan	2001	LRT 2 - Santolan	4	0.3%
2003	LRT 2 - Anonas	2001	LRT 2 - Santolan	8	0.6%
2004	LRT 2 - Cubao/Araneta	2001	LRT 2 - Santolan	14	1.0%
2005	LRT 2 - Betty Go Belmonte	2001	LRT 2 - Santolan	1	0.1%
2006	LRT 2 - Gilmore	2001	LRT 2 - Santolan	14	1.0%
2007	LRT 2 - J. Ruiz	2001	LRT 2 - Santolan	3	0.2%
2008	LRT 2 - V. Mapa	2001	LRT 2 - Santolan	10	0.7%
2009	LRT 2 - Pureza	2001	LRT 2 - Santolan	18	1.3%
2010	LRT 2 - Legarda	2001	LRT 2 - Santolan	40	2.8%
2011	LRT 2 - Recto	2001	LRT 2 - Santolan	88	6.2%
3001	MRT 3 - North Avenue	3013	MRT 3 - Taft Avenue	13	0.9%
3002	MRT 3 - Quezon Avenue	3013	MRT 3 - Taft Avenue	18	1.3%
3003	MRT 3 - GMA/Kamuning	3013	MRT 3 - Taft Avenue	3	0.2%
3004	MRT 3 - Cubao	3013	MRT 3 - Taft Avenue	18	1.3%
3005	MRT 3 - Santolan/Crame	3013	MRT 3 - Taft Avenue	4	0.3%
3006	MRT 3 - Ortigas	3013	MRT 3 - Taft Avenue	8	0.6%
3007	MRT 3 - Shaw Blvd.	3013	MRT 3 - Taft Avenue	28	2.0%
3008	MRT 3 - Boni	3013	MRT 3 - Taft Avenue	6	0.4%
3009	MRT 3 - Guadalupe	3013	MRT 3 - Taft Avenue	6	0.4%
3010	MRT 3 - Buendia	1020	LRT 1 - Roosevelt	1	0.1%
3010	MRT 3 - Buendia	3013	MRT 3 - Taft Avenue	2	0.1%
3011	MRT 3 - Ayala	3013	MRT 3 - Taft Avenue	1	0.1%
3013	MRT 3 - Taft Avenue	3001	MRT 3 - North Avenue	17	1.2%
3013	MRT 3 - Taft Avenue	3002	MRT 3 - Quezon Avenue	12	0.8%
3013	MRT 3 - Taft Avenue	3003	MRT 3 - GMA/Kamuning	5	0.4%
3013	MRT 3 - Taft Avenue	3004	MRT 3 - Cubao	18	1.3%
3013	MRT 3 - Taft Avenue	3005	MRT 3 - Santolan/Crame	4	0.3%
3013	MRT 3 - Taft Avenue	3006	MRT 3 - Ortigas	14	1.0%
3013	MRT 3 - Taft Avenue	3007	MRT 3 - Shaw Blvd.	13	0.9%
3013	MRT 3 - Taft Avenue	3008	MRT 3 - Boni	7	0.5%
3013	MRT 3 - Taft Avenue	3009	MRT 3 - Guadalupe	9	0.6%
3013	MRT 3 - Taft Avenue	3010	MRT 3 - Buendia	3	0.2%
3013	MRT 3 - Taft Avenue	3011	MRT 3 - Ayala	5	0.4%
3013	MRT 3 - Taft Avenue	3012	MRT 3 - Magallanes	1	0.1%
3013	MRT 3 - Taft Avenue	3013	MRT 3 - Taft Avenue	1	0.1%
Total	-	-	-	1,423	100.0%

OD pattern of respondents is shown in **Table 34**, aggregated into intercity/municipality flows.

Table 34 OD Pattern of Respondents

O/D	Alfonso	Angono	Antipolo	Bacoor	Binangonan	Cainta	Caloocan City	Dasmarinas	Dona Remedios Trinidad	General Trias	Imus	Indang	Las Pinas City	Makati City	Malabon City	Mandaluyong City	Manila	Marikina City	Morong	Muntinlupa City	Naic	Navotas City	Paranaque City	Pasay City	Pasig City	Pateros	Quezon City	Rodriguez	Rosario	San Juan	San Mateo	San Pedro	Taguig City	Tanza	Taytay	Trece Martires	Valenzuela City	Total	Share (%)
Alfonso	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0.1%
Angono	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.2%
Antipolo	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	29	0	0	1	0	1	0	0	0	0	13	0	0	3	0	0	0	0	0	0	51	3.8%
Bacoor	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	3	8	0	0	0	0	0	1	0	0	0	7	0	0	0	0	0	0	0	0	0	21	1.5%
Binangonan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.2%
Cainta	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	30	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	1	0	1	0	37	2.6%
Caloocan City	0	1	2	1	0	3	1	1	0	0	0	0	1	2	0	3	7	0	0	1	0	0	7	7	0	0	6	0	0	1	0	0	1	1	1	1	48	3.4%
Cardona	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Carmona	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Cavite City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Dasmarinas	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	5	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	10	0.7%
Dona Remedios Trinidad	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	1	2	0	0	0	0	0	5	10	0	0	0	0	0	0	0	1	0	0	0	0	24	1.6%
General Trias	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0.1%
Imus	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	1	8	0.6%
Jalajala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Las Pinas City	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	8	0	0	0	0	0	0	2	1	0	3	0	0	0	0	0	0	0	0	1	18	1.3%
Makati City	0	0	0	0	0	1	3	1	0	0	0	0	0	0	0	0	26	0	0	0	0	0	3	3	3	0	5	0	0	0	1	0	0	0	1	0	47	3.3%
Malabon City	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	5	1	3	0	1	0	0	0	0	0	0	0	0	0	15	1.1%
Mandaluyong City	1	0	0	2	0	0	2	3	0	0	3	0	0	0	0	0	12	1	0	0	1	0	1	12	0	0	1	0	0	0	0	0	0	1	0	0	40	2.8%
Manila	0	24	26	7	6	31	6	5	2	0	0	0	9	13	1	13	28	4	1	10	0	0	50	71	28	1	67	2	1	2	6	0	11	0	13	0	3	441	31.2%
Marikina City	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	6	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	14	1.0%
Morong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Muntinlupa City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	8	0.6%
Naic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	3	0.2%
Navotas City	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0.1%
Noveleta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Paranaque City	0	0	0	0	0	1	8	0	4	0	0	0	0	1	0	2	35	1	0	0	0	1	1	2	0	0	17	0	0	0	0	0	0	0	0	3	76	5.4%
Pasay City	0	0	2	0	0	0	14	0	3	0	0	0	0	3	5	5	61	0	0	0	0	0	3	17	3	1	33	1	1	0	1	1	1	0	0	11	169	12.0%
Pasig City	0	1	1	1	0	0	5	0	0	0	0	0	0	2	0	0	43	7	0	0	0	0	2	2	0	0	16	0	0	2	0	0	0	0	0	0	78	5.5%
Pateros	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Pililla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0.1%
Quezon City	0	3	9	6	5	6	5	3	1	1	5	0	2	5	0	2	73	1	0	1	0	0	16	39	4	0	3	1	0	0	0	0	2	1	7	0	0	202	14.3%
Rodriguez	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0.2%
Rosario	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.1%
San Juan	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	2	0	8	0.6%
San Mateo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.1%
San Pedro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.1%
Silang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0.1%
Tagaytay	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Taguig City	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	12	0	0	0	0	0	0	1	0	0	4	0	0	0	0	0	0	0	0	0	19	1.3%
Tanay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0.1%
Tanza	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.3%
Taytay	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	19	1.3%
Teresa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Trece Martires	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	0.2%
Valenzuela City	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	4	3	0	0	0	0	1	0	0	0	0	0	0	0	13	0.9%
Total	1	29	43	22	13	42	50	16	14	1	8	1	18	31	8	36	435	10	1	15	1	4	102	181	43	2	192	4	3	9	8	1	17	3	26	1	21	1412	100.0%
Share (%)	0.1%	2.1%	3.0%	1.6%	0.9%	3.0%	3.5%	1.1%	1.0%	0.1%	0.6%	0.1%	1.3%	2.2%	0.6%	2.5%	30.8%	0.7%	0.1%	1.1%	0.1%	0.3%	7.2%	12.8%	3.0%	0.1%	13.6%	0.3%	0.2%	0.6%	0.6%	0.1%	1.2%	0.2%	1.8%	0.1%	1.5%	100.0%	

Distribution of modes from origin to boarding station is shown in **Table 35** and **Table 36.**

Table 35 Mode Distribution from Origin to Boarding Station

Mode	LRT 1	LRT 2	MRT 3	Total	Share (%)
1. Cyclo/Motorcycle/Tricycle	58	35	8	101	7.1%
2. Private Car/Sedan/SUV/Open Back	13	17	4	34	2.4%
3. Delivery Vehicles, 2-Axle Truck and Other -Axle Veh.	0	0	0	0	0.0%
4. Trucks and Other Delivery Vehicles (3 or more Axle)	0	0	0	0	0.0%
5. Public Taxi	3	1	1	5	0.4%
6. AUV/Public FX	13	32	3	48	3.4%
7. Jeepney	274	182	91	547	38.4%
8. Mini-Bus	5	1	2	8	0.6%
9. Metro Manila Bus (Regular or Aircon)	44	2	9	55	3.9%
10. Long Distance Bus (Provincial Bus	39	1	12	52	3.7%
11. LRT/MRT	55	24	41	120	8.4%
12. Others	302	106	45	453	31.8%
Total	806	401	216	1,423	100.0%
Share (%)	56.6%	28.2%	15.2%	100.0%	-

Table 36 Using Others (#12) to Boarding Station

Other Mode	LRT 1	LRT 2	MRT 3	Total
SERVICE	1	0	0	1
SIDECAR	1	0	0	1
UNDEFINED	2	4	0	6
WALK	298	102	45	445
Total	302	106	45	453
Share (%)	66.7%	23.4%	9.9%	100.0%

Distribution of modes used from alighting station to destination is shown in **Table 37** and **Table 38**.

Table 37 Mode Distribution from Alighting Station to Destination

Mode	LRT 1	LRT 2	MRT 3	Total	Share (%)
1. Cyclo/Motorcycle/Tricycle	48	21	5	74	5.2%
2. Private Car/Sedan/SUV/Open Back	10	7	5	22	1.5%
3. Delivery Vehicles, 2-Axle Truck and Other -Axle Veh.	0	0	0	0	0.0%
4. Trucks and Other Delivery Vehicles (3 or more Axle)	0	0	0	0	0.0%
5. Public Taxi	4	1	1	6	0.4%
6. AUV/Public FX	14	82	7	103	7.2%
7. Jeepney	325	166	72	563	39.6%
8. Mini-Bus	8	0	1	9	0.6%
9. Metro Manila Bus (Regular or Aircon)	44	11	11	66	4.6%
10. Long Distance Bus (Provincial Bus	18	1	20	39	2.7%
11. LRT/MRT	19	26	26	71	5.0%
12. Others	316	86	68	470	33.0%
Total	806	401	216	1,423	100.0%
Share (%)	56.6%	28.2%	15.2%	100.0%	-

Table 38 Using Others (#12) to Destination

Other Mode	LRT 1	LRT 2	MRT 3	Total
PEDICAB	1	0	0	1
SERVICE	1	0	0	1
UNDEFINED	5	13	0	18
WALK	309	73	68	450
Total	316	86	68	470
Share (%)	67.2%	18.3%	14.5%	100.0%

Appendix E: Environmental Management Plan

Appendix E-1 Environmental Management Plan JICA Monitoring Form for LRT Line 1 Cavite Extension Project

Table 1 Construction Phase

Project Activity	Potential Environmental Impact	Mitigation Measures (Proposed/Implemented)	Parameters to be Monitored	Location	Methods, equipment and frequency of Measurement (Date and/or time of Measurement)	Measured Value (Average/Max/ Total, etc)	Philippine Standards/ Standard for Contract/Referred International Value	Input (e.g. cost, M/M)	Responsible Institution	Reporting
Construction of guideway, depots, and stations	Local economy (Employment)	Hire unskilled labor (>50%) and skilled labor (>30%) from the vicinity of the project sites	Employment rate	Barangays in the vicinity	Employment record		RA 6685		LRTA	・Quarterly Monitoring Report submitted to DOTC and JICA
Construction of guideway, depots and stations	Traffic congestion	Traffic Management Plan	Continuous flow of traffic	All construction sites	Daily monitoring for a construction period		-		LRTA/MMDA/ LGUs/	・Quarterly Monitoring Report submitted to DOTC and JICA
Construction of guideway, depots and stations	Community Health and Safety	Public Meetings	Opinions, grievance	Barangays in the vicinity	For a construction period		-		DPWH/ MMDA/LGUs	・Quarterly Monitoring Report submitted to DOTC and JICA
Construction of guideway, depots and stations	Relocation	Entitlement in accordance with Resettlement Action Plan	Progress of RAP Reports of grievance	Affected project sites	Refer to Resettlement Action Plan		Resettlement Action Plan		LRTA/ Interagency Executive and Technical Working Committees	・Submitted annually by RAP monitoring form to DOTC and JICA
Labor Camp	Occupational Health and Safety	Supply the works: -clean water and safe food -toilets/sewage treatment facilities -domestic solid waste management	Camp conditions	All camps	Weekly inspection		The Philippines Occupational Safety and Health Standards (As Amended), 1992		LRTA	・Quarterly Monitoring Report submitted to DOTC and JICA
Construction of guideway, depots and stations	Loss of trees	Tree replanting should be implemented Regular monitoring of replanted trees	Cutting trees and progress of replanting	Replanted sites	Visual inspection of tree growth		-		LRTA/LGUs DENR	・Quarterly Monitoring Report submitted to DOTC and JICA
Construction of guideway, depots and stations	Air pollution	Dust control measures: sprinkling of water; covers of the trucked material during transportation; locate the stockyard away from residential and sensitive areas Pollutant emission control measures: low emission construction vehicles, maintenance and inspection.	Ambient air quality TSP, NO_2, SO_2	Construction sites	Methods specified by the Implementing Rules and Regulations of the Philippine Clean Air Act of 1999 Weekly during construction		The Implementing Rules and Regulations of the Philippine Clean Air Act of 1999 WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide, Global Update 2005		LRTA/ DENR	・Quarterly Monitoring Report submitted to DOTC and JICA
Construction of guideway, depots and stations	Noise and vibrations	Proper service of equipment; installation of sound barriers for pile driving activity; mufflers and noise suppressors and regular maintenance of heavy equipment, construction machinery; use low-noise construction machines and heavy vehicles; construction activities to be restricted during day time hours only; inform construction schedule to residents in advance.	Noise level: L_{Aeq} (day and night)	Construction sites	Methods specified by the National Pollution Control Commission (NPCC) Memorandum Circular No. 002 Series of 1980, Section 78-Ambient Noise Quality and Emission Standards for Noise Weekly during construction		NPCC Memorandum Circular No. 002 Series of 1980, Section 78-Ambient Noise Quality and Emission Standards for Noise General EHS Guidelines; Environmental Noise Management, IFC 2007		LRTA/DENR	・Quarterly Monitoring Report submitted to DOTC and JICA

Project Activity	Potential Environmental Impact	Mitigation Measures (Proposed/Implemented)	Parameters to be Monitored	Location	Methods, equipment and frequency of Measurement (Date and/or time of Measurement)	Measured Value (Average/Max/ Total, etc)	Philippine Standards/ Standard for Contract/Referred International Value	Input (e.g. cost, M/M)	Responsible Institution	Reporting
			Vibration acceleration	Construction sites	Methods specified by the 2002/44/EC (EC Vibration Directive) or American Conference of Industrial Hygienists (ACGIH) Weekly during construction		2002/44/EC (EC Vibration Directive) or American Conference of Industrial Hygienists (ACGIH)		LRTA/DENR	・Quarterly Monitoring Report submitted to DOTC and JICA
Dredging, excavation and construction of guideway columns, depots and stations	Surface water quality degradation	Monitoring of TSS to avoid large increase of turbidity in surface water. To use the less turbidity-diffusive dredging method.	Surface water quality (TSS, BOD, Oil/Grease)	Construction sites of bridges and satellite depot	Methods specified by the Revised Effluent Regulations of 1990, Revising and Amending the Effluent Regulations of 1992 Monthly during construction		The Revised Effluent Regulations of 1990, Revising and Amending the Effluent Regulations of 1992		LRTA/ DENR	・Quarterly Monitoring Report submitted to DOTC and JICA
	Groundwater quality degradation due to excavation of the landfill area	Location of aquifer zones will be studied before any excavation activity is started in the landfill areas.	Groundwater quality (Total Coliform)	Excavation site close to the existing deep wells						
Dredging, excavation and construction of guideway columns and satellite depot	Sediment and water quality deterioration	Monitor the present sediment quality before dredging and excavation.	Sediment quality: Organic compound and Nutrients, Heavy metals, Persistent Organic Pollutants (POPs), Polycyclic Aromatic Hydrocarbons (PAHs)	Piling sites and Satellite depot (where waste soil and sand are generated from dredging and excavation)	Before dredging and excavation		Centre for Environment, Fisheries & Aquaculture Science (CEFAS) Guideline Action Levels (2003)		LRTA/ DENR	・Quarterly Monitoring Report submitted to DOTC and JICA
Construction of guideway, depots and stations	Waste generation	Solid Waste Management Plan. Proper implementation of separate collection and disposal	Site conditions and cleanliness	All construction sites and labor camp	Daily site inspection		Ecological Solid Waste Management Act of 2001		LRTA/DENR	・Quarterly Monitoring Report submitted to DOTC and JICA

Source: Study Team

Table 2 Operation Phase

Project Activity	Potential Environmental Impact	Mitigation Measures (Proposed/Implemented)	Parameters to be Monitored	Location	Methods, equipment and frequency of Measurement (Date and/or time of Measurement)	Measured Value (Average/Max/Total, etc)	Philippine Standards/ Standard for Contract/Referred International Value	Input (e.g. cost, M/M)	Responsible Institution	Reporting
Construction of guideway, depots and stations	Loss of trees including mangroves	Monitor the growth of replanting trees	Trees' height and diameter	Replanting sites	Once a year		-		LRTA/DENR/ LGUs	・Annual Monitoring Report submitted to DOTC and JICA
Reclamation	Subsidence	Regular monitoring of ground settlement at reclaimed areas	Settlement	Reclaimed area	Once a year		-		LRTA	・Annual Monitoring Report submitted to DOTC and JICA
Wastewater treatment at stations and depots	Surface water quality degradation	Proper operation and maintenance of wastewater treatment facilities at stations and depots	Effluent water quality (pH, TSS, BOD, COD, Oil/Grease, Phenol, Fiscal Coliforms)	Wastewater treatment facilities at stations and depots	Methods specified by the Revised Effluent Regulations of 1990, Revising and Amending the Effluent Regulations of 1992 2times per year		The Revised Effluent Regulations of 1990, Revising and Amending the Effluent Regulations of 1992		LRTA/ DENR	・Biannual Monitoring Report submitted to DOTC and JICA
Operation at the stations and depots	Waste generation	Proper implementation of separate collection and disposal	Cleanliness	Stations and depots	Site Monitoring		Ecological Solid Waste Management Act of 2001		LRTA/MMDA / LGUs	・Biannual Monitoring Report submitted to DOTC and JICA
Train operation	Noise and vibration	Noise and vibration attenuation measures: installation of noise barriers or shock absorber pads and ballast	Noise level: L_{Aeq} (day and night)	Noise sensitive areas such as residential area, school religious facilities along the extension line	Methods specified by the National Pollution Control Commission (NPCC) Memorandum Circular No. 002 Series of 1980, Section 78-Ambient Noise Quality and Emission Standards for Noise 2times per year		NPCC Memorandum Circular No. 002 Series of 1980, Section 78-Ambient Noise Quality and Emission Standards for Noise General EHS Guidelines; Environmental Noise Management, IFC 2007		LRTA/ DENR	・Biannual Monitoring Report submitted to DOTC and JICA
			Vibration acceleration	Sensitive areas such as residential area, school religious facilities along the extension line	Methods specified by the 2002/44/EC (EC Vibration Directive) or American Conference of Industrial Hygienists (ACGIH) 2times per year		2002/44/EC (EC Vibration Directive) or American Conference of Industrial Hygienists (ACGIH)		LRTA/ DENR	・Biannual Monitoring Report submitted to DOTC and JICA
Relocation	Living and livelihood of relocation families	Livelihood restoration program in accordance with Resettlement Action Plan	Living and livelihood conditions	Relocation site at Gen. Trias, Cavite	Refer to Resettlement Action Plan		Resettlement Action Plan		LRTA/Cavite Provincial Government	・Submitted annually by RAP monitoring form to DOTC and JICA
Operation of trains and stations	Congestion and disorder	•Efficient traffic management measures and parking restrictions •Efficient of public and private transit operations	Traffic congestion	All stations with intermodal facilities	Daily site patrol		Traffic Management Plan		LRTA/MMDA /LGUs	・Biannual Monitoring Report submitted to DOTC and JICA

Source: Study Team

Appendix E-2 Supplementary Environmental Impact Assessment Study

Results of Flora and Fauna Surveys

I. FLORA

1. Introduction

The study site that was assessed was primarily a wetland area located a few hundred meters inland from the eastern shore of Manila Bay, along the Coastal Road, near Bgy. Zapote in Las Piñas City. It is one of the few patches of mangrove vegetation that remains within the Bay. It is notable that Manila was named after a mangrove species locally called "nilad" (*Scyphiflora hydrophyllacea*), because of the abundance of this plant in the area during pre-colonial and colonial periods.

Due to encroachment by human settlement, the area is highly degraded and polluted. Where there are no human dwellings/shanties, some vegetation still manage to persist. There were two main types of vegetation there: Grasslands in the relatively dry areas and Mangroves in the wetland areas.

2. Methodology

We went to survey the trees and other plants in the site on June 16 and 23. Areas that were both occupied and unoccupied by human settlements were surveyed. Trees, shrubs, herbs, and vines that were seen opportunistically during the walks around the site were identified and noted, and some photos and voucher specimens were also taken for help in identification.

3. Results

The tree species that were identified in the site are listed in **Table 1**, while shrub, herb, and other non-woody plant species are shown in **Table 2**. The economic or ecological importance of the species was also listed if they could be determined.

Table 1 Tree species occurring in the study sites

Family	Species	Common name	Endemicity	Economic/ecological importance	IUCN *1	Philippine *2
Acanthaceae	*Avicennia marina*	Api-api	Native	Mangrove species	LC	-
Annonaceae	*Annona squamosa*	Atis	Introduced	Fruit crop	NE	-
Combretaceae	*Terminalia catappa*	Talisay	Native	Fruits edible	NE	-
Fabaceae	*Pithecellobium dulce*	Camachile	Introduced	Fruit crop	NE	-
Fabaceae	*Leucaena leucocephala*	Ipil-ipil	Introduced	Fuel wood	NE	-
Fabaceae	*Albizia* sp.		Not determined	Not determined	NE	-
Fabaceae	*Tamarindus indicus*	Sampaloc	Introduced	Fruit crop	NE	
Fabaceae	*Gliricidia sepium*	Kakawate	Introduced	Fuel wood	NE	-
Malvaceae	*Thespesia populnea*	Portia tree	Introduced	Ornamental	NE	-
Moraceae	*Ficus religiosa*	Bo tree	Introduced	Ornamental	NE	-
Moraceae	*Ficus septica*	Hauili	Native	Fruits provide food for bats and other wildlife; medicinal value	NE	-
Moringaceae	*Moringa oleifera*	Malunggay	Introduced	Food source; medicinal value	NE	-
Muntingiaceae	*Muntingia calabura*	Aratiles	Introduced	Fruits edible	NE	-
Myrtaceae	*Syzygium cumini*	Duhat	Native	Fruit crop	NE	-
Palmae	*Cocos nucifera*	Coconut	Native	Fruit crop, fiber source, lumber	NE	-
Palmae	*Nypa fruticans*	Nipa	Native	Roof material	LC	-

Source: Study Team

Note:
1) IUCN 2012. The IUCN Red List of Threatened Species, Version 2012.1.
2) DAO No. 2004-15, Establishing the National List of Threatened Philippine Plants and Their Categories, and the List of Other Wildlife Species.
3) (-): Not fall under any of the categories.

Table 2 Shrubs, herbs, and other non-woody plant species occurring in the study sites

Family	Species	Common name	Endemicity	Economic/ecological importance	IUCN *1	Philippine *2
Araceae	*Colocasia esculenta*	Gabi	Native	Root crop	LC	-*3
Asteraceae	*Chromolaena odorata*	Hagonoy	Introduced	Medicinal	NE	-
Asteraceae	*Blumea balsamifera*	Sambong	Native	Medicinal	NE	-
Caricaceae	*Carica papaya*	Papaya	Introduced	Fruit crop	NE	-
Convolvulaceae	*Ipomoea batatas*	Camote	Introduced	Food source	NE	-
Cucurbitaceae	*Coccinia* sp.		Introduced	Fruits provide food for birds	NE	-
Cyperaceae	*Cyperus* spp.	(sedges)	Introduced		NE	-
Euphorbiaceae	*Ricinus communis*	Castor plant	Introduced	Medicinal	NE	-
Euphorbiaceae	*Manihot esculenta*	Cassava	Introduced	Root crop	NE	-
Fabaceae	*Acacia farnesiana*	Aroma	Introduced	Invasive	NE	-
Malvaceae	*Sida rhombifolia*		Introduced	Medicinal	NE	-
Malvaceae	*Hibiscus esculentus*	Okra	Introduced	Fruit crop	NE	-
Musaceae	*Musa paradisiaca*	Banana	Introduced	Fruit crop	NE	-
Poaceae	*Panicum* sp.	(grass)	Native		NE	-
Poaceae	*Eleusine* sp.	(grass)	Native		NE	-
Poaceae	*Saccharum* sp.	Sugarcane	Native	Crop	NE	-
Portulacaceae	*Talinum triangulare*	Purslane	Introduced	Leaves are edible	NE	-
Verbenaceae	*Clerodendrum inerme*	Seaside clerodendrum	Introduced	Ornamental	NE	-

Source: Study Team

Note:
1) IUCN 2012. The IUCN Red List of Threatened Species, Version 2012.1.
2) DAO No. 2004-15, Establishing the National List of Threatened Philippine Plants and Their Categories, and the List of Other Wildlife Species.
3) (-): Not fall under any of the categories.

4. Discussion

Most of the tree and plant species surveyed were fruit trees or ornamentals, such as Atis (*Annona squamosa*), Sampaloc (*Tamarindus indicus*) and Talisay (*Terminalia catappa*), that were probably planted by the residents in the settlements. In addition, some residents also practice subsistence farming, wherein they plant cassavNa (*Manihot esculenta*), camote (*Ipomoea batatas*), etc. The other plants are weeds or grassland species typical of highly disturbed habitats.

The most abundant tree species surveyed was a mangrove tree called Api-api (*Avicennia marina*). This is expected, since the entire Manila Bay was historically covered with large tracts of the mangrove ecosystem. Unfortunately, what used to be a lush and diverse biome has now been decimated to only a handful of species.

Threatened Species:

None of the species reported in our results are classified as threatened, endangered and vulnerable, as shown in **Tables 1** and **2**.

1) IUCN Red List

According to the International Union for the Conservation of Nature and Natural Resources (IUCN), species are classified into nine groups, set through criteria such as rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation, as follows. In the IUCN Red List, the official term "threatened" is a grouping of three categories: Critically Endangered, Endangered, and Vulnerable.

- EX (Extinct): No individuals remaining.
- EW (Extinct in the Wild): Known only to survive in captivity, or as a naturalized population outside its historic range.
- CR (Critically Endangered): Extremely high risk of extinction in the wild.
- EN (Endangered): Not CR but whose survival in the wild is unlikely if causal factors continue operating.
- VU (Vulnerable): Neither CR nor EN but is under threat from adverse factors throughout their range and is likely to move to EN category in the near future.
- NT (Near Threatened): Likely to become endangered in the near future.
- LC (Least Concern): Lowest risk. Widespread and abundant taxa are included in this category.
- DD (Data Deficient): Not enough data to make an assessment of its risk of extinction.
- NE (Not Evaluated): Has not yet been evaluated against the criteria.

2) DAO No. 2007-01, Establishing the National List of Threatened Philippine Plants and Their Categories, and the List of Other Wildlife Species.

The following categories are used in the National List of Threatened Philippine Plants and Their Categories, and the List of Other Wildlife Species.

- CR (Critically Endangered): Extremely high risk of extinction in the wild.
- EN (Endangered): Not CR but whose survival in the wild is unlikely if causal factors continue operating.
- VU (Vulnerable): High risk of endangerment in the wild.
- Other Threatened Species: Not CR, EN nor VU but under threat from adverse factors such as over collection.
- Other Wildlife Species: Non threatened species of plants that have the tendency to become threatened due to destruction of habits or other similar causes.

5. Photographs of Botanical Survey

Photo 1. Shanties and human settlements typically found in the site

Photo 2. The site is highly polluted with domestic sources of garbage and other effluents

Photo 3. Grassland vegetation type

Photo 4. Mangrove vegetation type

Photo 5. Subsistence farming is practiced by some residents.

Photo 6. *Avicennia marina*, the mangrove species that is most abundant in the site.

II. FAUNA

1. Methodology

Primary sampling was basically transect/ocular surveys for birds while opportunistic observations and ethno-biological interviews were conducted whenever possible for other groups of wildlife. Most information from other taxa aside from birds were consulted from published species accounts, field guides and manuals, personal accounts and data from previous surveys/visits within this coastal area of Manila Bay. Detailed description of transect walk for birds and opportunistic survey for other vertebrates is discussed further:

1) Bird Surveys

Birds were systematically surveyed (diurnal only, no nocturnal surveys conducted) within the proposed JICA funded LRT Line 1 Satellite Depot in Zapote, Bacoor, Cavite on 16-23 June 2012. For rapid site assessments such as this study, birds were used as proxy for assessing the overall faunal composition in the area. Birds can easily be observed unlike other animal groups such as small mammals or lizards which require trapping or mist-netting. Bird-watching over an established transect is a widely used standard in conducting rapid site assessments and sustained monitoring even by non-specialists (Herzog et al. 2002). Data collected from the field includes listing of species and the number of individuals both from visual and aural observations (Bibby et al. 1992). Bird species nomenclature follows published accounts of Philippine birds (Kennedy et al. 2000).

2) Other wildlife inventory

Other faunal groups such as amphibians, small mammals or reptiles were assessed opportunistically during line transect counts for birds. Species inventory for other groups such as rodents and bats in the project site was inferred to historical records, published information and field guides: bats (Ingle and Heaney 1992) , amphibians (Alcala and Brown 1998) and reptiles based on Global Reptiles Database.

3) Threatened and important species

Faunal species in this inventory for the site was reviewed if listed as threatened, protected and needing conservation efforts based on updated list from the World Conservation Union (IUCN 2011), Convention on the International Trade of Endangered Species (CITES) and Convention on Migratory Species (CMS). More specifically, species were reviewed under the concern of Philippine laws particularly the Wildlife Act R.A. 9147 and the Wildlife Resources Conservation and Protection Act (2001).

2. Results

1) Bird communities

A total of fourteen species of birds were observed in all areas of the proposed project site in Las Pinas, Cavite. Majority of the species were resident breeding or those that can be found in the Philippine islands as well as in other areas of Southeast Asia. This type of species is also considered geographically widespread. Three species were migratory or those that do not breed in the Philippines. The migrants include the most abundant species in the area which was the Little Egret numbering to at least fifty individuals. There were no endemic species or those that are restricted to the Philippines.

The bird profile was typical of muddy shoreline areas as it was composed of wading species (shorebirds) such as the egret, a heron, night herons and a waterhen. These types of birds still persisted in the undeveloped muddy intertidal areas which were surrounded by human settlements and engulfed by solid garbage. Some birds that require tree vegetation were also present such as the yellow-vented bulbul and fantail while some species were basically dwellers of grassland and open areas such as the munias and zebra-dove. These strictly terrestrial species were found out to be

adaptable to urbanized settings of Metro Manila mostly in wooded parks and gardens (Vallejo, Aloy & Ong 2009).

Table 3 Listing of Avian Species Observed during Rapid Site Surveys in Zapote, Las Piñas and Bacoor, Cavite

Species	English Name	Relative Abundance	Residency[*1]	IUCN[*2]	Philippine[*3]
Egretta garzetta	Little egret	50+	M	LC	-[*4]
Passer montanus	Eurasian tree-sparrow	8	R	LC	-
Hirundo tahitica	Pacific swallow	6	R	LC	-
Lonchura malacca	Chestnut munia	6	R	LC	-
Butorides striatus	Little heron	5	M	LC	-
Pycnonotus goiavier	Yellow-vented bulbul	4	R	LC	-
Gerygone sulphurea	Golden-bellied flyeater	3	R	LC	-
Geopelia striata	Zebra dove	3	R	LC	-
Columba livia	Feral pigeon	3	R	LC	-
Amaurornis phoenicurus	White-breasted waterhen	3	R	LC	-
Nycticorax caledonicus	Rufous night-heron	2	R	LC	-
Rhipidura javanica	Pied fantail	2	R	LC	-
Megalurus palustris	Striated grassbird	2	R	LC	-
Nycticorax nycticorax	Black-crowned night-heron	2	M	LC	-

Source: Study Team

Note:
1) Residency connotations: R = resident; M = migratory.
2) IUCN 2012. The IUCN Red List of Threatened Species, Version 2012.1.
3) DAO No .2004-15 Establishing the List of Terrestrial Threatened Species And Their Categories, And The List Of Other Wildlife Species Pursuant To Republic Act No. 9147, Otherwise Known As The Wildlife Resources Conservation And Protection Act Of 2001. (-): Not fall under any of the categories.
4) (-): Not fall under any of the categories.

2) Other wildlife

Opportunistic observations lead to documentation of small mammals such as the remains of the Asian house shrew *Suncus murinus*. This small mammal is a close relative of true rodents. Based on literature reviews, abundance of garbage and dense human settlements should pave way for rats to occur which is likely the Oriental house rat *Rattus tanezumi*. As for cold-bloodied animals, even though it was not observed the Marine Toad *Rhinella marina* is likely to occur in the area as this species is globally widespread and have become associated with human communities.

The study area was primarily a marsh type habitat. There could be a quite number of intertidal dwelling fish inhabitants such as the mudskippers which were observed during low tide. Some of the notable fishes observed were fish larva and adults of milkfish (*Chanos chanos*) while saltwater-tolerant variety of tilapia was also observed.

3) Threatened species

As shown in **Table 3**, there were no species listed as threatened under international and national lists specifically from published list of the World Conservation Union (IUCN 2012), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 2011; Appendices I-III) and Convention on the Conservation of Migratory Species of Wild Animals (CMS 2012; Appendices I & II).

According to DAO No. 2004-15, Establishing the List of Terrestrial Threatened Species And Their Categories, And The List Of Other Wildlife Species Pursuant To Republic Act No. 9147, Otherwise Known As The Wildlife Resources Conservation And Protection Act Of 2001, The following categories are used:

- CR (Critically Endangered): Extremely high risk of extinction in the wild.
- EN (Endangered): Not CR but whose survival in the wild is unlikely if causal factors continue operating.
- VU (Vulnerable): Neither CR nor EN but is under threat from adverse factors throughout their range and is likely to move to EN category in the near future.
- Other Threatened Species: Not CR, EN nor VU but under threat from adverse factors such as over collection.
- Other Wildlife Species: Non threatened species of plants that have the tendency to become threatened due to destruction of habits or other similar causes.

3. Summary and Conclusion

The proposed extension and depot area in Zapote, Cavite featured a coastal muddy habitat that was characterized by a disturbed monotypic stand of mangrove trees. Disturbance was primarily pollution, mangrove collection for fuel and human encroachment along these muddy intertidal zones. Nevertheless, few species of birds were resilient especially the wetland migrants Little Egrets and some wading bird residents such as waterhens. These species were known to occur even in polluted coastal habitats in Manila Bay. However as compared to more less disturbed similar habitat type like the Las Piñas Coastal Lagoon protected zone, diversity of shorebirds was lower for this site. Probably the most important vegetative feature was the sparse growths of mangrove trees enabling these wading birds to seek refuge and occur even in these densely human populated areas. Total or significant removal of these standing mangrove species due to LRT 1 project implementation would result into absence of these birds in the future.

4. Photos

Photo 1. Captured immature Little Heron (Photo by AB Aloy)

Photo 2. An adult Little Heron standing motion-less along the muddy coastal banks awaiting to prey on small fish (Photo by AB Aloy)

Photo 3. A Little Egret foraging over garbage encroached coastal habitats in Zapote, Cavite (Photo by AB Aloy)

Photo 4. Two individuals of Yellow-vented Bulbul were resilient omnivorous birds that occurs in vegetated areas even in parks and gardens of Metro Manila (Photo by AB Aloy)

Photo 5. A White-breasted Waterhen photographed here camouflaged against the lush and thick under growths of mangrove out growths (Photo by RS Gonzales)

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Results of Sediment Quality Survey

1. Introduction

The sediment quality assessment is one of the surveys for the Environmental Impact Assessment (EIA) on the proposed Light Rail Transit (LRT) Line 1 Cavite Extension Project in Zapote, Bacoor. It aims to evaluate the current sediment quality within the project site through measurements of in situ parameters as well as sediment sampling for laboratory analyses. The field data and laboratory results will be used as baseline information in the Supplementary EIA report.

2. Survey Site

Bacoor City in the Province of Cavite is approximately 15 kilometers southwest of Metro Manila. It is bordered to the east by Las Piñas City and Muntinlupa City of Metro Manila, to the south by Dasmariñas, to the west by Kawit and Imus, and to the north by Bacoor Bay, an inlet of Manila Bay.

The survey site is located within the LRT satellite depot in Barangay Zapote. There are two pre-identified sampling sites - Wawa 1 and Wawa 2, located in the swamp along the Zapote River (**Figure 1**).

Source: Study Team (Google Earth©)

Figure 1 Locations of the Two Sampling Sites (yellow dots)

3. Materials and Methods

The survey was undertaken to gather baseline information on the sediment quality in the project site. A handheld Global Positioning System (GPS) unit was used to navigate and locate the two sampling sites.

Direct measurements of in situ parameters were done during the field survey. Thermometer and pH meter were used to obtain the sediment temperature and pH, respectively. The instruments were washed with distilled water before and after every use. Sediment color and other physical properties were identified directly as observed by the unaided eye.

Benthic sediments for laboratory analyses were collected through grab sampling. Such technique is ideal to collect an undisturbed bottom sample with minimal disruption to the surface layer. A plastic pail was submerged gradually into the water. Upon reaching the bottom, it was steadily maneuvered to scour the sediments approximately in the uppermost ten centimeters. After measuring the temperature and pH, and identifying the color, a plastic shovel was used to transfer sediments from the pail to the sampling bottles. Sampling bottles used were glass jars with plastic lid, which were cleaned and washed with acid. Samples were stored in the ice box while in the field to reduce loss of volatiles as well as decrease bacterial activity, and then were frozen afterwards.

These were submitted to three separate laboratories:

1) Mines and Geosciences Bureau (MGB) Petrochemical Laboratory for the analyses of eight (8) metals namely: arsenic (As) , cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni) and zinc (Zn);
2) SGS Philippines, Inc. for the particle size distribution, moisture content, total organic carbon, total nitrogen and total phosphorus; and
3) SGS Australia Pty Ltd., which was subcontracted by SGS Philippines, Inc., for the organochlorine pesticides (HCB - hexachlorobenzene, DDT - dichlorodiphenyltrichloroethane, chlordane, aldrin, dieldrin and endrin), total PCBs (polychlorinated biphenyls) and total PAHs (polyaromatic hydrocarbons). The turnaround of the results from the laboratories ranged from seven to 21 working days.

4. Results

Table 1 Field Survey Data

Parameters	Wawa 1	Wawa 2
Geographical coordinates	14°28.448' N 120°58.132'E	14°28.332' N 120°58.162'E
Date of sampling	June 20, 2012	June 20, 2012
Time of sampling	11:44 am	12:30 pm
Sediment temperature	29°C	31°C
Sediment pH	7.40	7.17
Sediment color	Dark gray	Black
Sediment properties	Silt with garbage debris (leaves)	Silt with garbage debris (sanitary napkin)
Water depth where sediments were collected	1.36 meters	1.27 meters
Weather Condition	Sunny	Sunny

Source: Study Team

Table 2 Quantification Limits and Methodology of Laboratory Analyses

Substance	Quantification Limit	Methodology
Particle size distribution	Not applicable	Sieve test (mesh #200 and mesh #325)
Moisture content	0.002 %	ASTM D2216-10
Organic carbon	0.03 %	Black and Walkley (Lab Manual for the Analysis of Soils, Waters, Fertilizers, Feeds, Plant Tissues, etc. 1st edition)
Nitrogen	0.1 %	Based on AOAC Official Methods, 18th edition, 2005
Phosphorus	5.7 mg/kg	SMEWW 4500-P B and C
Metals		
Arsenic (As)	-	Flame AAS using HVG
Cadmium (Cd)	-	Flame AAS
Chromium (Cr)	-	Flame AAS
Copper (Cu)	-	Flame AAS
Lead (Pb)	-	Flame AAS
Mercury (Hg)	-	Cold Vapor using MA-2000
Nickel (Ni)	-	Flame AAS
Zinc (Zn)	-	Flame AAS
Organic Compounds		
HCB	660 µg/kg	USEPA-8270D
Aldrin	0.1 – 0.2 mg/kg	AN420
Alpha-chlordane	0.1 – 0.2 mg/kg	AN420
Dieldrin	0.1 – 0.2 mg/kg	AN420
Endrin	0.1 – 0.2 mg/kg	AN420
Gamma-chlordane	0.1 – 0.2 mg/kg	AN420
p,p-DDT	0.1 – 0.2 mg/kg	AN420
1-methylnaphthalene	660 µg/kg	USEPA-8270D
2-methylnaphthalene	660 µg/kg	USEPA-8270D
Acenaphthene	660 µg/kg	USEPA-8270D
Acenaphthylene	660 µg/kg	USEPA-8270D
Anthracene	660 µg/kg	USEPA-8270D
Benzo(a)anthracene	660 µg/kg	USEPA-8270D
Benzo(a)pyrene	660 µg/kg	USEPA-8270D
Benzo(b&k)fluoranthe	660 µg/kg	USEPA-8270D
Benzo(ghi)perylene	660 µg/kg	USEPA-8270D
Chrysene	660 µg/kg	USEPA-8270D
Dibenzo(ah)anthracene	660 µg/kg	USEPA-8270D
Fluoranthene	660 µg/kg	USEPA-8270D
Fluorene	660 µg/kg	USEPA-8270D
Indeno(1,2,3-cd)pyrene	660 µg/kg	USEPA-8270D
Naphthalene	660 µg/kg	USEPA-8270D
Phenanthrene	660 µg/kg	USEPA-8270D
Pyrene	660 µg/kg	USEPA-8270D
PCB Congener C101	0.1 – 0.2 mg/kg	AN420
PCB Congener C118	0.1 – 0.2 mg/kg	AN420
PCB Congener C138	0.1 – 0.2 mg/kg	AN420
PCB Congener C153	0.1 – 0.2 mg/kg	AN420
PCB Congener C180	0.1 – 0.2 mg/kg	AN420
PCB Congener C28	0.1 – 0.2 mg/kg	AN420
PCB Congener C52	0.1 – 0.2 mg/kg	AN420

Source: Study Team

Table 3 Results of Laboratory Analyses

Substance	Wawa 1	Wawa 2
Mesh #325 Retained (0.044mm)	10.35 %	35.45 %
Mesh #325 Passed Through (0.044mm)	89.65 %	64.55 %
Mesh #200 Retained (0.074mm)	9.20 %	25.49 %
Mesh #200 Passed Through (0.074mm)	90.80 %	74.51 %
Moisture content	72.0 %	64.6 %
Organic carbon	1.17 %	1.23 %
Nitrogen	<0.1 %	<0.1 %
Phosphorus	87.0 mg/kg	113.3 mg/kg
Metals (mg/kg)		
Arsenic (As)	5.93	5.78
Cadmium (Cd)	<1	<1
Chromium (Cr)	17	17
Copper (Cu)	172	136
Lead (Pb)	43	43
Mercury (Hg)	0.28	0.215
Nickel (Ni)	5	39
Zinc (Zn)	389	402
Organic Compounds (mg/kg)		
HCB	<0.2*	<0.1
Aldrin	<0.2*	<0.1
Alpha-chlordane	<0.2*	<0.1
Dieldrin	<0.2	<0.2
Endrin	<0.2	<0.2
Gamma-chlordane	<0.2*	<0.1
p,p-DDT	<0.2*	<0.2*
1-methylnaphthalene	<0.2*	<0.1
2-methylnaphthalene	<0.2*	<0.1
Acenaphthene	<0.2*	<0.1
Acenaphthylene	<0.2*	<0.1
Anthracene	<0.2*	<0.1
Benzo(a)anthracene	<0.2*	<0.2*
Benzo(a)pyrene	<0.2*	<0.1
Benzo(b&k)fluoranthe	<0.2*	<0.2
Benzo(ghi)perylene	<0.2*	<0.1
Chrysene	<0.2*	<0.1
Dibenzo(ah)anthracene	<0.2*	<0.1
Fluoranthene	<0.2*	<0.2*
Fluorene	<0.2*	<0.1
Indeno(1,2,3-cd)pyrene	<0.2*	<0.1
Naphthalene	<0.2*	<0.1
Phenanthrene	<0.2*	<0.1
Pyrene	<0.2*	<0.2*
PCB Congener C101	<0.2*	<0.1
PCB Congener C118	<0.2*	<0.1
PCB Congener C138	<0.2*	<0.1
PCB Congener C153	<0.2*	<0.1
PCB Congener C180	<0.2*	<0.1
PCB Congener C28	<0.2*	<0.1
PCB Congener C52	<0.2*	<0.1

Source: Study Team

Notes:
1. "<" less than means the test result is lower than the quantification limit.
2. Samples for organic compound analyses contained large amount of liquid, which was removed from the soil prior to analyses
3. Due to high moisture content and sample matrix, limits of reporting (or practical quantification limits) were raised (with *)
4. Results are in dry-weight basis

5. Discussion

Benthic sediments from the two sampling sites are dark gray to black in color. Grain size is generally silt (0.0039 – 0.0625 mm, Wentworth classification) where most particles passed through mesh number 325 (<0.044 mm). Few detritus such as leaves, broken glass and other gabage were also mixed with the samples.

Temperature of sediments from Wawa 2 is higher than the one measured from Wawa 1. This could be because sampling was done in Wawa 2 a little past noontime when ambient temperature was also higher. The pH of sediments from the two sites is slightly basic. Both samples have high moisture content, too (i.e. more than 50%).

Laboratory analyses revealed that the levels of TOC, Nitrogen and Phosphorus recorded at these swamps were relatively low. Therefore it is inferred that the nutrients concentrations in the sediments does not reflect the characteristics of an estuarine environment greatly enriched by organic matter and nutrients.

The Canadian Interim Sediment Quality Guidelines (ISQGs) and Centre for Environment, Fisheries and Aquaculture Science (CEFAS) Guideline Action Levels for the disposal of dredged materials were bases to assess the sediment quality in terms of metals, organochlorine pesticides, total PCBs and total PAHs.

The Canadian ISQGs currently include threshold effect levels (TELs) and probable effect levels (PELs) (**Table 4**). The levels are used to identify the three ranges of chemical concentrations with regards to biological effects. If below TEL, the minimal effect range within which adverse effects rarely occur; if between TEL and PEL, the possible effect range within which adverse effects occasionally occur; and if above PEL, the probable effect range within which adverse effects frequently occur.

The CEFAS guidelines (**Table 5**) are not statutory contaminant concentrations for dredged materials but are used as part of a weight of evidence approach to decision-making on the disposal of materials to sea. If concentrations are below action level 1, then refusal of disposal to sea due to contamination is unlikely; if between action levels 1 and 2, then further assessment is required; and if more than action level 2, then dredged materials may not be approved for disposal to sea.

Table 4 Canadian Interim Sediment Quality Guidelines (ISQGs)

Substance	Marine water[*1]		Fresh water	
	ISQG/TEL[*2]	PEL[*3]	ISQG/TEL[*2]	PEL[*3]
Metals [mg/kg]	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic (As)	7.24	41.6	5.9	17
Cadmium (Cd)	0.7	4.2	0.6	3.5
Chromium (Cr)	52.3	160	37.3	90
Copper (Cu)	18.7	108	35.7	197
Lead (Pb)	30.2	112	35.0	91.3
Mercury (Hg)	0.13	0.7	0.17	0.486
Zinc (Zn)	124	271	123	315
Organic Compounds [µg/kg]	µg/kg	µg/kg	µg/kg	µg/kg
Chlordane	2.26	4.79	4.5	8.87
DDD	1.22	7.81	3.54	8.51
DDE	2.07	374	1.42	6.75
DDT	1.19	4.77	1.19	4.77
Dieldrin	0.71	4.3	2.85	6.67
Endrin	2.67	62.4	2.67	62.4
Heptachor epoxide	0.6	2.74	0.6	2.74
Lindane (UCH)	0.32	0.99	0.94	1.38
PCBs: Aroclor 1254	63.3	709	60	340
PCBs: Total PCBs	21.5	189	34.1	277
PAH: Acenaphthene	6.71	88.9	6.71	88.9
PAH: Acenaphthylene	5.87	128	5.87	128
PAH: Anthracene	46.9	245	46.9	245
PAH: Benzo(a)anthracene	74.8	693	31.7	385
PAH: Benzo(a)pyrene	88.8	763	31.9	782
PAH: Chrysene	108	846	57.1	862
PAH: Dibenzo(ah)anthracene	6.22	135	6.22	135
PAH: Fluoranthene	113	1494	111	2355
PAH: Fluorene	21.2	144	21.2	144
PAH: 2-methylnaphthalene	20.2	201	20.2	201
PAH: Naphthalene	34.6	391	34.6	391
PAH: Phenanthrene	86.7	544	41.9	515
PAH: Pyrene	153	1398	53	875

Source: Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (2002)

Note:

(1) Including estuarine.

(2) Interim Sediment Quality Guidelines (ISQG). The lower value, referred to as the threshold effect level (TEL), represents the concentration below which adverse biological effects are expected to occur rarely.

(3) The upper value, referred to as the probable effect level (PEL), defines the level above which adverse effects are expected to occur frequently.

(4) By calculating TELs and PELs according to a standard formula, three ranges of chemical concentrations are consistently defined:

1) the minimal effect range within which adverse effects rarely occur (i.e., fewer than 25% adverse effects occur below the TEL),

2) the possible effect range within which adverse effect occasionally occur (i.e., the range between the TEL and PEL), and

3) the probable effect range within which adverse biological effects frequently occur (i.e., more than 50% adverse effects occur above the PEL).

Table 5 CEFAS Guideline Action Levels for the disposal of dredged materials

Substance	Units	Action Level 1	Action Level 2
Arsenic (As)	mg/kg	10	25-50
Cadmium (Cd)	mg/kg	0.2	2.5
Chromium (Cr)	mg/kg	20	200
Copper (Cu)	mg/kg	20	200
Lead (Pb)	mg/kg	25	250
Mercury (Hg)	mg/kg	0.15	1.5
Nickel (Ni)	mg/kg	10	100
Zinc (Zn)	mg/kg	65	400
Organotins	mg/kg	0.1	1
PCBs: sum 7 congeners	mg/kg	0.01	-
PCBs: sum 7 congeners	mg/kg	0.02	0.02
Oil (petroleum hydrocarbons)	mg/kg	100	-
DDT: sum DDT + derivatives	mg/kg	0.001	-
Dieldrin	mg/kg	0.005	-

Source: Centre for Environment, Fisheries & Aquaculture Science (CEFAS) Guideline Action Levels (2003)

Results of metal analysis show that sediments from Wawa 1 have higher concentrations of As, Cu, and Hg compared to those from Wawa 2. On the other hand, sediments from Wawa 2 have higher concentrations of Ni and Zn vis-à-vis Wawa 1 sediments.

Based on the Canadian ISQGs, the following assessment is applicable to both sampling sites: As and Cr are below TEL; Cu, Hg and Pb are between TEL and PEL; and Zn is above PEL. The value of Cd is inconclusive as its quantification limit is above TEL, though it is definitely below PEL. There is no TEL and PEL values for Ni, thus, cannot be assessed.

Based on the CEFAS guidelines, this assessment can be derived: As, Cr and Ni from Wawa 1 are below action level 1; Cu, Pb, Hg, Ni from Wawa 2 and Zn from Wawa 1 are between action levels 1 and 2; and Zn from Wawa 2 is almost the same as action level 2. Similarly, Cd cannot be assessed because of its quantification limit. Nevertheless, its concentration is below action level 2.

Results of all organic compounds are lower than the quantification limit whose values range from 0.1 mg/kg (100µg/kg) to 0.2 mg/kg (200µg/kg). Some substances have raised limits of reporting during testing because of high moisture content and sample matrix. In general, concentration of most substances is higher in sediments from Wawa 1.

6. CONCLUSION AND RECOMMENDATIONS

In order to assess the potential impacts of the proposed project, it is imperative to understand the natural environment of the site. This includes studying the physical and chemical characteristics of sediments in the river system.

There is a possibility of anthoropogenic pollution in the sediments from Wawa 1 and 2. The phosphorus could be due to the household detergents disposed directly by the residents to the swamp. While the organic carbon could be attributed to the presence of dump sites around the area. Therefore, waste management should be considered.

Based on the prescribed guidelines, the adverse effects of the high concentration of Zn could frequently occur, and the disposal of dredged materials with high concentration of Zn to sea may be disapproved. Hence, special attention should be given in monitoring and evaluating this metal.
Although the results of organic compounds were lower than the minimum quantification limit, it does not mean their concentrations are below the TEL and/or PEL. Some of the Persistent Organic

Pollutants (POPs) and PAHs might be exist at TEL and/or even PEL. This is because the areas of Wawa 1 and Wawa 2 are near the dump sites, and there are numerous households around them who contribute to waste accretion. Therefore, more sediment samples should be collected and rigorously analyzed to investigate the extent of concentration of these organic compounds within Wawa 1 and Wawa 2 at the pre-construction phase.

Potential Impacts on Esturine Environment and Mitigation Measures

During the construction phase of the proposed development, the dredging and excavation activities would remove the surface sediments within the project site. This would expose the sediments at depth or even the bedrock, which have lower level of contamination than the surface. In this respect, dredging would improve the quality of the surface sediment, and thus, an impact of minor beneficial significance is predicted.

The sediment quality is likewise expected to recover during this phase. This is because the dump sites and communities that are currently the pollution sources would be removed from the area and relocated. Thus, an impact of major beneficial significance is predicted.

On the other hand, dredging and excavation would cause siltation and increase in the turbidity of water draining to the river and sea. When water becomes turbid and murky, the amount of sunlight entering the deeper parts of the water would decrease and eventually affect both freshwater and marine organisms. The chemical contaminants contained in the sediments would also be deposited to the sea.

In order to minimize the unwanted impacts in the water quality, regulated dredging and excavation in terms of the volume of sediments being dug up and the spatial extent of unearthing should be observed. Consideration of structural mitigation measures such as diffusion prevention, if deemed necessary by the contractor, is also recommended during the detailed design stage.

7. References

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AN420 method:
https://docs.google.com/open?id=1saPqqVp8nBKY6ybZWALdzz0_6zbtVFGvTG3MLOnEeOTRdyT8offztbtj3wzg

US EPA 8270D method:
https://docs.google.com/open?id=1pcqAz62OjQsVfoLSawbG6-c03oM5Q2M8CFh0t9N1nWtrZhzyri3Oj 8Nv65q

Appendix E-3 List of Potential Affected Households in Proposed Satellite Depot

ID no.	Location	Name of Household Head	HH Size	Year of Residency	Occupation (HH Head)	Tenurial Status	Use of Structure	Type of Structure	Remarks (change from 2008 census)
1	Wawa2	Enot,Conchita Elleran	2	10	Fish Vendor	Owner	Residential	Temporary/Movable	
2	Wawa2	Dote,JunRey Andno	5	10	Side-car Driver	Renter	Residential	Temporary/Movable	
3	Wawa2	Violen,Luisito Papauran	8	12	Taho Vendor	Owner	Residential	Temporary/Movable	
4	Wawa2	Mahusay, Eleonor Enot	8	10	Fish Vendor	Owner	Residential	Semi-permanent	
5	Wawa2	Mancinldo,Rogelio Santos	2	?	Carpenter	Owner	Residential	Semi-permanent	
6	Wawa2	Cabanza, Marissa	5	?	Construction Worker	Owner	Residential	Semi-permanent	New Household
9	Wawa2	Traboc, Andres Dayon	5	?	Home Helper	Owner	Residential	Semi-permanent	
10	Wawa2	Rosales, Danle Mantal	6	12	Fish Vendor	Owner	Residential	Semi-permanent	
11	Wawa2	Dapadap, Ramilo Guelas	6	12	Fisherman	Owner	Residential	Semi-permanent	
12	Wawa2	Cancillar,Ledelina Aguellas	5	3	Manicure	Owner	Residential	Temporary/Movable	New Household
13	Wawa2	Cantuba, Jordan O.	4	4	Side-Car Driver	Owner	Residential	Temporary/Movable	New Household
14	Wawa2	Cantuba,Jaymar Ordono	4	3	Pedi-Cab Driver	Owner	Residential	Temporary/Movable	New Household
15	Wawa2	Cantuba,Antonio Armogera	5	11	Pedi-Cab Driver	Owner	Residential	Semi-permanent	
16	Wawa2	Pacleta,Diomedes Omin	10	8	Pedi-Cab Driver	Owner	Residential	Semi-permanent	
17	Wawa2	Janaban,Rudy Villafuerte	8	6	Electrician	Owner	Residential	Semi-permanent	
18	Wawa2	Dumagan,Rommel Bucado	6	?	Pedi-Cab Driver	Owner	Residential	Temporary/Movable	
19	Wawa2	Recososa,Alfredo Atal	6	10	Carpenter	Owner	Residential	Temporary/Movable	
20	Wawa2	Donor, Gregorio Sr.	4	12	Construction Worker	Owner	Residential	Temporary/Movable	
21	Wawa2	Donor, Greaorio Bolor Jr.	8	4	Garbage Collector	Owner	Residential	Temporary/Movable	
22	Wawa2	Pioquid, Joselito 8alais	6	7.5	Garbage Collector	Owner	Residential	Temporary/Movable	
23	Wawa2	Corcillar, Roderick Guelas	3	8	Barber	Owner	Residential	Semi-permanent	
24	Wawa2	Lopez, Noel Melgar	4	9	Security Guard	Owner	Residential	Semi-permanent	
25	Wawa2	Maestre, Bien Picardal	5	7	Construction Worker	Renter	Residential	Temporary/Movable	
26	Wawa2	Holar, Raul Rodriguez	4	6	Driver	Owner	Resid/Comm	Temporary/Movable	
27	Wawa2	Lucinisio, Ricky Etleran	3	5	Fisherman	Owner	Residential	Temporary/Movable	
28	Wawa2	Tolones, Ricardo N.	2	1	-	Renter	Residential	Temporary/Movable	New Structure
29	Wawa2	Clamor, Jose Fortun	4	8	Welder	Owner	Residential	Temporary/Movable	
30	Wawa2	Amante, Rex Odober	5	9	Fisherman	Owner	Residential	Temporary/Movable	

ID no.	Location	Name of Household Head	HH Size	Year of Residency	Occupation (HH Head)	Tenurial Status	Use of Structure	Type of Structure	Remarks (change from 2008 census)
31	Wawa2	Aranda,ricardo alfonso	6	2.5	Auto painter	Renter	Residential	Temporary/Movable	New Household
32	Wawa2	Mang aran, Mario. Castro	3	0.42	Construction Worker	Renter	Residential	Semi-permanent	New Household
33	Wawa2	Yepis, Susana Cadaro	3	5	Landry	Rent-fre	Resid/Comm	Temporary/Movable	
34	Wawa2	PacHta, Alfonzo Umen	3	12	Carpenter	Owner	Resid/Comm	Temporary/Movable	
35	Wawa2	Rigo, Faustino Espinosa Jr.	4	0.5	Construction Worker	Renter	Residential	Temporary/Movable	New Household
36	Wawa2	Reyes, Nestor Igloso	3	12	Fisherman	Owner	Residential	Temporary/Movable	
37	Wawa2	Dapitan, Noli Lagarto	4	11	Construction Worker	Owner	Residential	Semi-permanent	New Household
38	Wawa2	Gallano,Jonell C.	6	-	Security Guard	Owner	Residential	Temporary/Movable	New Household
39	Wawa2	Castillo, Nino	7	0.42	Security Guard	Renter	Residential	Temporary/Movable	New Household
40	Wawa1	Merciales, Ricardo Cedeno	5	11	Fisherman	Owner	Residential	Temporary/Movable	
41	Wawa1	Casica, Emar Bola	5	?	-	Owner	Residential	Temporary/Movable	
42	Wawa1	Cyrus, Santos Merciaus	2	2	Sari-Sari Store	Owner	Resid/Comm	Temporary/Movable	New sari-sari
	Total		194	-	-	-	-	-	-

Source: LRTA Community Relations

Appendix E-4 Draft Entitlement Matrix

Table 1 Draft Entitlement Matrix For Informal Settlers

Type of Loss	Application	Entitled Person	Compensation/Entitlements	Responsible Organization	Remarks/ Issues to be accomplished by LRTA
HOUSEHOLDS OF INFORMAL SETLLERS	Landless, informal occupants of public land and private land, except Professional Squatters and Squatting Syndicates as defined in RA 7279.	Qualified beneficiary households: a. The household has not availed of any government housing assistance. b. The household shall have agreed to dismantle his/her structure from the affected areas of the project. c. The household must be included in the Census Masterlist of the Project in 2008. (*1) Beneficiaries shall be prioritized as follows: Priority I: Qualified structure owners Priority II: Qualified non-structure owners (renters and rent-free occupants)	• The housing package option: 1) A house and lot package at Gen. Trias, Cavite. (Rent with option to buy: *2) or 2) Financial assistance equivalent to minimum wage multiplies by 60 days (UDHA 7279); or, Cash compensation for affected structures at full replacement cost. (whichever is higher: *3) •Transportation and manpower assistance to the relocation sites for family members and personal possessions during actual relocation (including disqualified families) • Food Assistance during transfer: A minimum of three (3) days food assistance provided by the sending LGUs for every family being relocated. 3)Balik-Probinsya (Back to the province) Program: (*4)	LRTA, Cavite Province	(*1) The validation of beneficiary list of informal settlers in RAP (2008) has been undertaken from the middle of July 2012 by retagging operation and re-census survey. The validation survey will be completed in three months. If discrepancy is found to be large due to encroachment or moving-out, reevaluation by the Beneficiary Selection, Awards and Arbitration Committee shall be considered. (*2) Rent is not determined yet, but it depends on the result of the census based on the income and expenses of the affected family. (*3) The gap should be filled in. According to LRTA, no affected households chose the financial assistance option. (*4) The availability and eligibility of the Balik-Probinsya Program should be confirmed. According to LRTA, no affected households chose the Balik-Probinsya Program.
	Structures	Qualified structure owners	Ditto	LRTA, Cavite Province	
	Crops, Trees and Perennials (*5)	Qualified households	Cash compensation for crops (which are not yet suitable for harvesting), trees, and perennials at current market value.	LRTA, Cavite Province	(*5) No households whose livelihood depends on land based activities such as agriculture.

Type of Loss	Application	Entitled Person	Compensation/Entitlements	Responsible Organization	Remarks/ Issues to be accomplished by LRTA
	Livelihood rehabilitation assistance and training	Qualified beneficiary households/families who relocated will be relocated to Gen. Trias, Cavite	➢ Training • Skills training to match labor demands of the economic zones • Small business development training and assistance with business management training and marketing ➢ Micro credit • Loans to establish small business and enterprise ➢ Job placement • Assistance to find jobs with local employers • Assistance to secure contracts and/or subcontractors for worker guilds ➢ Cooperatives • Assistance to establish cooperatives for service providers, producers, consumers, transport and credit associations. ➢ Education Assistance •Unit schools are established within the relocation site; • Every elementary and high school student will be guaranteed enrolment in the nearest public school.	LRTA, Cavite Province	

Source: Study Team

Table 2 Draft Entitlement Matrix For Legal Asset Owners

This draft entitlement matrix is based on the DPWH "Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy, 3rd edition (2007)

Type of Loss	Application	Entitled Person	Compensation/Entitlements	Responsible Organization	Remarks/ Issues to be accomplished by LRTA
LAND (Classified as Agricultural, Residential, Commercial, or Institutional) (*6)	More than 20% of the total landholding lost or where less than 20% lost but the remaining land holding become economically unviable.	Affected Family (AF) with Torrens Title Certificate (TCT) or tax declaration (Tax declarations that can be legalized to full title), or other acceptable proof of ownership	• Cash compensation for loss of land at full replacement cost at the informed request of PAFs • If feasible, land for land will be provided in terms of a new parcel of land of equivalent productivity, at a location acceptable to PAFs. • Rehabilitation assistance in the form of skills training and other development activities and equivalent to PhP xx,000 (*7) will be provided in coordination with other government agencies if the present means of livelihood is no longer viable and the PAF will have to engage in a new income activity.	LRTA	(*6) Land acquisition has been undertaken in accordance with the procedures based on RA 8974. (*7) For example, PhP 15,000 according to DPWH's LARRIP Policies (2007).
		AF with no title or tax declaration to the land or other acceptable proof of ownership	•Cash compensation for damaged crops at market value at the time of taking. • Agricultural lessors are entitled to disturbance compensation equivalent to five times the average of the gross harvest for the past 3 years but not less than PhP xx,000. (*8,9)	LRTA	(*8) According to LRTA, there are no agricultural activities in the private lands. (*9) For example, PhP 15,000 according to DPWH's LARRIP Policies (2007).
	Less than 20% of the total landholding lost or where less than 20% lost or where the remaining land holding still viable for use.	AF with TCT or tax declaration (Tax declarations that can be legalized to full title), or other acceptable proof of ownership	• Cash compensation for loss of land at full replacement cost at the informed request of PAFs	LRTA	
		AF with no title or tax declaration to the land or other acceptable proof of ownership	•Cash compensation for damaged crops at market value at the time of taking. • Agricultural lessors are entitled to disturbance compensation equivalent to five times the average of the gross harvest for the past 3 years but not less than PhPxx,000. (*8,9)	LRTA	

Type of Loss	Application	Entitled Person	Compensation/Entitlements	Responsible Organization	Remarks/ Issues to be accomplished by LRTA
STRUCTURES (Classified as Residential/ Commercial/ Industrial)	More than 20% of the total landholding loss or where less than 20% loss but the remaining structures no longer function as intended or no longer viable for continued use.	Owners of structure with full title or tax declaration to the land or those who are covered by customary law (e.g., possessory rights, usufruct) or other acceptable proof of ownership	• Cash compensation for entire structure at full replacement cost. • Transportation assistance • Rehabilitation assistance in the form of skills training and other development activities and equivalent to PhP xx,000 (*7) will be provided in coordination with other government agencies if the present means of livelihood is no longer viable and the PAF will have to engage in a new income activity.	LRTA	
		Owners of structures, have no title or tax declaration to the land or other acceptable proof of ownership	• Cash compensation for entire structure at full replacement cost. • Transportation assistance • Rehabilitation assistance in the form of skills training and other development activities and equivalent to PhP xx,000 (*7) will be provided in coordination with other government agencies if the present means of livelihood is no longer viable and the PAF will have to engage in a new income activity.	LRTA	
		Renters (tenants) of leased affected structures	• If shifting is required, PAF is given transitional allowance equivalent to one month rent of a similar structure within the same area (*10) • Transportation assistance	LRTA	(*10) For example, according to DPWH's LARRIP Policies (2007), rental subsidy equivalent for 3-month, maximum Php15,000.
	Less than 20% of the total landholding lost or where the remaining structure can still function and is viable for continued use.	Owners of structure with full title or tax declaration to the land or those who are covered by customary law (e.g., possessory rights, usufruct) or other acceptable proof of ownership	• Cash compensation for the affected portion of the structure as replacement cost, including the cost of restoring the remaining structure with no depreciation nor deduction for salvaged building materials (full replacement cost).	LRTA	
		Owners of structures, have no title or tax declaration to the land or other acceptable proof of ownership	• Ditto	LRTA	

Type of Loss	Application	Entitled Person	Compensation/Entitlements	Responsible Organization	Remarks/ Issues to be accomplished by LRTA
IMPROVEMENTS	Severely or marginally affected	Owners of improvements, PAF with or without TCT, tax declaration, etc.	• Cash compensation for the affected improvements at full replacement cost.	LRTA	
CROPS, TREES, PERRENIALS			• Cash compensation for crops (which are not yet suitable for harvesting), trees, and perennials at current market value. (*5)	LRTA	
BUSINESS (*11)	Entire shop affected or when the remaining structure becomes not viable for continued use, with or without a building permit	Owner of structure with or without full title or tax declaration to the land or those who are covered by customary law (e.g., possessory rights, usufruct) or other acceptable proof of ownership	• Compensation in cash for the entire structure at full replacement cost. • Subsistence allowance of PhP xx,000 (*12) to each PAF • Rehabilitation assistance in the form of skills training and other development activities and equivalent to PhP xx,000 will be provided in coordination with other government agencies if the present means of livelihood is no longer viable and the PAF will have to engage in a new income activity. • If household is relocating, PAF will be entitled to: - Free transportation - Substitute lot of equal or bigger area and, preferably, near the PAF household's original place	LRTA	(*11) According to LRTA, there are no affected business owners. (*12) For example, PhP 15,000 according to DPWH's LARRIP Policies (2007).
		Renters (tenants) of affected shops	• Subsistence allowance of PhP xx,000. (*12) • If shifting, either permanently or temporarily is required, shop renters are entitled to free transportation • Rehabilitation assistance in the form of skills training and other development activities and equivalent to PhP xx,000 (*12) will be provided in coordination with other government agencies if the present means of livelihood is no longer viable and the PAF will have to engage in a new income activity.	LRTA	

Type of Loss	Application	Entitled Person	Compensation/Entitlements	Responsible Organization	Remarks/ Issues to be accomplished by LRTA
	Shops, with or without building permit, partially affected and the remaining structures are still viable for continued use.	Owners of structure with or without full title or tax declaration to the land or those who are covered by customary law (e.g., possessory rights, usufruct) or other acceptable proof of ownership	• Compensation in cash for affected portion of the structure, including the cost of restoring the remaining structure and reconnection of any damaged utilities with no deduction for salvaged building materials. • PAF will be entitled to a transitional allowance to cover for their computed income loss during the demolition and reconstruction of their ships, but not to exceed a 1 month period.	LRTA	
		Renters (tenants) of affected shops	• Shop renters will be entitled to a transitional allowance to cover for their computed income loss during the period that their business is interrupted.	LRTA	
VENDORS	Ambulant vendors in Baclaran area	Ambulant vendors permitted by LGUs	• Transportation assistance •Temporary relocation site within the area where they can still continue their business	LRTA, LGUs	
PUBLIC STRUCTURES	Loss of, or damage to, public infrastructure (e.g., Barangay waiting shed, military outpost).	-	• Compensation in cash at replacement cost to respective barangay governments.	LRTA, LGUs	
LIVELIHOOD REHABILITATION ASSISTANCE AND TRAINING	If the present means of livelihood is no longer viable and the PAF will have to engage in a new income activity	Land based activities (agriculture) Business (shops)	Refer to corresponding entitlements. • Rehabilitation assistance in the form of skills training and other development activities and equivalent to PhP xx,000 (*12) will be provided in coordination with other government agencies if the present means of livelihood is no longer viable and the PAF will have to engage in a new income activity.	LRTA	(*12) For example, PhP 15,000 according to DPWH's LARRIP Policies (2007).

Source: Study Team

Appendix E-5 Draft Environmental Checklist (Railways) for LRT Line 1 Cavite Extension Project

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1. Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Y (b) N (c) N (d) N	(a) The Environmental Impact Statement (EIS) was submitted to the Environmental Management Bureau (EMB) on June 19, 2012. (b) Under review by EMB and the EIA Review Committee. (c) Approval will come in the form of an Environmental Compliance Certificate (ECC) which will be issued by the EMB after the substantive review process. (d) This is outside the purview of the ECC issuance and EIA review process. However, specific permits (e.g., discharge permit, authority to construct wastewater treatment facilities, etc.) will be secured before commencement of constrution.
	(2) Explanation to the Local stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) For the current ECC application, Public Consultation meetings were conducted on March 9, 12 and 13, 2012 in Bacoor, Cavite, Las Pliñas and Parañaque, respectively, to gather issues and concerns that the stakeholder and communities may have towards the Project. (b) The comments and issues were resolved and these are continually monitored by the LRTA.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Several alternative alignments had been examined in 1990s. The Project, as currently proposed, is a result of a selection process which considered the minimization of social and environmental impacts.
2. Pollution Control	(1) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? (b) Do effluents from the project facilities, such as stations, comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas not to comply with the country's ambient water quality standards?	(a) Y (b) Y, N	(a) Although it is foreseen to be minimal, best practices in construction and site management can easily prevent sediment-laden runoff from reaching adjacent water bodies. (b) The design of physical structures will conform to the Philippine building and environmental standards and regulations. No untreated effluents will be discharged from the facilities to water bodies.
	(2) Wastes	(a) Are wastes generated from the project facilities, such as stations and depot, properly treated and disposed of in accordance with the country's regulations?	(a) Y	(a) The Project is governed by Presidential Decree No. 984 and Department of Environment and Natural Resources Administrative Order No. 35, Series of 1992 (DAO 35) – regulations on effluents and Republic Act No 6969 – regulations on hazardous wastes. Specific permits (e.g., discharge permit, authority to construct wastewater treatment facilities, etc.) will be secured later.
	(3) Noise and Vibration	(a) Do noise and vibrations from the vehicle and train traffic comply with the country's standards?	(a) Y	(a) A study was undertaken to predict the noise level to be generated by the proposed Project that could affect the Baclaran Church. It can be deduced from these findings that the operation of the LRT trains, will not

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				significantly affect the Baclaran Church activities in terms of nuisance from the noise it will generate. Although the effects on the Baclaran Church religious rites/activities are expected to be minimal, it would still be prudent to adopt noise minimization measures such as the provision of noise barriers, or by using shock absorber pads and ballast to help reduce noise and vibration.
	(4) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence (especially in case of Undergrounds/Subways)?	(a) N	(a) Not Applicable
3. Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) The alignment will traverse highly urbanized and mostly built-up areas.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock? (e) Is there a possibility that installation of rail roads will have impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered? f) In cases the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	(a) N (b) N (c) N (d) Y (e) N (f) N	(a) The route alignment will pass through dominantly urban and built-up areas. No sensitive ecosystem or habitat will be affected. A Satellite Depot at Zapote is planned in the former mangrove swamp, but where already deteriorated by the informal settles. (b) No. (c) Not Applicable (d) No disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock will be anticipated. (e) Native plant species will be used for re-vegetation. (f) Not Applicable
	(3) Hydrology	(a) Is there a possibility that alteration of topographic features and installation of structures, such as tunnels will adversely affect surface water and groundwater flows?	(a) N	(a) The study for flood protection measures at Satellite Depot in Detailed Design shall be conducted, since one of the flood flow routes in the swamp will be reclaimed at Satellite Depot at Zapote.
	(4) Topography and Geology	(a) Is there a soft ground on the route that may cause slope failures or landslides? Are adequate measures considered to	(a) Y (b) N	(a) More detailed investigation will be necessary during the Detailed Design stage so that potential for liquefaction and ground settlement for

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		prevent slope failures or landslides, where needed? (b) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(c) Y, Y	critical sections will be able to be thoroughly assessed. (b) There is no large-scale filling and cutting work. (c) Contractor will be prohibited from stockpiling construction spoils anywhere near water courses nor artificial drainage systems to avoid clogging of these drainage systems. Conventional sediment and erosions control measures will be put in place. Sufficient and effective drainage systems will be incorporated in the detailed design of the structures and stations to offset effects of increase in amount of impermeable surfaces as well as to compensate for the differences in elevation between the raised (constructed) areas and the surrounding low-lying communities.
4. Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) Y (b) Y (c) Y (d) Y (e) Y (f) Y (g) Y (h) Y (i) Y (j) Y	(a) In 2002 a Resettlement Action Plan (RAP) was once prepared for LRTA by Test Consultants, Inc. However, the LRT Line Extension Project was not implemented. In November 2008 the Relocation Action Plan (RAP) was made based on a series of consultations with households, giving attention to the informal settlers, who would be directly affected by the L1CEP within the ROW of the proposed alignment. The RAP was revised by LRTA in 2012 to update the relocation work schedule started from April 2012. Relocation Action Plan (2008) reported that the result of the census registered 1714 affected families in all the areas and 1941 structures to be demolished. “Resumption of works of Consultancy for Social Preparation and Pre-Relocation” schedule in 2012 for the re-validation of actual number of more or less 2,000 affected families and more or less 1,914 structures that need to be demolished. In the proposed satellite depot at Zapote, 42 households (194 persons) may likely to be relocated. (b) A series of public consultations were held in October to November 2008 in Bacoor, Cavite, Las Piñas City and Parañaque. (c) & (d) The housing package option would be a compromise of a house and lot package at fully developed and serviced sites at General Trias, Cavite or financial assistance equivalent to minimum wage multiplies by 60 days (Urban Development Housing Act of 1992). The selected resettlement site located in Gen. Trias, Cavite with an area of approximately 20 hectares (ha) was acquired. This site was selected based on the survey results, consultation meetings and internationally-accepted guidelines on relocation of informal settlers, who opted for relocation within the Province of Cavite. Horizontal development of the resettlement site is substantially complete; there are about 180 housing units that have been constructed. The documented number of households to be relocated is about 2,000. The construction of the remaining 1,820

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				housing units will be started as soon as LRTA has transferred the additional fund to the Province of Cavite. (e) Refer to (a) (f) Within the frame work of the RAP, women's participation will be achieved through the gender planning. (g) Refer to (a) (h) To facilitate the smooth implementation of the relocation program and to ensure that basic services needed are provided, an inter-agency committee was organized. The inter-agency committee is composed of representatives coming from LRTA, NHA, PCUP, HUDDC, MMDA, LGU of Paranaque, Las Pinas, Bacoor Cavite and the Provincial government of Cavite. (i) The monitoring plan is developed in RAP. Monitoring and evaluation of all assistance packages will be undertaken by the Community Relations Office of LRTA. All families receiving any type of assistance will be monitored monthly by the estate management office of the Governor. The scope of monitoring shall include implementation schedule, assistance package, community participation, and grievance resolution. (j) The grievance redress mechanism is established in RAP. The LRTA has created an Award and Arbitration Committee (AAC) in each sending LGU to determine qualified beneficiaries for relocation, arbitrate in matters of claims and disputes and safeguard of the affected families. The AAC is composed of NHA as chair, LRTA as co-chair, concerned LGU, PCUP, Barangay Officials, and community representative of the area concern.
	(2) Living and Livelihood	(a) Where railways are newly installed, is there a possibility that the project will affect the existing means of transportation and the associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? Are adequate measures considered for preventing these impacts? (b) Is there any possibility that the project will adversely affect the living conditions of inhabitants other than the affected inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (c) Is there any possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate	(a) Y, N (b) N (c) N (d) Y (e) N (f) N	(a) The Project may affect the existing means of transportation (public bus, jeepney, tri-cycles, etc.), but the associated workers may move to other locations such as the new stations. The Project will not cause any significant changes in sources of livelihood and unemployment. (b) The Project will not cause any significant adversely impacts on the living conditions of other inhabitants. (c) Since workers will be locally employed in accordance with Republic Act No. 6685, no influx of workers from other areas is expected. (d) The Traffic Management Plan was one of the requirements stipulated in the ECC issued to LRTA in 2002 and submitted to EMB in January 2002. The plan would still be applicable, however there may have been changes in traffic routing and the opening of new roads near and around the route alignment such that some of the findings and recommendations

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		considerations given to public health, if necessary? (d) Is there any possibility that the project will adversely affect road traffic in the surrounding areas (e.g., by causing increases in traffic congestion and traffic accidents)? (e) Is there any possibility that railways will impede the movement of inhabitants? (f) Is there any possibility that structures associated with railways (such as bridges) will cause a sun shading and radio interference?		in the traffic study may no longer hold true. An updating or validation of the traffic study must be undertaken by LRTA to properly address the potential impacts of the Project on traffic. This may be required as a post-ECC requirement in order to incorporate plans and strategies in the Detailed Engineering Design and overall Project implementation plans. (e) Since the railway is elevated guide way, the movement of inhabitants is not changed. (f) No significant impacts are expected.
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archaeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) Refer to "Landscape" below. There is no possibility that the Project will directly damage local archaeological, historical, cultural and religious heritage sites along proposed railway.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) Y, Y	(a) The degree to which views of/from historically or culturally significant buildings and other structures is obstructed or otherwise affected warrants consideration in isolation from a purely aesthetic perspective. Local/city landmark and religious buildings and monuments are of particular interest. Effects are expected to vary since some corridor sections are part of a dense built urban fabric and others have open views capes. The potential loss of archaeological or built heritage features must be addressed at the Detailed Design stage, to minimize potential effects to the greatest degree possible, by design consideration.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N (b) N	(a) Not Applicable (b) Not Applicable
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security	(a) Y (b) Y (c) Y (d) Y	(a) LRTA shall not violate any Laws and Ordinances associated with the working condition in the project. On the contrary, such laws and ordinances shall be strictly observed and implemented. (b) LRTA shall ensure safety measures for the individuals involved in the project; this provision shall be incorporated in the Health and Safety Management Plan that shall be established as part of the contracts between the proponent and the contractor. (c) Safety instruction for new recruits, safety meetings and safety patrols shall be undertaken periodically. (d) LRTA shall ensure that security guards shall not violate the safety of other individuals involved or local residents; this provision shall also be incorporated as part of the Health and Safety Management Plan to be established by the contractor with approval of the project proponent.

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		guards involved in the project not to violate safety of other individuals involved, or local residents?		
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) Y (b) Y (c) Y (d) Y	(a) An Impact Management Plan (IMP) is included in EIS containing measures to address all impacts likely to occur throughout all phases of Project development. This is in accordance with the guidelines in Department of Environment and Natural Resources Administrative Order No. 30, Series of 2003 (DAO 2003-30). (b) Refer to (a). (c) Some of the aspects that are analyzed in the context of development intervention relate to: • improvement or impoverishment of livelihoods; • access to or exclusion from resources; and • expansion of knowledge. After a thorough study of the history and present conditions prevalent in the areas of concern, the Community Relations (ComRel) Team of the LRTA conducted an extensive and exhaustive community immersion to validate the views of social analysts regarding squatter colonies. In light of the above, the ComRel Team of LRTA drafted a Social Development Plan (SDP) relative to the Project, the impacts on the informal settlers and the corresponding mitigating measures to at least alleviate the impacts on those who will be directly affected by the Project. (d) The Traffic Management Plan was one of the requirements stipulated in the ECC issued to LRTA in 2002 and submitted to EMB in January 2002. The plan would still be applicable, however there may have been changes in traffic routing and the opening of new roads near and around the route alignment such that some of the findings and recommendations in the traffic study may no longer hold true. An updating or validation of the traffic study must be undertaken by LRTA to properly address the potential impacts of the Project on traffic. This may be required as a post-ECC requirement in order to incorporate plans and strategies in the Detailed Engineering Design and overall Project implementation plans.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	(a) Y (b) Y (c) Y (d) Y	(a) (b) (c) & (d) A Monitoring Program will be established as stipulated in Department of Environment and Natural Resources (DENR) Administrative Order No. 30, Series of 2003 (DAO 2003-30), a Multi-Partite Monitoring Team (MMT) must be formed immediately after the issuance of the ECC. The main goal of the MMT is to monitor the Proponent's as well as the Contractor's compliance to the ECC conditions, the IMP, and other applicable laws, rules, and regulations.

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		(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?		
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects including large areas of deforestation). (b) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of power transmission lines and/or electric distribution facilities).	(a) Y (b) Y	(a) A permit to cut shall be secured by the Contractor from the DENR prior to cutting of trees along the road sides and satellite depot. (b) The Program Management Office will start the utility management planning process during the Preliminary Design Phase, and will establish an inter-active dialogue and communication with the authorities and companies having jurisdiction over utilities. The Program Management office will produce and obtain approval for detailed Utility Management Plans during the detailed design and construction phases.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to trans boundary or global issues should be confirmed, if necessary (e.g., the project includes factors that may cause problems, such as trans boundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) Y	(a) The LRT system will have positive impacts in terms of reduction of Greenhouse Gas due to transition in the mode of transportation from motor vehicle to railway.

Source: Study Tea