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NOV 28 2013

Rene K. Limcaoco
Undersecretary
Planning and Project Development
DEPARTMENT OF TRANSPORATION AND COMMUNICATIONS
Unit 169, 16th Floor The Columbia Tower
Ortigas Avenue, Mandaluyong City 1555

Subject: Confirmation of ECC 9907-036-120D and ECC 0706-014-7110

Dear Sir:

This refers to your letter dated 12 November 2013 asking confirmation of the Environmental Compliance Certificates (ECCs) issued for the Northrail Projects pursuant to Presidential Decree 1586, the Philippine EIS System and its implementing rules and regulations, DAO30-2003.

North Luzon Railways Corporation was issued an ECC 9907-036-120D for the Manila-Clark Rapid Railway System (MCRRS) Project from Clark to Valenzuela City on November 14, 2000 and ECC 0706-014-7110 was issued for the Valenzuela to Caloocan on December 18, 2007. Based on the review of the document submitted, this office interposes no objection on the proposed configuration of the Northrail Projects as it will not cause any adverse impacts to the environment.

Hence, this Office hereby confirms the validity of the above mentioned ECC for the **Malolos-Caloocan Section** encompassing the two (2) ECCs issued for the **Northrail Projects** which will now be called as **North-South Commuter Railway (NSCR) Project**. We would like to remind the proponent, through DOTC to comply with all the conditions setforth in the said ECC.

We hope that this satisfy the requirements of the potential funding agency, the JICA.

Very truly yours,

ATTY. JUAN MIGUEL T. CUNA
OIC, Director

Protect the environment... Protect life...

7201311-15-2

NORTHRAIL
North Luzon Railways Corporation

FINAL REPORT

Based on the Technical Re-scoping of MCRRS Caloocan – Valenzuela, 28 October 2003

INTEGRATED ENVIRONMENTAL IMPACT STATEMENT

Caloocan – Valenzuela Segment of the

NorthRail Project Phase 1 Section 1

Volume 1
MAIN TEXT

October 2007

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AC	*alternate current or Air-conditioner*
AFC	*Automatic Fare Collection*
AHI	*Asia Halcrow Inc.*
BCDA	*Bases Conversion Development Authority*
BITS	*Binary Digits*
BOD	*Biochemical Oxygen Demand*
C&T	*Census and Tagging*
C&T	*Census and Tagging*
CHR	*Commission on Human Rights*
CNMEG	*China National Machinery and Equipment Corp. (Group)*
COD	*Chemical Oxygen Demand*
COPD	*Chronic Obstructive Pulmonary Disease*
CSEZ	*Clark Special Economic Zone*
CTC	*Centralized Traffic Control*
DAO	*DENR Administrative Order*
DBM	*Department of Budget and Management*
DECS	*Department of Education, Culture and Sports*
DENR	*Department of Environment and Natural Resources*
DMIA	*Diosdado Macapagal International Airport*
DMU	*Diesel Multiple Unit*
DOF	*Department of Finance*
DOH	*Department of Health*
DOTC	*Department of Transportation and Communications*
DPWH	*Department of Public Works and Highways*
DSWD	*Department of Social Welfare and Development*
ECC	*Environmental Compliance Certificate*
EGF	*Environmental Guarantee Fund*
EIA	*Environmental Impact Assessment*
EIARC	*Environmental Impact Assessment Review Committee*
EIS	*Environmental Impact Statement*
EMB	*Environmental Management Bureau*
EMF	*Environmental Monitoring Fund*
EMU	*Electrified Multiple Unit*
EMVF	*East Marikina Valley Fault*
EU	*Environmental Unit*
FMEA	*Failure Modes and Effects Analysis*
FS	*Feasibility Study*
GF	*Guadalupe Formation*
GPS	*Global Positioning System*

GSIS	*Government Service Insurance System*
HARV	*Home Along the Riles Valenzuela*
HDMF	*Home Development Mutual Fund*
HPN	*Hypertension*
HUDCC	*Housing and Urban Development Coordinating Council*
IP	*Indigenous People*
IRR	*Implementing Rules and Regulations*
JHA	*Job Hazard Analysis*
JNR	*Japanese National Railways*
LAN	*Local Area Network*
LGU	*local government unit*
LIAC	*local inter agency committee*
LRT	*Light Rail Transit*
MCRRS	*Manila – Clark Rapid Railway System*
MCU	*Manila Central University*
MERALCO	*Manila Electric Company*
MLN	*Manila Line North*
MLS	*Main Line South*
MMDA	*Metro Manila Development Authority*
MMT	*Multi-partite Monitoring Team*
MOA	*Memorandum of Agreement*
MOU	*Memorandum of Understanding*
MRT	*Metro Rail Transit*
MWSI	*Maynilad Water Services Inc.*
NAAQS	*National Ambient Air Quality Standards*
NAMRIA	*National Mapping and Resource Information Authority*
NCR	*National Capital Region*
NCR	*National Capital Region*
NDC	*National Development Company*
NEDA	*National Economic Development Authority*
NEDA ICC	*NEDA Investment Coordinating Council*
NGO	*non-governmental organization*
NHA	*National Housing Authority*
NHI	*National Historic Institute*
NHMFC	*National Home Mortgage Financing Corporation*
NLE	*North Luzon Expressway*
NLRC	*North Luzon Railways Corporation*
O&M	*Operations and Maintenance*
ODA	*overseas development assistance*
OGCC	*Office of the Government Corporate Council*
PAF	*project affected family*
PAGASA	*Philippine Atmospheric, Geophysical and Astronomical Services Administration*

PAG-IBIG	*Pagtutulungan sa Kinabukasan: Ikaw, Bangko, Industria at Gobyerno*
PCI	*Pacific Consultants Inc.*
PCUP	*Presidential Commission for the Urban Poor*
PE	*PolyEthylene*
PGA	*Peak Ground Acceleration*
PhilEXIM	*Philippine Export Import Bank*
PHILVOCS	*Philippine Institute of Volcanology and Seismology*
PMST	*Project Management Support Team*
PNP	*Philippine National Police*
PNR	*Philippine National Railways*
PNRA	*Philippine National Railways Authority*
PO	*people's organization*
PROC	*People's Republic of China*
PTT	*Post, Telegraph and Telephone*
PVC	*chlorinated PolyVinyl Chloride*
QAL	*Quarternary Alluvium*
RA	*Republic Act*
RC	*road crossing or reinforced concrete*
RCC	*Reinforced Cement Concrete*
RDC	*Regional Development Council*
ROW	*right-of-way*
S&H	*Health and Safety*
SATS	*South African Transport Services*
SDH	*Synchronous Digital Hierarchy*
SRG	*Spanish Railway Group*
SRTS	*Strong Republic Transit System*
SS	*suspended solids*
TB	*tuberculosis*
TCI	*Test Consultants Inc.*
TMP	*traffic management plan*
TOR	*Terms of Reference*
TSP	*Total Suspended Particulate*
UDHA	*Urban Development and Housing Act*
UIC	*Union Internationale des Chemins de fer*
UPAO	*Urban Poor Affairs Office*
URTI	*Upper Respiratory Track Infection*
VRLA	*Valve Regulated Lead Acid*
WBS	*Work Breakdown Schedule*
WMVF	*West Marikina Valley Fault*

1 Executive Summary

1.1 Brief Description of Project

The NorthRail Project will reactivate the rail service north of Metro Manila, which, for decades has been abandoned by the Philippine National Railways (PNR).

Upon its completion, the NorthRail Project will provide efficient transport service for passengers and goods between Metro Manila and Central and Northern Luzon. This is expected to enhance the development and growth potential of the said areas. In this undertaking, PNR will be a major partner as the North Luzon Railways Corporation (NLRC) will maximize the use of the right-of-way (ROW) of PNR's Main Line North (MLN) in the execution of this Project.

NLRC will initially implement the NorthRail Project Phase 1 Section 1 to provide commuter service from Caloocan to Malolos with intermediate stations at Valenzuela, Marilao, Bocaue and Guiguinto.

The estimated project cost for the NorthRail Project Phase 1 Section 1 amount to US$503 million, excluding debt service. The cost outlays of this Project were spread over the construction period of 3 years.

Project cost for the Caloocan to Valenzuela section, for which this Environmental Impact Assessment (EIA) study applies, amount to US$ 263.20.

NorthRail Project Phase 1 Section 1 will commence its construction 6 months after the start of its design. The design is estimated to begin first quarter of year 2004. The duration of the project construction is approximately 3 years.

The Environmental Management Bureau (EMB) of the Department of Environment and Natural Resources (DENR) granted an Environmental Compliance Certificate (ECC) for the Valenzuela to Clark section of the NorthRail Project (ECC No. 9907-036-120D Manila - Clark Rapid Railway System (MCRRS) project Phase IA-1 Valenzuela to Clark) last 14

November 2000 (please refer to Annex A). On November 7, 2003, NLRC was granted a 3-year extension for the abovementioned ECC (please refer to Annex B). NLRC will eventually apply for a change in design in order for the issued ECC to conform with the new design of this rail project.

In addition, Test Consultants, Inc. (TCI) submitted an Environmental Impact Statement (EIS) for the Caloocan to Valenzuela section of the NorthRail Project (previously named MCRRS Project Phase IA-2 Caloocan to Valenzuela segment) last April 2000. The said EIS has reached the substantive review stage. NLRC even conducted a public hearing for this project on August 26, 2000 at Brgy. Tinajeros, Malabon City (please refer to Annex AE). However, due to significant political events that affected the NorthRail Project the said review was discontinued.

Moreover, the NorthRail Project was recently re-packaged for another overseas development assistance (ODA) loan and because of this, there are significant changes from the previous design to the current design being pursued by the NLRC. A major difference between the two is the change from an electrified system to a diesel system. Also, NLRC will adopt narrow gauge instead of standard gauge for its tracks. Both designs still have double track system, and grade-separated at road crossings (with adequate clearances) but the new design will have slightly lower embankments.

The statement "slightly lower embankment for grade separation road crossings" means that the embankment is lower as compared to original Spanish Railway Group (SRG) design.

The vertical alignment / levels will be adjusted in order to save on embankment costs (where applicable). However, flood level projections will still govern design considerations.

The vertical clearance for rail-over-road crossings will remain the same, if not higher.

Even at the earliest stage of the NorthRail Project, NLRC have taken an active role in the relocation of informal settlers within the PNR ROW. However, in year 2001, Her Excellency, President Gloria Macapagal-Arroyo issued a directive to transfer the relocation of project affected families (PAFs) of the NorthRail Project Phase 1 Section 1 to shelter agencies in order to enhance the Project's viability (please refer to Annex X). As a result, the Housing and Urban Development Coordinating Council (HUDCC) took over the relocation of informal settlers for the entire Section 1 of the NorthRail Project and appointed the National Housing Authority (NHA) as its implementing agency.

For clarification, the NorthRail Project was previously named as the MCRRS Project. The NorthRail Project is re-classified as follows:

TABLE 1-1: COMPARISON OF NORTHRAIL AND MCRRS PROJECT SEGMENTS

Project Sections / Segments	MCRRS Project		NorthRail Project	
Calumpit – Clark	Phase IA-1	Section 3	Phase I	Section 2
Malolos – Calumpit		Section 1		
Valenzuela – Malolos				Section 1
Caloocan – Valenzuela	Phase IA-2	Section 2		
Caloocan – Fort Bonifacio	Phase IB		Phase III	
Branch line to Subic Economic Freeport Zone	Phase II		Phase II	
Extension to San Fernando, La Union	Phase III		Phase IV	
Extension to Laoag City and San Jose City	Phase IV			

This EIA study will cover the Caloocan - Valenzuela segment of the NorthRail Project Phase 1 Section 1. This segment is part of Phase 1 Section 1 of the NorthRail Project.

1.2 Brief Description of Methodology

This EIA study covers the Caloocan – Valenzuela segment of the NorthRail Project Phase 1 Section 1. This study is basically an update of the previously submitted EIS for MCRRS Phase 1A-2 undertaken by the TCI. The update was carried out by the NLRC with the support of a consultant who was a previous employee of the NLRC and has handled the previous ECC applications for the different segments of the NorthRail Project (please refer to Section 1.3.3 of this Report).

As mentioned above, the EIA for this particular segment of the NorthRail Project has been previously undertaken by the TCI together with the NLRC. As such, most of the baseline environmental data presented in this report were cited from the EIS of MCRRS Phase 1A-2. Updates for some of the statistical data that were presented in the previous study were gathered. Point of references to these updated data will be explicitly stated throughout the Report in order to avoid mix-up from the previous data.

1.3 Brief Description of Data Gathering

1.3.1 Scope of the Study

This EIA study included assessment of the environmental conditions along the PNR ROW from Samson Road in Caloocan City up to the boundary of Valenzuela City in Metro Manila and Meycauayan in Bulacan. Since this study is a resumption of the previous EIA study for the MCRRS Phase IA-

2, some of the data presented in this report particularly the baseline environmental conditions were obtained from the previous study. Updates to these data (whenever reasonably available) were incorporated in this Report.

Water quality, and air quality / noise (including vibration) were given emphasis in this Report as agreed during the technical re-scoping conducted for this project. Safety measures for handling oil reserves at the Depot, and possible terrorism attacks were also tackled in this EIA study. Finally, updates of relocation program from the NHA are also included in this report as part of the objective to address the concerns regarding the social acceptability aspect of the Project.

1.3.2 *Duration / Period of the Study*

The overall duration of the EIA study for this segment of the NorthRail project is about 6 years:

TABLE 1-2: TASKS UNDERTAKEN FOR CALOOCAN – VALENZUELA SEGMENT OF THE NORTHRAIL PROJECT EIA

Inclusive Period	Tasks Undertaken
May and June 1997	scoping and consultations, field research and surveys gathered
January 1999 – February 2000	preparation of the MCRRS Phase IA-2 EIS
March 2000	procedural evaluation screening of Draft EIS of the MCRRS Phase IA-2
April 2000	submission of final EIS of the MCRRS Phase IA-2
April – December 2000	substantive review of Final EIS of the MCRRS Phase IA-2
August 2000	conduct of public hearing of the MCRRS Phase IA-2
August 2003 – March 2004	Preparation of the new EIS for the Caloocan – Valenzuela section of the NorthRail Project. This new EIS to include new project assumptions and designs.

As a background, NLRC commissioned TCI to conduct an EIA study for MCRRS Phase 1A (Caloocan - Clark segment) in 1997. Phase 1A of the MCRRS Project was divided into two sections, Phase 1A-1 (Valenzuela - Clark segment) and Phase 1A-2 (Caloocan - Valenzuela segment), in order to distinguish inter-urban service from metro service. Both NLRC and TCI carried out a thorough EIA study for both sections of the MCRRS Phase 1A.

MCRRS Phase 1A-1 (Valenzuela - Clark segment) was granted an ECC on November 2000 and an extension of the same was obtained, rendering it valid until November 2006. NLRC intends to apply for a change in design in order for the ECC to conform with the new basic design parameters of the NorthRail Project. On the other hand, NorthRail updated the EIS of MCRRS Phase 1A-2 (Caloocan – Valenzuela segment) which is actually this Report (EIS of Caloocan – Valenzuela segment of the NorthRail Project).

1.3.3 *Study Team*

This update of the EIS for Caloocan – Valenzuela segment of the NorthRail Project Phase 1 Section 1 was undertaken by the technical team of NLRC.

TABLE 1-3: EIA STUDY TEAM

Dennis Paulo C. Jugueta	Project Engineer North Luzon Railways Corporation 2nd Floor Old Officer's Club House, Jusmag Area, Philippine Army Recreation Center Fort Bonifacio, Taguig, Metro Manila Tel.: 816-09-16 Fax: 894-41-91
Josefa B. Calimag	Consultant 4768-G Barasoain St., Brgy. Olympia, Makati City Tel.: 819-52-31 Fax: 750-04-68

1.3.4 *Methodology*

Please refer to Section 1.2 of this Report.

1.3.5 *Documentation*

On October 28, 2003, the EMB conducted a technical re-scoping for the MCRRS Valenzuela – Caloocan Segment (or Caloocan – Valenzuela Segment of the NorthRail Project for which this EIA study applies). In the said meeting, NLRC made a presentation to update the EIA Review Committee (EIARC) headed by Dr. Teodoro M. Santos of the current status of the NorthRail Project.

NLRC prepared this EIS in response to the requirements requested by the EIARC as documented in the First Level Scoping Checklist attached as Chapter 2 of this Report.

1.4 Brief Description of Baseline Environmental Conditions

Table 1-4 below summarizes the current environmental conditions where the Project will be situated. The data presented in this table were taken from the EIS of MCRRS Phase 1A-2 with some minor revisions.

1.5 Tabulated Summary of Major Impacts, Main Mitigating Measures, Main Components of the Environmental Management Plan

Table 1-5 summarizes the predicted environmental impacts of the Project, which are grouped into two parts: physical and socio-economic environments. The physical environment includes climate, topography and geomorphology, land and resource use, terrestrial and aquatic ecology, and atmosphere. On the other hand, the socio-economic environment covers human-related factors, such as demography, income, health, investment, work safety, and resettlement of affected families.

This summary identifies and briefly describes the probable environmental impacts of the Project, both positive and negative. Indirect and direct impacts are identified and assessed, and are presented in all stages of the Project (pre-construction, construction, completion / operation, and maintenance phases).

1.6 Tabulated Summary of the Environmental Monitoring Plan

Table 1-6 below details the proposed Environmental Monitoring Plan.

TABLE 1-4: BRIEF DESCRIPTION OF THE PROJECT ENVIRONMENT

Environmental Aspects	Condition
1. Physical Environment	
1.1. Land Environment	
1.1.1. Geology	The Regional Geology of Central Luzon may be defined as covered by Recent and Quarternary Alluvium (QAL) overlying sediments and ultramatic complex. The geology along the proposed alignment is alluvium, of recent origin and consists of boulders, gravel, sand and silt in the river beds and plains. From Caloocan City to Meycauayan the area is mainly underlain by Guadalupe Formation (GF) and some portions by QAL. Along the PNR ROW the terrain is almost level (0 to 3 % slope). East of the PNR ROW are some 5% slope or gently sloping and undulating terrain while west of the railway the terrain slope is about 1% to nearly level.
1.1.2. Pedology	Soil at the western side of the PNR ROW is Obando Fine Sandy Loam and at the eastern part is Prensa Clay Loam. The quality of the Obando Sandy Loam soil is not very suitable for use as railway embankment material due to its very low plasticity. The Prensa Clay Loam is loose and gravelly clay. The station site is gravelly clay and tuffaceous material.
1.1.3. Land Use	The entire segment from Valenzuela Depot up to Samson Road is part of the PNR ROW. The land adjacent to the proposed alignment is mixed uses.
1.2. Water Environment	
1.2.1. Water Quality	
1.2.1.1. Surface Water	The surface waters at the Project Site are the Tullahan River in Malabon City and Panaca Creek in Caloocan City. The Tullahan River watershed starts in the surrounding area of La Mesa Reservoir in Quezon City. reaches the bottom structure of the railway bridge over the Tullahan River. On the other hand, the Panaca Creek originates just east of the PNR ROW in Barangay 80 of Caloocan City and crosses it. It also serves as drainage of wastewater coming from households and runoff in the area during a rainfall.
1.2.1.2. Ground Water	Water wells were noted in Caloocan City and Malabon City PNR ROW areas. Enquiries from residents indicated the water table in a well is about 120 ft below ground level. Since the Project will not use the river and ground water as sources of water supply, or for other uses, all existing wells within the PNR ROW will be closed and sealed.
1.3. Air Environment	
1.3.1. Meteorology / Climatology	Under the Modified Coronas classification system, the climate at the project site falls under Type I. The Type I climate has pronounced seasons; dry from December to May and wet from June to December, when the area experiences heavy rains. The average annual rainfall (1961-1995 period) is 2434.3mm. An average of 2 cyclones pass through the area per year. Wind speed is generally light with an average of 2 meters per second (mps). The highest wind speed recorded occurred in May 17, 1984 with a speed of 80 mps. Annual prevailing wind direction is predominantly northeast.
1.3.2. Air Quality	Total Suspended Particulates (TSP) - TSP ranged from 159 µg/Ncm in Valenzuela City to 739 µµg/Ncm in Caloocan City near the existing PNR station close to Samson Road, 201 µµg/Ncm in Malabon City and 250 µµg/Ncm in Valenzuela City at the NFA Compound. It should be noted that the 2 sampling stations exceeded the 300 µµg/Ncm TSP standard set by DENR. This is probably due to vehicular movements and emissions from factories especially in Valenzuela City. Sulfur Dioxide (SO_2) - the concentration of SO_2 in all sampling points in Valenzuela City, Caloocan City and Malabon City near the PNR ROW indicated very low values compared to the DENR standard of 340 µg/Ncm.

TABLE 1-4: BRIEF DESCRIPTION OF THE PROJECT ENVIRONMENT

1.3.3. Noise Levels	In Caloocan City, the measured noise levels in the sampling points are 68-73 dB(A) at the corner of Maskardo St. and EDSA, 74-78 dB(A) at the west side of A. Bonifacio monument, 75-78 dB(A) at the east side of Manila Central University (MCU) and 74-76 dB(A) near the existing PNR station which are higher than the standard of 65 dB(A). In Malabon City sampling station, the noise levels measured are 68-72 dB(A) which are also higher than the standard. Similarly, in Valenzuela City, at the two sampling stations, the values found are also higher than the DENR standards. The very high values can be attributed to the presence of numerous motor vehicles near the sampling sites.
2. Biological Environment	A number of trees and ornamental plants were noted along the PNR ROW within the project area. Trees were planted by the PAFs for many purposes: for use as firewood, for their fruits and for shed, ornamentals as well as trees for landscaping. Many of the plants will be removed to clear the area of impediments to project operation, subject to the approval by the DENR to cut the trees and depending on land availability and operations requirements. A variety of wild and domesticated animal were noted along the PNR ROW. These are mostly birds, chicken and dogs. No aquatic flora and fauna were found within this segment of the PNR ROW.
3. Socio-cultural and Economic Environment	
3.1. Caloocan City	
3.1.1. Population	Caloocan City, as of 1995, has a household population of 1,021,977 persons. There are slightly more females (50.2%) than males. Barangays 1,2 and 73 are the more densely populated having densities of 823.5, 1230.5 and 849.6 persons per hectare, respectively. In year 2000, Caloocan City has a household population of 1,174,673 in 249,567 households.
3.1.2. Literacy and Education	Caloocan City has a literacy rate of 98.9%. There are 48 public and 37 private elementary schools. It also has 17 government and 21 private secondary schools. There are 4 private colleges and 3 universities. There are also 12 DECS vocational schools. The Caloocan City Government through its Manpower Training Program, offers courses in dressmaking, basic course on computer, etc.
3.1.3. Labor and Employment	About 60% of the labor force (15 years old and over) are employed. During the last 10 years the labor force registered a yearly average increase of 5%, while the working force growth was estimated at the rate of 4.5%.
3.1.4. Housing and Social Services	Caloocan City registered a shortage in housing units. Only 64% of the households own the housing unit that they occupy and 63% of the house owners own the lot they occupy. As of 1994, there is an estimated 45,500 informal settlers occupying dangerous areas, government and private properties and road right-of-ways.
3.1.5. Economic Profile	Caloocan City serves as the center for commerce and industry for the communities of Malabon City, Navotas and Valenzuela City. Trading which, is 90% of the total economic activities, is the largest business sector while the 10% is allotted to manufacturing activities. Among the manufacturing activities, production of wearing apparel ranks first followed by fabrication of metal products and production of furniture.
3.1.6. Health	Caloocan City registered a crude death rate of 31% per thousand population. Bronchitis and pneumonia are the common causes of illness. Upper Respiratory Track Infection (URTI) ranks highest in terms of morbidity cause. The leading causes of mortality are vascular diseases, pneumonia and cancer. Caloocan has 24 health centers, 11 privately owned hospitals and government hospitals.

TABLE 1-4: BRIEF DESCRIPTION OF THE PROJECT ENVIRONMENT

3.1.7. Infrastructure and Public Utilities	There are about 173 kms of roads serving South Caloocan City. These are Rizal Ave. Extension - Gen MacArthur Road, EDSA-Samson Road, A. Mabini St., and part of the North Luzon Tollway. Only Samson Road crosses the PNR ROW. Various modes of transportation exists. For short distance travel in narrow streets jeepneys are used by commuters, while in major roads buses are used. LRT Line 1 along Rizal Ave. serves the city with the North-end terminal located at Monumento in South Caloocan City.
3.1.8. Water Supply / Sewerage	About 75% of the households water supply come from the Maynilad Water Services, Inc. (MWSI) reservoir in Quezon City, while 23% use wells and the rest rely from other sources. Households use septic tank for their sewage treatment. Caloocan City does not have centralized sewerage system.
3.1.9. Flood Control / Drainage System	Many parts of South Caloocan City are flood prone areas. Barangay Sangandaan in South Caloocan City is one of those areas and is crossed by the PNR ROW. Due to lack of natural surface drainage system, storm water overflows into the streets and to low lying areas causing floods in the area during heavy rains.
3.1.10. Energy and Power	The Manila Electric Company (MERALCO) provides power to about 91,744 customers, 91% are for residential use. About 88% of the households have electricity.
3.2. Malabon City	
3.2.1. Population	Malabon City, as of 1995, has a population of 347,447 persons in 74,657 households of which 49.7% were male and 50.3% were female. The municipality has a population density of 22,035 people per km^2. The city has been experiencing population increase primarily due to in-migration. In year 2000, Malabon City has a household population of 336,516 in 74,137 households.
3.2.2. Literacy and Education	Malabon City has a literacy rate of 98.9%. There are 54 educational institutions, 37 public and 17 private schools, of different levels from pre-school through graduate school
3.2.3. Labor and Employment	Approximately 60% of the labor force (15 years old and over) are employed. The other 4% are unemployed and the rest, 36% are not in the labor force. During the past 10 years the labor force registered a yearly average increase of 5%, while the working force growth rate was estimated to be 4.5%.
3.2.4. Housing and Social Services	There is a housing shortage of about 19,200 housing units from 1993 to 1998. The city government considers this as one of its priorities. Only 64% of the residents own the house they occupy and only 50% own the lot where their house is located.
3.2.5. Economic Profile	Approximately 60% of the labor force (15 years and over) are employed, 4% are unemployed and the rest are not in the labor force. Malabon City has 5,649 business establishments, 38.4% are engaged in trade and commerce, 13% in manufacturing and 40% in services.
3.2.6. Health	The leading causes of morbidity are bronchitis followed by diarrhea and pneumonia, and of mortality, are vascular disease, pneumonia and cancer. Data are not available for infant mortality and morbidity.
3.2.7. Infrastructure and Public Utilities	The basic road system of Malabon City consists of national, provincial, municipal and barangay roads totaling of about 116,868 kms. Only the Gov. Pascual Ave. crosses the PNR ROW. Malabon City has 21,033 registered vehicles of all categories. It has 75.77 vehicles per 1000 population against National Capital Region's (NCRs) 216/1000. Based on a late survey only 10% of the population owns a car or other type of motor vehicle.
3.2.8. Water Supply / Sewerage	The MWSI from its water reservoir in Quezon City serves 77% of the households in Malabon City. About 19% depend on groundwater. Within the PNR ROW, the squatters had constructed their own wells. No centralized sewerage system exists in the municipality. Wastewater treatment is by septic tank or pits.
3.2.9. Flood Control / Drainage System	A total of 7 out of 21 barangays are flood prone areas. These barangays include Catmon, Tinejeros (which crosses PNR ROW), Niugan, Muzon, Tonsuya, Longos and Hulong Duhat.

TABLE 1-4: BRIEF DESCRIPTION OF THE PROJECT ENVIRONMENT

3.3. Valenzuela City	
3.3.1. Population	Valenzuela City is undergoing a high population growth rate primarily due to in-migration. As of 1995 it has a population of 437,165 persons in 94,377 households. The population density was 103 persons/ha. Annual growth rate is 5.16%. In year 2000, Valenzuela City has a household population of 481,047 in 106,382 households.
3.3.2. Literacy and Education	The municipality has a literacy rate of 97%. There are 38 educational institutions, 6 tertiary schools, 5 technical schools, 1 training center and 26 secondary schools, for both public and private schools.
3.3.3. Labor and Employment	As of 1992 (latest data available) about 149,000 of the labor force (15 years and older) are employed, 23,000 are not while 103,000 are not in the labor force. During the last 10 years the labor force registered a yearly average increase of 60%, while the working growth was estimated at 40%.
3.3.4. Housing and Social Services	There is a shortage of housing units in Valenzuela City. Only 70% of the households own their housing unit they occupy and 65% of the house owners own the lot they occupy. There are about 3,770 families occupying the PNR ROW
	Valenzuela City has a crude death rate of 35/1000. The leading cause of mortality is URTI with a rate of 2380/10,000 and of morbidity is pneumonia at the rate of 163/10,000. Infant mortality is due to Vascular disease and morbidity is UpperRespiratory Infection.
3.3.5. Health	
3.3.6. Infrastructure and Public Utilities	The road system in Valenzuela City consists of national, provincial, municipal and barangay roads totaling of about 6 kms. There are 1 national and 12 barangay roads which crosses the PNR ROW through barangays Dalandanan, Karuhatan, Malanday, Malinta and Marulas.
3.3.7. Water Supply / Sewerage	The MWSI supplies water to the city. Along the PNR ROW the residents buy their water requirement from adjacent households connected to the system. The main sanitary facilities are septic tanks since there is no centralized sewerage system in the city. Industries have their own wastewater treatment system and air pollution control facilities in accordance with the requirement of DENR.
3.3.8. Flood Control / Drainage System	A large portion of Valenzuela City is flood prone. To minimize flooding, flood waters are pumped out from the flooded areas and are discharged to the natural drainage system and/or to the Tullahan River and Meycauayan River. The flood prone barangays traversed by the PNR ROW include Malanday, Dalandanan, Karuhatan and Marulas
3.3.9. Energy and Power	The MERALCO provides electricity for Valenzuela City. About 495 households within the PNR ROW are connected to the system. Those not served by the system use gas as substitute.

TABLE 1-5: PREDICTED ENVIRONMENTAL IMPACT

Legend: A – high negative impact
B – low negative impact
C – high positive impact
D – low positive impact

Predicted Impacts	Pre-construction / Construction		Operation / Maintenance		Expected Residual Effects / Remarks
	Degree of Impact	Recommended Mitigating Measures	Degree of Impact	Recommended Mitigating Measures	
PHYSICAL ENVIRONMENT					
Air Quality and Noise					
(ground preparation, use of heavy equipment, metal works, train stations)					
• dust/particulate emissions	B	• spraying of water on unpaved grounds (roads, parking lots, etc.)			• not significant; temporary
• noise nuisance	B	• proper equipment maintenance • place temporary perimeter wall around equipment • limit noise-generating work at daytime • limit simultaneous operation of equipment			• not significant; temporary
(stop and acceleration, loading and unloading, repair and maintenance, metal to metal contact)					
• noise nuisance			B	• regular maintenance of trains so it could burn diesel fuel efficiently • use good brake system • use continuous welded rails and regular maintenance of rail tracks. • play mellow music at station • schedule daytime repair of • equipment • provide concrete perimeter fence with mastic or • polymer coating where • necessary and applicable • replanting of trees and other vegetation to serve as noise buffers	• insignificant; residual noise will be within DENR standards

TABLE 1-5: PREDICTED ENVIRONMENTAL IMPACT

Legend: A – high negative impact
B – low negative impact
C – high positive impact
D – low positive impact

Predicted Impacts	Pre-construction / Construction		Operation / Maintenance		Expected Residual Effects / Remarks
	Degree of Impact	Recommended Mitigating Measures	Degree of Impact	Recommended Mitigating Measures	
• noise nuisance			B	• provide noise control for areas that are sensitive to noise such as hospitals, schools, places of worship and the like	• insignificant; residual noise will be within DENR standards
(train operation)					
• noise nuisance from passing trains			B	• construct baffle wal • provide perimeter wall to prevent intruders into the PNR ROW which will minimize need to use horn to alert them	• minimal; long term • present and projected levels within DENR standards
• smoke emission from passing trains			B	• regular maintenance of trains so it could burn diesel fuel more efficiently • where applicable, put additives in the train's fuel to reduce smoke emission to minimal level • planting of trees and other vegetation to serve as smoke buffers and CO_2 absorbers	• minimal; long term
• waster fuel and lubricant oil, cleaning chemicals in the depot			A	• waste diesel fuel and used oil will be placed in special containers and sold to dealers for recycling purposes • cleaning chemicals will be accumulated in flushing bays and treated in treatment facilities for recycling purposes	• minimal; long term

TABLE 1-5: PREDICTED ENVIRONMENTAL IMPACT

Legend: A – high negative impact; B – low negative impact; C – high positive impact; D – low positive impact

Predicted Impacts	Pre-construction / Construction		Operation / Maintenance		Expected Residual Effects / Remarks
	Degree of Impact	Recommended Mitigating Measures	Degree of Impact	Recommended Mitigating Measures	
• wastes fuel and lubricant oil, cleaning chemicals in the depot			A	• drainage conduits will be constructed with special linings and proofing to avoid ground contamination	• minimal; long term
• improvement of air quality along roadways			C	• reduced number of motor vehicles on the road due to shift of commuters from road to rail transport mode will result to lesser smoke emission on the road	• long term; positive impact
Environment and Resource Use					
(removal of old PNR tracks, informal settlers, illegal structures, earthmoving)					
• soil erosion and flooding	B	• construction of effective drainage system and canals for the project • replanting of trees and sodding • construction of temporary catchment basins			• major impact; temporary
• degradation of existing ecosystem	B	• none; natural re-colonization of environment will occur			• major impact; temporary
• clearing of natural water ways previously occupied and erected with illegal structures by informal dwellers will reduce flooding	C	• none			• major impact; long term
(completion of new raised tracks)					
• depreciation of landscape views and aesthetics				• landscaping, planting trees and other vegetation along the track embankment and slope will enhance the view along the railway	• minor to major impact; long term
• hinders migration and dispersal of organisms				• construction of transverse drainage canals and culverts • propagation of floating plants by buoyant objects and agriculture debris	• major impact; long term

TABLE 1-5: PREDICTED ENVIRONMENTAL IMPACT

Legend: A – high negative impact
B – low negative impact
C – high positive impact
D – low positive impact

Predicted Impacts	Pre-construction / Construction		Operation / Maintenance		Expected Residual Effects / Remarks
	Degree of Impact	Recommended Mitigating Measures	Degree of Impact	Recommended Mitigating Measures	
• littering and dumping of wastes by train commuters at stations and along the tracks			B	• employment of janitorial services • installation of trash cans, rubbish bins and appropriate signage along strategic places within the railway system • train units are air-conditioned, throwing out of garbage by commuters along the tracks while on board will not be possible	• major impact; long term
• accidental spill of oil, deleterious chemicals and/or combustible materials			A	• extreme care and safety measures will be strictly followed should there be a need to transport dangerous goods • the dangerous goods should be placed in appropriate containers to avoid breakage or leakage	• Possibility is remote
• obstruction and clogging of waterways/drainage	B	• leftover materials and debris should be hauled away from site	B	• regular monitoring to check any blockage	• minor to major impact; short/long term
Seismic, Geology and Climatic Conditions					
(excavation of overburden and filling of low- lying areas)					
• erosion and siltation	B	• prepare and implement environmentally appropriate soil disposal plan • use of siltation ponds • proper construction of embankment	B	• regular monitoring; re sodding of embankment	• insignificant; temporary

TABLE 1-5: PREDICTED ENVIRONMENTAL IMPACT

Legend: A – high negative impact
B – low negative impact
C – high positive impact
D – low positive impact

Predicted Impacts	Pre-construction / Construction		Operation / Maintenance		Expected Residual Effects / Remarks
	Degree of Impact	Recommended Mitigating Measures	Degree of Impact	Recommended Mitigating Measures	
(engineering design of new raised railway tracks)					
• ground shaking hazard	B	• design parameter of peak ground acceleration not less than 0.5g • all structures will be in-placed in solid and well-compacted foundation	B	• trains, railway tracks and ballast will be maintained regularly to minimize vibration and ground shaking • since these impacts greatly affect the infrastructure and operations of the system, the design calls for measures specifically to minimize the occurrence of said impacts	• insignificant to minimal
• liquefaction hazard	B	• foundation will be set on more stable ground • provide good water drainage in the foundation			• insignificant
• ground rapture hazard	B	• proposed alignment will be located at site far from known active geologic structures			• minimal
SOCIO-ECONOMIC ENVIRONMENT					
(removal of old PNR tracks and realignment of railways)					
• displacement of households living within PNR right-of-way	A/C	• off-site in-city resettlement program • "Balik Probinsiya" program • inventory of house and lot units from NHA, the National Home Mortgage Financing Corporation (NHMFC) and other shelter agencies will also be offered			• slight increase in transportation expenses and added expenses for amortization • provision of land / property tenure • improvement in living conditions of PAFs

TABLE 1-5: PREDICTED ENVIRONMENTAL IMPACT

Legend: A – high negative impact
B – low negative impact
C – high positive impact
D – low positive impact

Predicted Impacts	Pre-construction / Construction		Operation / Maintenance		Expected Residual Effects / Remarks
	Degree of Impact	Recommended Mitigating Measures	Degree of Impact	Recommended Mitigating Measures	
• displacement of households living within • PNR right-of-way	A/C	• off-site in-city resettlement program • "Balik Probinsiya" program • inventory of house and lot units from the NHA, NHMFC and other shelter agencies will also be offered			• environment conducive for residential purposes • social and economic reintegration into their resettlement areas (e.g. schooling, employment, etc.) • possibility of income opportunities at their new residences / communities
• displacement of elementary/high school students	A	• displaced students to be absorbed by receiving schools within the city • proper coordination with receiving LGUs			• temporary
• displacement of employed household members	B	• displacement will not be as adverse as the resettlement program will be off-site and in- city • it is also possible that new income opportunities are available at the new residences/communities			• temporary
• income loss of business establishments plus loss of employment of their workers/ employees	A	• advance notice of demolition and project briefing • coordination with provincial/municipal development councils on possible interventions/assistance • PNR to terminate all lease agreements at least 30 days prior to demolition			• capital cost of transferring to a new site • additional cost in rent/lease • bankruptcy of weaker establishments plus loss of employment of their workers/ employees

TABLE 1-5: PREDICTED ENVIRONMENTAL IMPACT

Legend: A – high negative impact
B – low negative impact
C – high positive impact
D – low positive impact

Predicted Impacts	Pre-construction / Construction		Operation / Maintenance		Expected Residual Effects / Remarks
	Degree of Impact	Recommended Mitigating Measures	Degree of Impact	Recommended Mitigating Measures	
• destruction of social, health and religious facilities	A	• advance information to LGUs and affected users • coordination with potential donors/ sponsors for the • construction of replacements if necessary			• temporary disruption of services/activities
• destruction of walls and other private structures encroaching PNR right-of-way	A	• advance notice to owners			• wastage of investments • additional cost on part of utility companies • temporary interruption of services • lesser access of some residents to water facilities
• repositioning of electrical posts and hand pumps	A	• advance information and coordination with utility companies • advance notice to the public on interruption of services			• temporary disruption of services/activities
• displacement of private lot owners where new crossings would be constructed	A	• cash compensation based on prevailing market prices will be included in costing for relocation			• difficulty of finding / constructing a new home for homeowners
• increase traffic congestion due to construction of major road crossings	B	• fielding of traffic enforcers • construction of underpasses			• temporary
• reduced accessibility of residents from interior barangays and subdivisions to McArthur Highway	B	• phased construction • construction of connecting roads and new road crossings prior to closure of existing crossings • advance notice/billboards			• temporary inconvenience among residents during construction
• increase traffic congestion due to closure/construction of major road crossings	B	• phased construction • preparation and implementation of traffic rerouting plans • advance notice/billboards			• temporary inconvenience during construction

TABLE 1-5: PREDICTED ENVIRONMENTAL IMPACT

Legend: A – high negative impact
B – low negative impact
C – high positive impact
D – low positive impact

Predicted Impacts	Pre-construction / Construction		Operation / Maintenance		Expected Residual Effects / Remarks
	Degree of Impact	Recommended Mitigating Measures	Degree of Impact	Recommended Mitigating Measures	
• increased vehicular flow in areas adjacent to stations thereby increasing traffic congestion			B	• coordination with the Metro Manila Development Authority (MMDA) • fielding of traffic enforcers near stations	• traffic congestion can be minimized but not totally prevented
• reduced accessibility of pedestrians from interior barangays and subdivisions to McArthur Highway			B	• none	• long term
• reduce traffic congestion due to expected shift of road based commuters (especially private vehicle owners) to rail based mass transport system			C	• none	
• manpower requirements for construction of structures	C	• direct hiring and employment of both unskilled and skilled laborers	C	• direct hiring and employment for regular/permanent positions	• significant; short/long term dependent on qualifications of workers
• additional source of income near construction site	D	• encourage entrepreneurship			• significant • opportunity for those with properties near construction site
• induce establishment of more businesses on the proposed stations			C	• encourage and regulate business enterprises on proposed stations and nearby areas	• significant • opportunity for those with properties near construction site
• accelerate development of Manila / Central Luzon growth corridor area			C	• none	• significant; long term
• facilitate efficient linkages between PNR's SouthRail, Light Rail Transits (LRTs), Metro Rail Transits (MRTs), buses, trucks and private cars			C	• none	• significant; long term
• encourage dispersal of Metro Manila population to Central / Northern Luzon			C	• none	• significant; long term

Source: Feasibility Study for NorthRail Project Phase 1 Section 1 (Caloocan – Malolos), NLRC, May 2003

TABLE 1.6: ENVIRONMENTAL MONITORING PLAN

Project Stage/Activity	Indicator Parameter	Sampling Points	Frequency of Sampling	Responsibility	Cost
CONSTRUCTION STAGE					
Monitoring Activities					
	a. Air Quality				
– Soil scraping / hauling / levelling / ground preparation/removal of old PNR tracks	TSP/fugitive dust	Downwind from work site in PNR ROW at nearest receptor area	Daily ocular; use high volume sampler. Periodic at 3 nearby construction site within a geographical area	Multi-partite Monitoring Team (MMT)/NLRC	Part of Environmental Monitoring Fund (EMF) Please refer to Table 7-2
– Heavy equipment operation	SO_2	Downwind from work site near equipment in operation at nearest receptor area	Periodic at 3 nearby sampling stations within a geographical area	MMT/NLRC	EMF Please refer to Table 7-2.
	NO_2	Downwind from work site near equipment in operation at nearest receptor area	Periodic at 3 nearby sampling stations within a geographical area	MMT/NLRC	EMF Please refer to Table 7-2.
	b. Noise				
– Equipment operation and construction of the NorthRail Project	Noise, dB (A)	At work site, at the periphery of the ROW nearest the source of noise generation	Daily/use of noise level meter; subject to change	MMT/NLRC	EMF Please refer to Table 7-2.
	c. Hydrology				
– Construction of the railroad bridge	Erosion/obstruction drainage/siltation/ flooding	Along work site under the bridge	Daily ocular during rainfall until completion of construction	MMT/NLRC	EMF Please refer to Table 7-2.
	d. Vibration				
– Construction of NorthRail Project	Cracks in nearby structures, water ponding near foundation, stability of embankments	Structures within 15 m and 30 m from center line of ROW	Daily-ocular; detection observation of cracks in structures/use of vibration meter	MMT/NLRC	EMF Please refer to Table 7-2.
OPERATION STAGE					
Monitoring Activities					
	a. Air Quality				
– Vehicle and train movements at stations	TSP/fugitive dust	At station areas downwind where there is activity in progress	Daily ocular; or use of high volume sampler; periodic (simultaneous) at 3 adjacent in-line stations	MMT/NLRC	NLRC's Annual Budget Please refer to Table 7-2.

TABLE 1.6: ENVIRONMENTAL MONITORING PLAN

Project Stage/Activity	Indicator Parameter	Sampling Points	Frequency of Sampling	Responsibility	Cost
– Vehicle and train movements at stations	SO_2	At station areas downwind where there is activity in progress	Daily ocular; or use of High Volume Sampler; periodic (simultaneous) at 3 adjacent in-line stations	MMT/NLRC	NLRC's Annual Budget Please refer to Table 7-2.
	NO_2	At station areas downwind where there is activity in progress	Daily ocular; or use of High Volume Sampler; periodic (simultaneous) at 3 adjacent in-line stations	MMT/NLRC	NLRC's Annual Budget Please refer to Table 7-2.
	b. Noise				
– Movement of trains along the NorthRail Project alignment	Noise level, dB(A)	At all stations, at perimeter along sensitive areas, at curves along alignment.	Weekly initially, then monthly; will adjust as per findings	MMT	Operations and Maintenance (O&M) cost/EMF Please refer to Table 7-2.
	c. Waste Collection				
– Solid waste collection/disposal	Trash along ROW and in stations/depot	Along NorthRail alignment and in stations/depot	Daily or as necessary as per refuse collection schedule	NLRC	NLRC's Annual Budget Please refer to Table 7-2.
– Wastewater disposal	BOD, DO, TS, PH total Coliform	Effluent of treatment plants and at receiving water after dilution	Monthly, then quarterly depending on experience	NLRC	NLRC's Annual Budget Please refer to Table 7-2.
– Hazardous wastes	Spillage of oil and other chemicals	At depot	Daily/ocular	NLRC	O&M cost Please refer to Table 7-2.
	d. Hydrology				
	Blockage of drainage system	Along the whole length of the NorthRail alignment	Periodic or when necessary	NLRC	O&M cost Please refer to Table 7-2.
	Erosion of embankments or siltation of drainage system or adequacy of drainage section	At bridge site	Periodic or when necessary	NLRC	O&M cost Please refer to Table 7-2.
	e. Vibration				
– Train movement	Cracks in structures	Structures near perimeter of ROW	Monthly, ocular; or if necessary using Vibration Meter	NLRC	Environmental Guarantee Fund (EGF) Please refer to Table 7-2.

TABLE 1.6: ENVIRONMENTAL MONITORING PLAN

Project Stage/Activity	Indicator Parameter	Sampling Points	Frequency of Sampling	Responsibility	Cost
	f. Stability of the NorthRail facilities				
	Structural integrity of the system (rails, alignment, foundation, embankments, power lines)	The entire NorthRail system	Periodic inspection subject to adjustment	NLRC	O&M cost Please refer to Table 7-2.

2 Summary of Scoping Agreements

2.1 Introduction

On October 28, 2003, the EMB conducted a technical re-scoping for the MCRRS Valenzuela - Caloocan Segment. In the said meeting, NLRC made a presentation to update the EIARC headed by Dr. Teodoro M. Santos of the current status of the NorthRail Project. It was also discussed in the said meeting that:

- the NorthRail Project was repackaged for a Chinese ODA loan;
- there are major changes in the basic design parameters of the Project; and
- the relocation of PAFs has been transferred to shelter agencies headed by the HUDCC / NHA.

NLRC prepared this EIS in response to the requirements requested by the EIARC.

Below is a copy of the First Level Scoping Checklist.

3 Project Description

3.1 Basic Project Information

3.1.1 *The NorthRail Project*

The NLRC was created by the Bases Conversion Development Authority (BCDA) to spearhead the reactivation of the rail service north of Metro Manila, which, for decades has been abandoned by the PNR. This reactivation is called the NorthRail Project.

Upon its completion, the NorthRail Project will provide efficient transport service for passengers and goods between Metro Manila and Central and Northern Luzon, particularly between various former military bases currently being converted as economic zones, commercial and/or residential areas (Fort Bonifacio, Clark Air Base, Subic Naval Base, and Poro Point). This is expected to enhance the development growth potential of the said areas. In this undertaking, PNR will be a major partner as NLRC will maximize the use of the ROW of PNR's MLN in the implementation of this NorthRail Project.

The NorthRail Project is divided into four (4) phases (please refer to Figure 3-1), namely:

Phase I .... Caloocan City to Clark Special Economic Zone
Phase II.................................... branch line to Subic Economic Freeport Zone
Phase III .... extension to Fort Bonifacio Global City
Phase IV .... extension to San Fernando, La Union

Phase I of the NorthRail Project would cover an 80-kilometer rail line between Caloocan City in Metro Manila and the Diosdado Macapagal International Airport (DMIA) at the Clark Special Economic Zone (CSEZ) in Pampanga. It will be implemented in two principal sections (Figure 3-2):

Section 1 (Figure 3-3) .... Caloocan to Malolos
Section 2 .... Malolos to Clark Special Economic Zone

The section between Caloocan and Malolos will be constructed first because of many favorable reasons, as follows:

- it is completely along the PNR ROW;
- it has the ridership, Bulacan being the site of major dormitory towns of Metro Manila workers and students; and
- unlike Section 2, the travel demand is not dependent on the opening of the DMIA.

Phase 1 Section 1 (Caloocan – Malolos segment) of the NorthRail Project will initially provide commuter service from Caloocan to Malolos with intermediate stations at Valenzuela, Marilao, Bocaue and Guiguinto.

3.1.2 *MCRRS Phase 1A-2 (Caloocan – Valenzuela Segment)*

Start point at RDK 116+318 (Caloocan) to RDK 122+800 (end of Valenzuela segment).

TCI submitted an EIS for the Caloocan to Valenzuela section of the NorthRail Project (previously referred to as MCRRS Project Phase IA-2 Caloocan to Valenzuela segment) last April 2000. The said EIS has reached the substantive review stage. NLRC and even conducted a public hearing for this project on August 26, 2000 at Brgy. Tinajeros, Malabon City (please refer to Annex AE). However, due to significant political events that affected the NorthRail Project the said review was discontinued.

The original EIA study for MCRRS Phase 1A-2 (Caloocan – Valenzuela segment) is exactly the same segment as NorthRail Phase 1 Section 1 (Caloocan – Valenzuela segment). As such, NLRC did not undertake an entirely new EIA study.

However, there are significant changes from the previous design of MCRRS Phase1A-2 to the current design of NorthRail Phase 1 Section 1 (Caloocan – Valenzuela segment) being pursued by NLRC. A major difference between the two is the change from an electrified system to a diesel system. Also, NLRC will adopt narrow gauge instead of standard gauge for its tracks. Both designs still have double track system, and grade-separated at road crossings (with adequate clearances) but the new design will have slightly lower embankments. This means that the embankment is lower as compared to original Spanish Railway Group (SRG) design. The vertical alignment / levels will be adjusted in order to save on embankment costs (where applicable). However, flood level projections will still govern design considerations.

The vertical clearance for rail-over-road crossings will remain the same, if not higher.

This EIS incorporates the new design as described above.

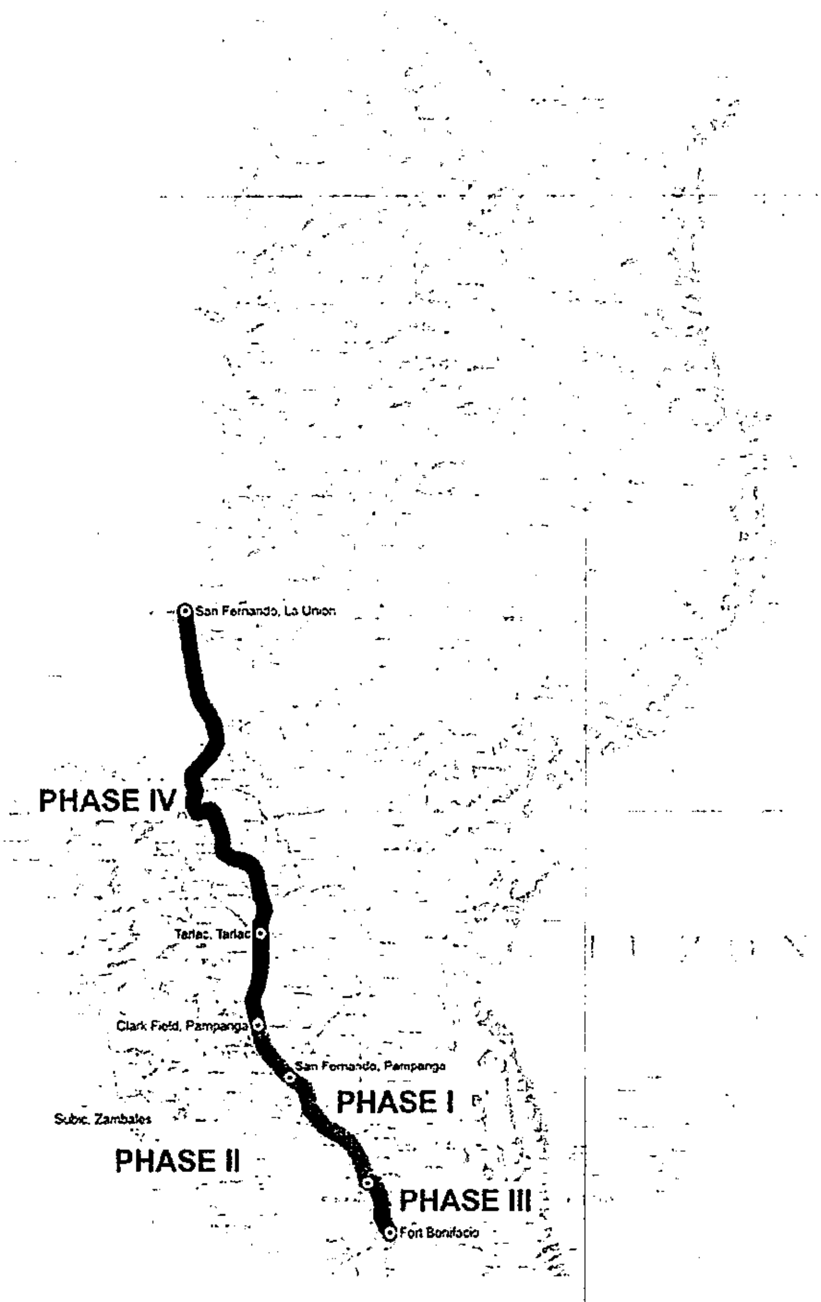


Figure 3.1: The NorthRail Project

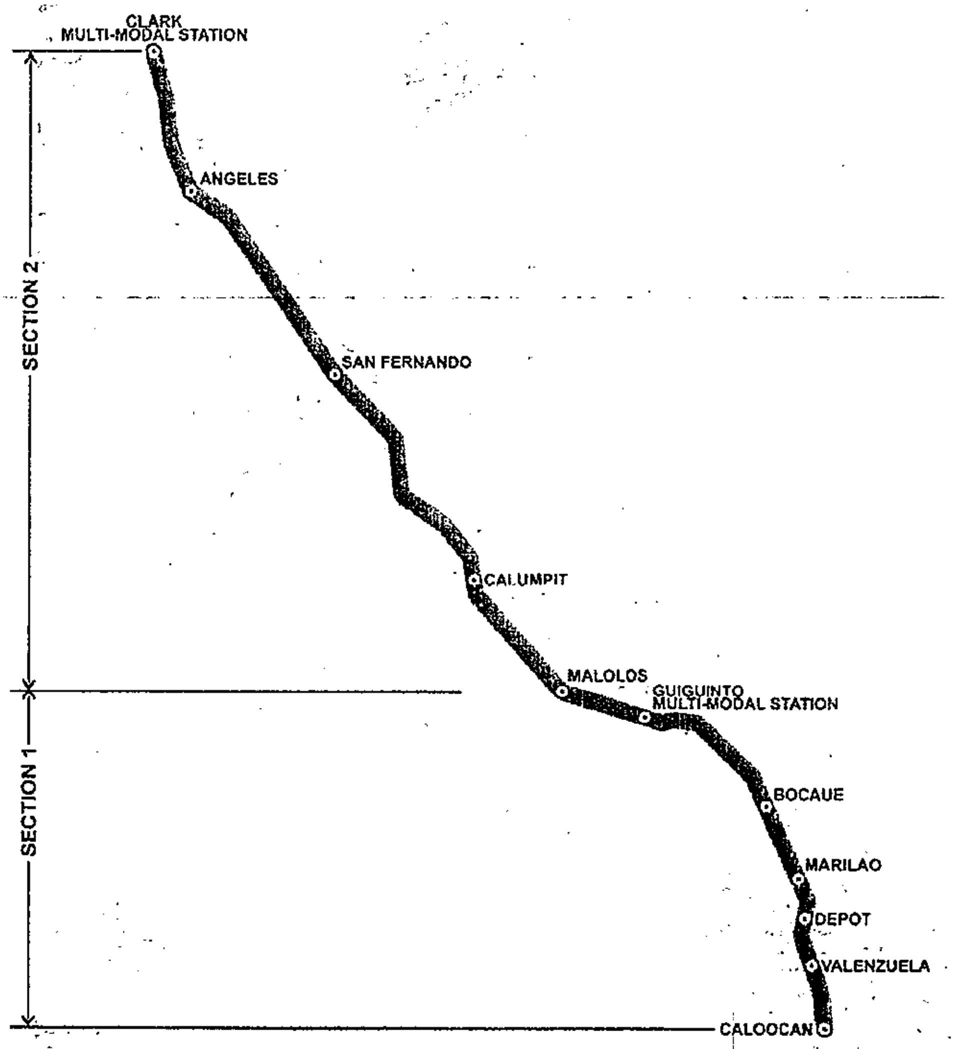


Figure 3.2: NorthRail Project Phase 1

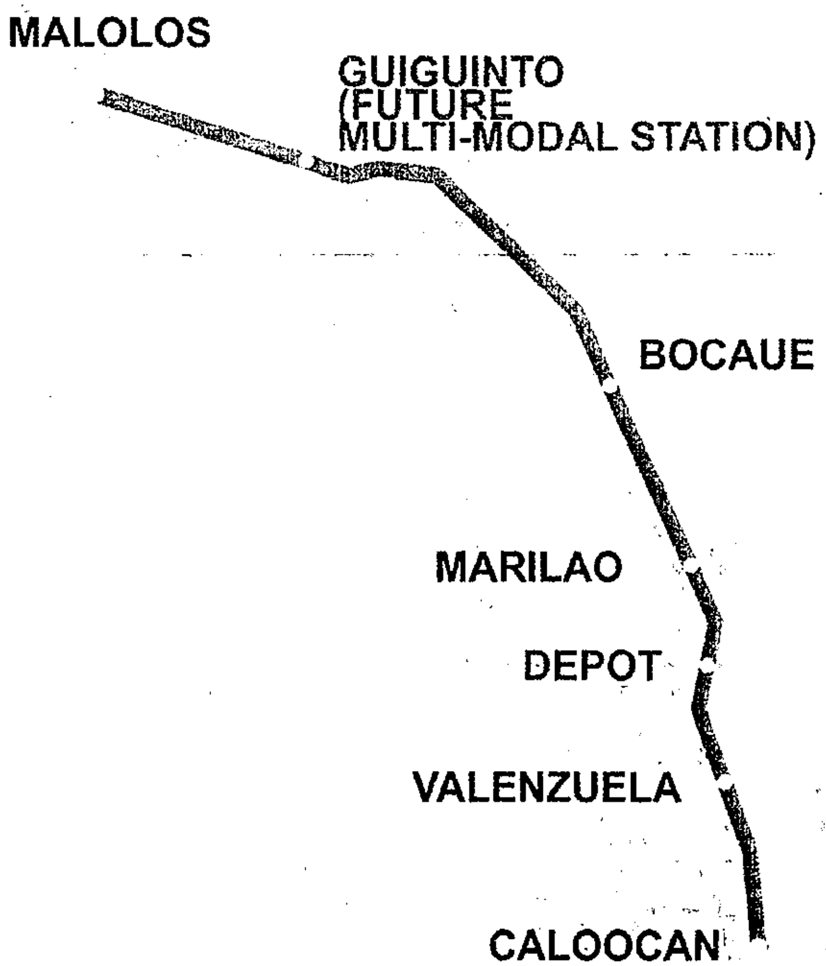


Figure 3.3: NorthRail Project Phase 1 Section 1

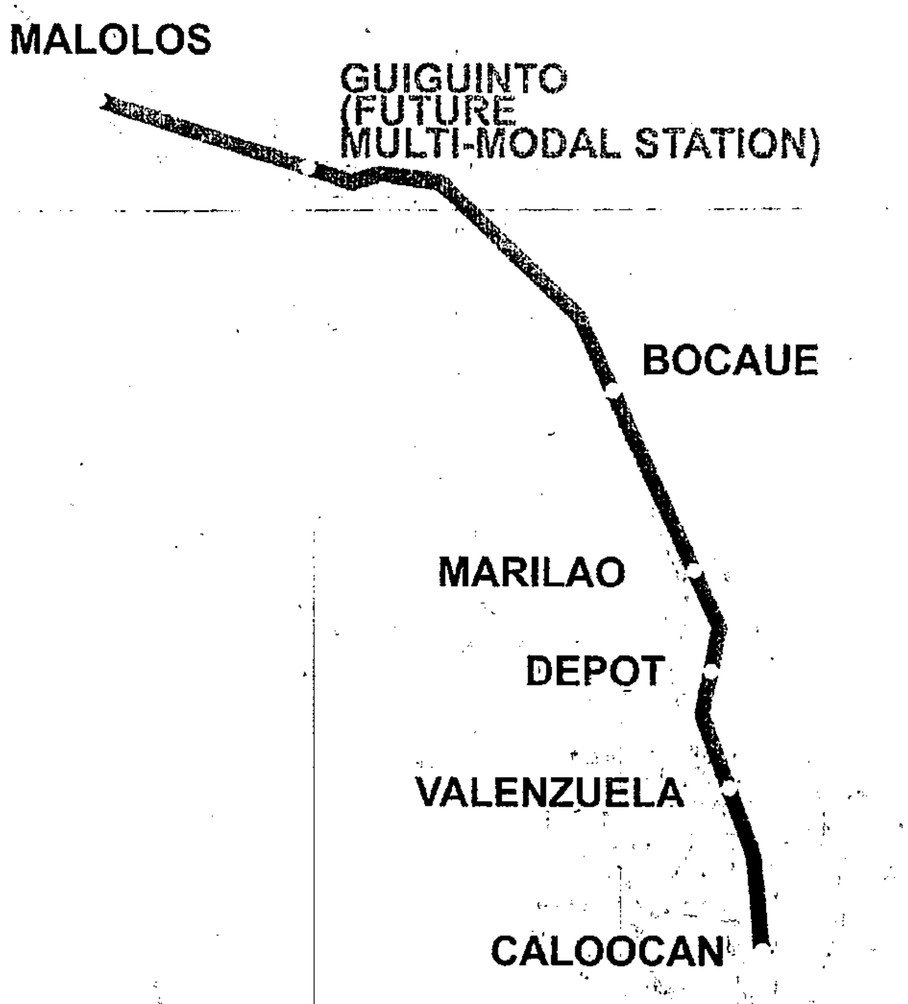


Figure 3.4: Caloocan – Valenzuela Segment of the NorthRail Project

3.1.3 *Events that Affected the Substantive Review of the MCRRS Phase 1A-2*

In January 2001, a change in Administration took place and major infrastructure projects without a definite funding scheme were temporarily suspended pending review by the new Administration. At the time, BCDA was contemplating on the possible dissolution of NLRC.

In June 2001, a memorandum from the National Economic Development Authority Investment Coordinating Council (NEDA-ICC) required that all approved projects that were not implemented (the NorthRail Project included) should re-submit their Feasibility Study (FS). A copy of the said memorandum is attached in this Report as Annex C. At the time, NLRC is looking for a possible foreign investor who would be willing to pursue the NorthRail Project under the terms and conditions acceptable to the Philippine Government.

During the last quarter of 2001, Her Excellency, President Gloria Macapagal Arroyo issued a directive to transfer the relocation component of the NorthRail Project to shelter agencies (please refer to Annex X). The reason for this is that NLRC should not bear the cost for relocation of informal settlers as this task is not part of its mandate. Also, the relocation component is costly and will affect the viability of the NorthRail Project. As a result, NLRC transferred all its documents pertaining to relocation program for PAFs to the NHA.

On August 16, 2002, the BCDA received a letter request from the NEDA to submit the FS for the NorthRail Project (please refer to Annex D). On September 15, 2002, NLRC entered into a Memorandum of Understanding (MOU) with the China National Machinery and Equipment Corp. (Group), or CNMEG for the latter to prepare the FS of the NorthRail Project Phase 1 Section 1, Caloocan – Malolos segment free of charge (please refer to Annex E). Similarly, the Pacific Consultants, Inc. (PCI) together with Asia Halcrow Inc. (AHI) volunteered to prepare an FS for the same project using the same major assumptions. Thereafter, NLRC updated its 1999 Feasibility Study Caloocan / Monumento – Calumpit section previously approved by the NEDA – ICC last 23 September 1999 and the NEDA Board last 21 October 1999 (please refer to Annex F). NLRC incorporated in its revised FS the data gathered from both studies conducted by CNMEG and PCI/AHI. The said revised FS was submitted in May 2003 and was granted an approval from the NEDA Board in December 2003 (please refer to Annex G).

The ECC application only covers the railroad and its supporting structures and all quarry activities shall secure separate ECC or quarry permits from appropriate government agencies. Please refer to Annex AF.

3.2 Current Status of the NorthRail Project Phase 1 Section 1 (Caloocan – Malolos segment)

3.2.1 *Prime Contractor for the Project*

As previously mentioned the CNMEG has expressed its interest in the NorthRail Project and entered into an MOU with NLRC for the preparation of an FS for the NorthRail Project.

Subsequently, the People's Republic of China (PROC) designated CNMEG as the prime contractor for NLRC. The said designation was submitted to the Office of the Government Corporate Council (OGCC) for opinion. According to OGCC, the designation of CNMEG as prime contractor will not violate Republic Act (RA) 9184 and its Implementing Rules and Regulations (IRR). Please refer to Annex I for details of OGCC opinion on the designation of CNMEG as the prime contractor.

In November 2003, NLRC and CNMEG produced a Technical Document of Contract which forms part of the Supply Contract, to signify that both parties have agreed in principle on the basic technical design parameters for the Project. Most of these parameters are discussed in Section 2.4 of this Report. The Supply Contract between NLRC and CNMEG was signed on December 30, 2003 and was made effective upon the signing of the loan agreement for NorthRail Project Phase 1 Section 1 on February 26, 2004.

3.2.2 *NEDA Approval*

On December 18, 2003, the NEDA-ICC Cabinet Committee approved the NorthRail Project Phase 1 Section 1. The NEDA Board has confirmed the ICC approval of the project on its December 22, 2003 meeting (please refer to Annex G).

3.2.3 *Preliminary Project Target Schedules*

Tentative target schedule for the implementation of NorthRail Project Phase 1 Section 1 (Caloocan – Malolos) is illustrated below:

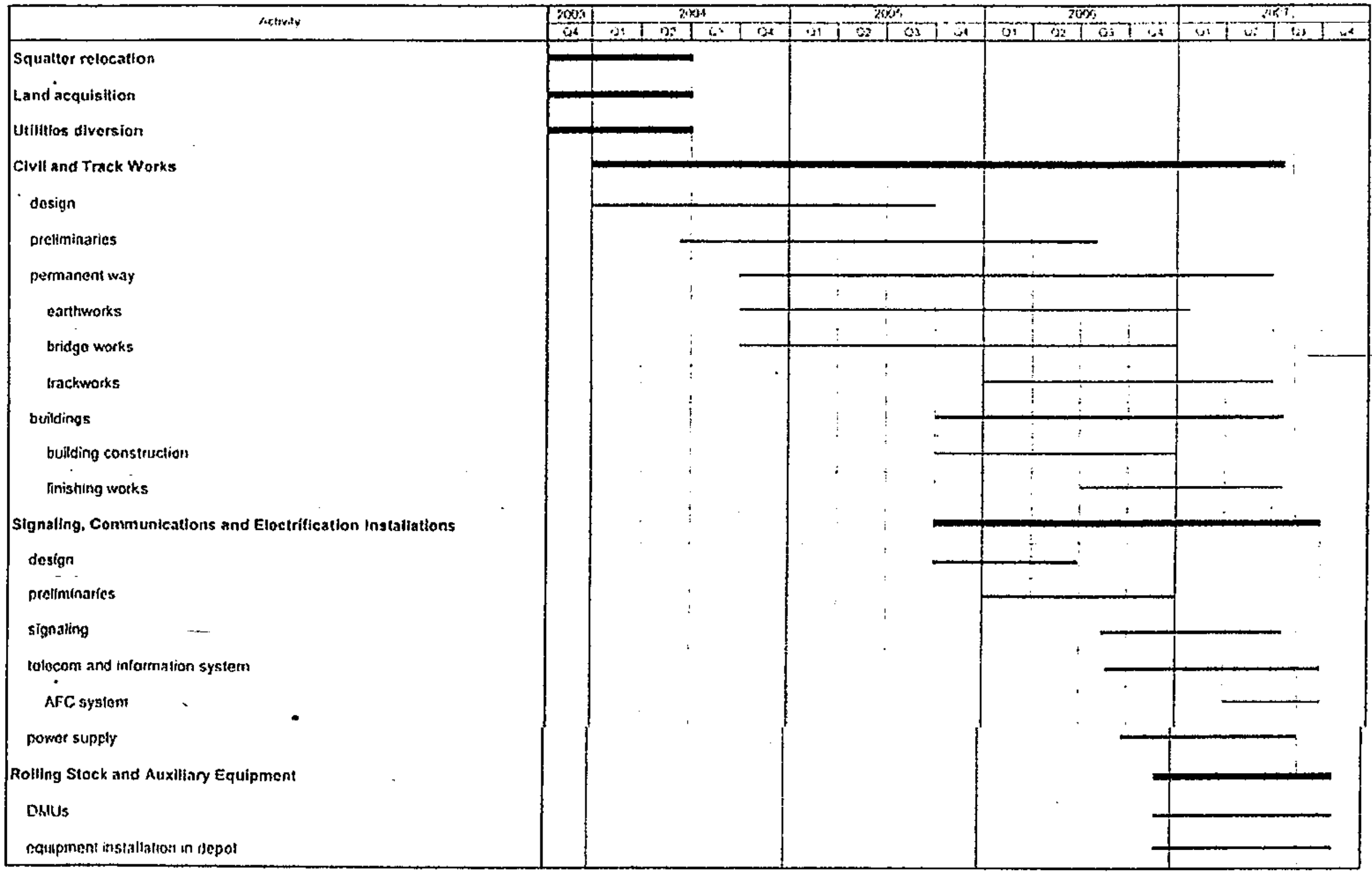


FIGURE 3.5: Preliminary Project Schedule

Source: North Luzon Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document of Contract between NLRC and CNMEG, November 2003

3.2.4 *Preliminary Rehabilitation of MLN*

NLRC will initially rehabilitate the portion of the MLN from Caloocan to at least Valenzuela. The primary purpose of this rehabilitation is the transport of construction materials from Valenzuela (staging area) to the different sections being constructed. As a secondary purpose, during the periods that the rehabilitated line is not being used to transport materials, the line shall provide commuter service where applicable. This would increase awareness of the public on the commuter service to be ultimately provided by the NorthRail Project.

3.2.5 *Project Cost as Approved by the NEDA*

The estimated project cost for the NorthRail Project Phase 1 Section 1 amount to US$503 million, excluding debt service. Table 3-1 below shows its major components, cost outlays during the construction period, and additional capital expenditures during operations (related to additional rolling stock needed for the expected increase in ridership).

The cost outlays of the Project were spread over the construction period of 3 years: 38% is projected to be incurred on the first year, 37% on the second year, and 25% on the third year.

TABLE 3-1: NORTHRAIL SECTION 1 (CALOOCAN – MALOLOS) ESTIMATED PROJECT COSTS (IN US$ M)

Items	During Construction				During Operation	
	Total	2004	2005	2006		
Civil and Track Works	280.90	98.52	113.88	68.49		
Design	7.01	7.01	-	-		
Preliminaries	28.38	9.37	15.75	3.26		
Permanent Way	193.27	61.85	76.34	55.08		
Stations	26.01	8.84	10.14	7.02		
Depot	14.53	7.56	6.98	-		
Contingencies (5%)	11.69	3.90	4.67	3.12		
Right of Way	17.50	13.50	4.00	-		
Land acquisition	7.50	7.50	-	-		
Utilities diversion	10.00	6.50	4.00	-		
Signaling and Communications	29.84	13.35	10.66	5.83		
Design	0.76	0.76	-	-		
Preliminaries	2.53	1.77	0.38	0.38		
Signaling	13.52	5.41	5.41	2.70		
Communications	3.90	1.56	1.56	0.78		
Ticketing system	3.46	-	1.73	1.73		
Power supply	4.40	3.30	1.10	-		
Contingencies (5%)	1.26	0.55	0.48	0.24		

ABLE 3-1: NORTHRAIL SECTION 1 (CALOOCAN – MALOLOS) ESTIMATED PROJECT COSTS (IN US$ M)

Items	During Construction				During Operation	
	Total	2004	2005	2006		
Rolling Stock	87.79	26.34	26.34	35.12	19.00	26.25
Diesel Multiple Units (DMUs)	87.79	26.34	26.34	35.12	19.00	26.25
Subtotal	416.03	151.71	154.88	109.44	19.00	26.25
Other costs	87.02	31.67	32.67	22.98	2.47	3.41
Project Mngt	13.58	4.94	5.06	3.59	-	-
(Owner's Engr.)	54.08	19.65	20.14	14.30	2.47	3.41
Taxes	10.53	7.08	7.17	5.09	-	-
Others						
Total Project Cost	503.04	183.37	187.24	132.42	21.47	29.66

Source: Feasibility Study for NorthRail Project Phase 1 Section 1 (Caloocan – Malolos), NLRC, May 2003

For purposes of the evaluation of this EIS, the estimated cost for the Caloocan – Valenzuela segment of the NorthRail Project is approximately US$263.20 million. This was calculated based on the cost estimate for the NorthRail Project Phase 1 Section 1 as detailed above. In the absence of an itemized cost estimates for all components of the entire system, some items were estimated by ratio and proportion. Table 3.-2 below details the total cost estimate for the Caloocan – Valenzuela segment of the NorthRail Project.

TABLE 3-2: ESTIMATED PROJECT COSTS (IN US$ M) OF CALOOCAN – VALENZUELA SECTION OF THE NORTHRAIL PROJECT

Items	Cost
Civil Track Works	112.43
Design	1.58
Preliminaries	6.38
Permanent Way (Caloocan – Valenzuela)	72.26
Stations	
Valenzuela Station	7.66
Caloocan Station	4.51
Depot	14.35
Contingencies (5%)	5.35
Right-of-Way	3.94
Land Acquisition	1.69
Utilities Diversion	2.25
Signaling and Communications	6.75
Design	0.17
Preliminaries	0.57
Signaling	304
Communications	0.88
Ticketing System	0.78
Power Supply	0.99
Contingencies	0.32

TABLE 3-2: ESTIMATED PROJECT COSTS (IN US$ M) OF CALOOCAN – VALENZUELA SECTION OF THE NORTHRAIL PROJECT

Items	Cost
Rolling Stock	88.82
DMUs	87.79
6 DMUs	24.55
15 DMUs	63.24
Price Escalation	1.03
Other Costs	211.97
Project Management (Owner's Engineer)	13.58
Taxes	27.55
Others	10.12
TOTAL PROJECT COST (Caloocan – Valenzuela segment)	263.20

Source: Feasibility Study for NorthRail Project Phase 1 Section 1 (Caloocan – Malolos), NLRC, May 2003

3.2.6 *Project Funding*

(a) BCDA

At present, the source of fund for the operations of the NLRC comes from the BCDA. NLRC is a government corporation wholly owned by the BCDA. All funds coming from the BCDA are reflected as advances or additional equity to the NLRC.

(b) ODA from the Chinese Government

Last August 30, 2003, the Export – Import Bank of China (for the Government of the PROC) entered into an MOU with the Department of Finance, DOF (for the Government of the Republic of the Philippines) regarding the utilization of 400Million US Dollars Preferential Buyer's Credit for the NorthRail Project (please refer to Annex H).

On February 26, 2004, the Export-Import Bank of China and the Philippines' DOF signed the loan agreement for the construction of NorthRail Project Phase 1 Section 1.

(c) GSIS

The Government owes the Government Service Insurance System (GSIS) some Pesos 17 million in unpaid remittances. A payment plan in the form of land asset is being considered. At present, the land being considered is within the CSEZ in Pampanga. If the GSIS will accept this as payment for Government debts, the GSIS will have basis and interest to invest at least Pesos 2 Billion in the NorthRail Project, as the Project will act as the catalyst in the development of Central and Northern Luzon thereby increasing the value of the property GSIS would acquire within the CSEZ.

d) Others

The NLRC is looking into other possible sources of funds, especially for the required counterpart funds for the ODA loan. Commercial loan packages from local / international lending agencies are being studied for viability. At present, NLRC is negotiating with the Philippine Export

Import (PhilEXIM) Bank to provide the required guarantee for the commercial loan as well as be the fund arranger and manager for the counterpart funds of the ODA loan.

3.3 Description and Location

This railway project is part of the Strong Republic Transit System (SRTS) initiated by Her Excellency, President Gloria Macapagal – Arroyo. This Project aims to help alleviate the traffic problem north of Manila particularly the McArthur Highway and the North Luzon Expressway (NLE). The introduction of this new rail system will provide an alternative mode of transport to address the increasing demand for trips to Bulacan and complement the existing public transport system within the area.

The Caloocan – Valenzuela segment of the NorthRail Project is located within the PNR ROW MLN from Samson Road in Caloocan City up to the boundary of Valenzuela City in Metro Manila and Meycauayan in Bulacan. The coordinates of the Project, based on in-house surveyor of NLRC:

TABLE 3-3: PROJECT COORDINATES

Area	Coordinates	
	X	Y
Caloocan City	479000.45	1621089.61
	496988.60	1621568.24
Malabon City	496987.29	1621586.00
	496856.36	1623363.92
Valenzuela City	496860.15	1623313.13
	495639.92	1627266.82

Currently, NLRC is undertaking the relocation survey of the PNR ROW, which will verify the abovementioned coordinates.

The Project will traverse through the PNR ROW from Caloocan to Valenzuela. It will pass through the following Barangays:

TABLE 3-4: LISTS OF AFFECTED BARANGAYS

Barangay	City
Barangay 01	Caloocan
Barangay 02	
Barangay 80	Malabon
Acacia	
Potrero	
Tinajeros	
Tugatog	

TABLE 3-4: LISTS OF AFFECTED BARANGAYS

Dalandanan	Valenzuela
Karuhatan	
Malanday	
Malinta	
Marulas	
Veinte Reales	

The alignment map of the NorthRail Project Phase 1 Section 1 is shown in Figure 3.6. The alignment maps for Caloocan – Valenzuela segment of the NorthRail Project are shown in Figures 3.7 – 3.8.

Figures 3.9 – 3.16 were taken from the EIS for MCRRS Phase 1A-2 (Caloocan – Valenzuela segment) which contains maps that shows the existing structures within PNR ROW from Samson Road in Caloocan City up to the boundary of Valenzuela City in Metro Manila and Meycauayan in Bulacan. Figure 3.10 was altered to show the cleared ROW in the Caloocan section of the Project.

The Project will be implemented by the NLRC. NLRC was formed in 1995 as a wholly owned subsidiary of BCDA. Once completed, operation and maintenance of the system is foreseen to be undertaken by a private contractor. This will be regulated by the Department of Transportation and Communication (DOTC) or a Philippine National Railways Authority (PNRA), should the legislation creating said authority be in place by the time the NorthRail Project is operational.

NLRC is located at:

2nd Floor, Old Officer's Club House
Philippine Army Recreation Center
Fort Bonifacio, Taguig, Metro Manila
Telephone Nos. : 816-09-16
894-41-91 (fax)

NLRC is represented by its President, Mr. Jose L. Cortez, Jr., who is concurrently the Undersecretary for Rail of the DOTC.

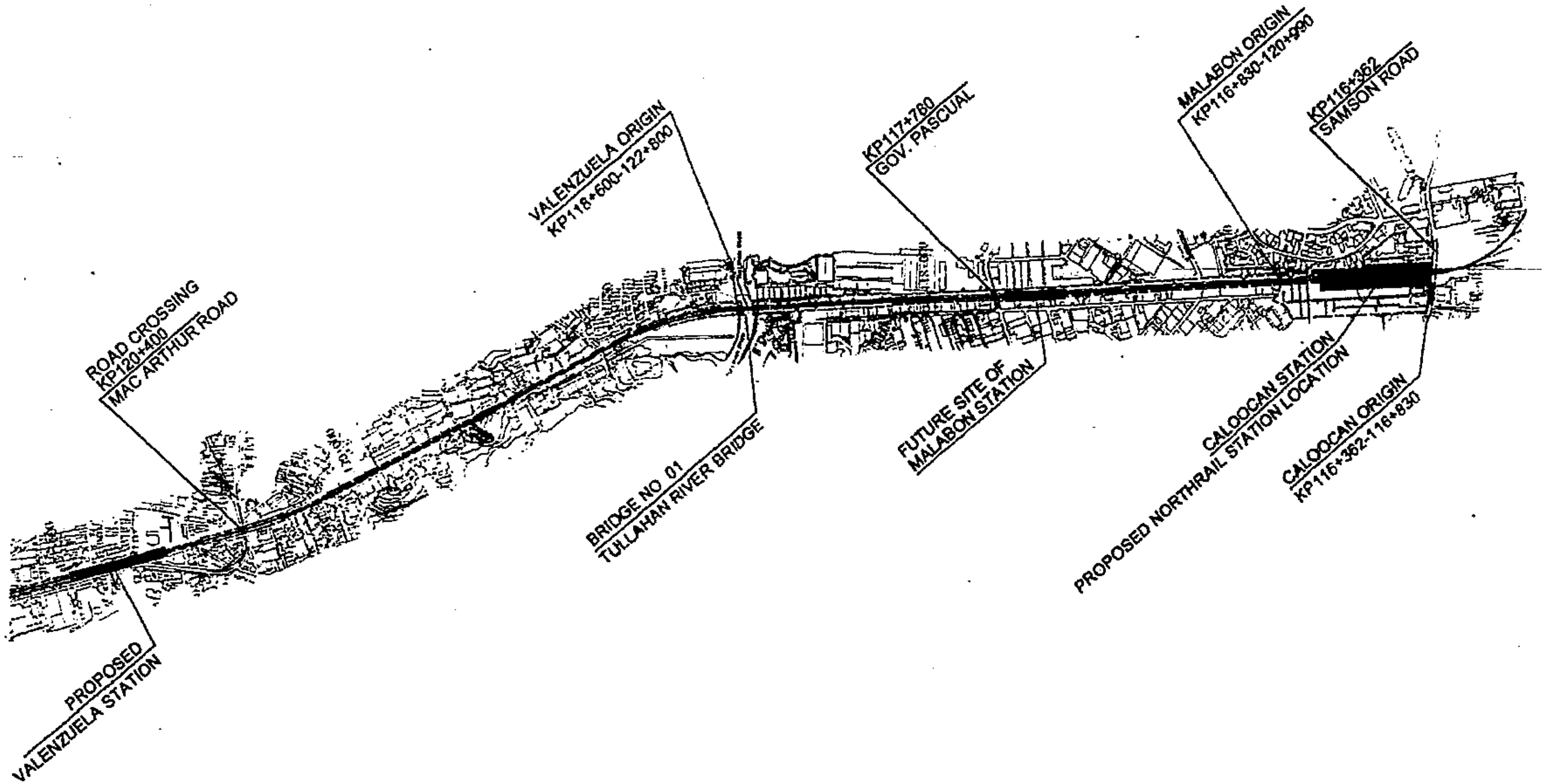


FIGURE 3.7: Alignment of the Caloocan – Valenzuela segment of the NorthRail Project (page 1 of 2)
(Note: Figure NOT to scale)

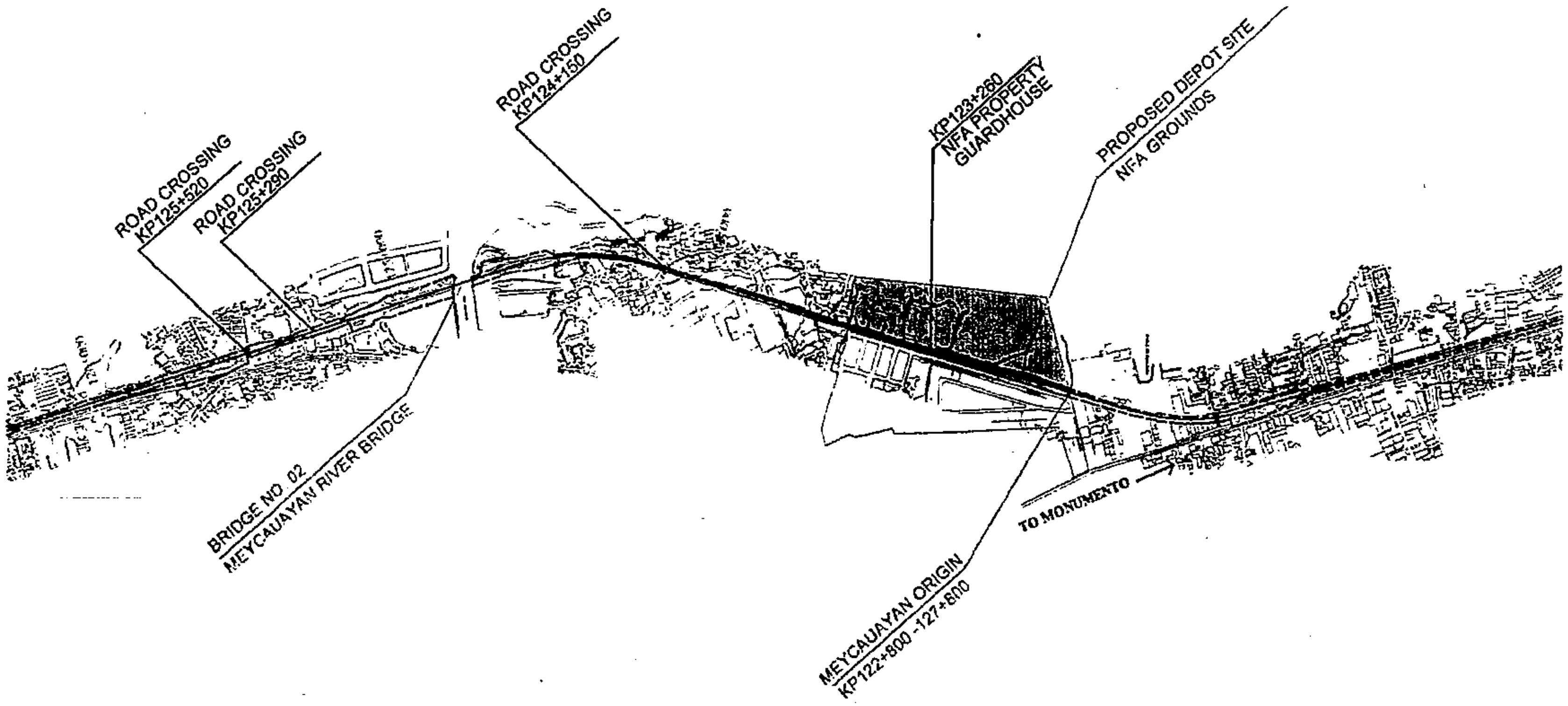


FIGURE 3.6: Alignment of the Caloocan – Valenzuela segment of the NorthRail Project (page 2 of 2)
(Note: Figure NOT to scale)

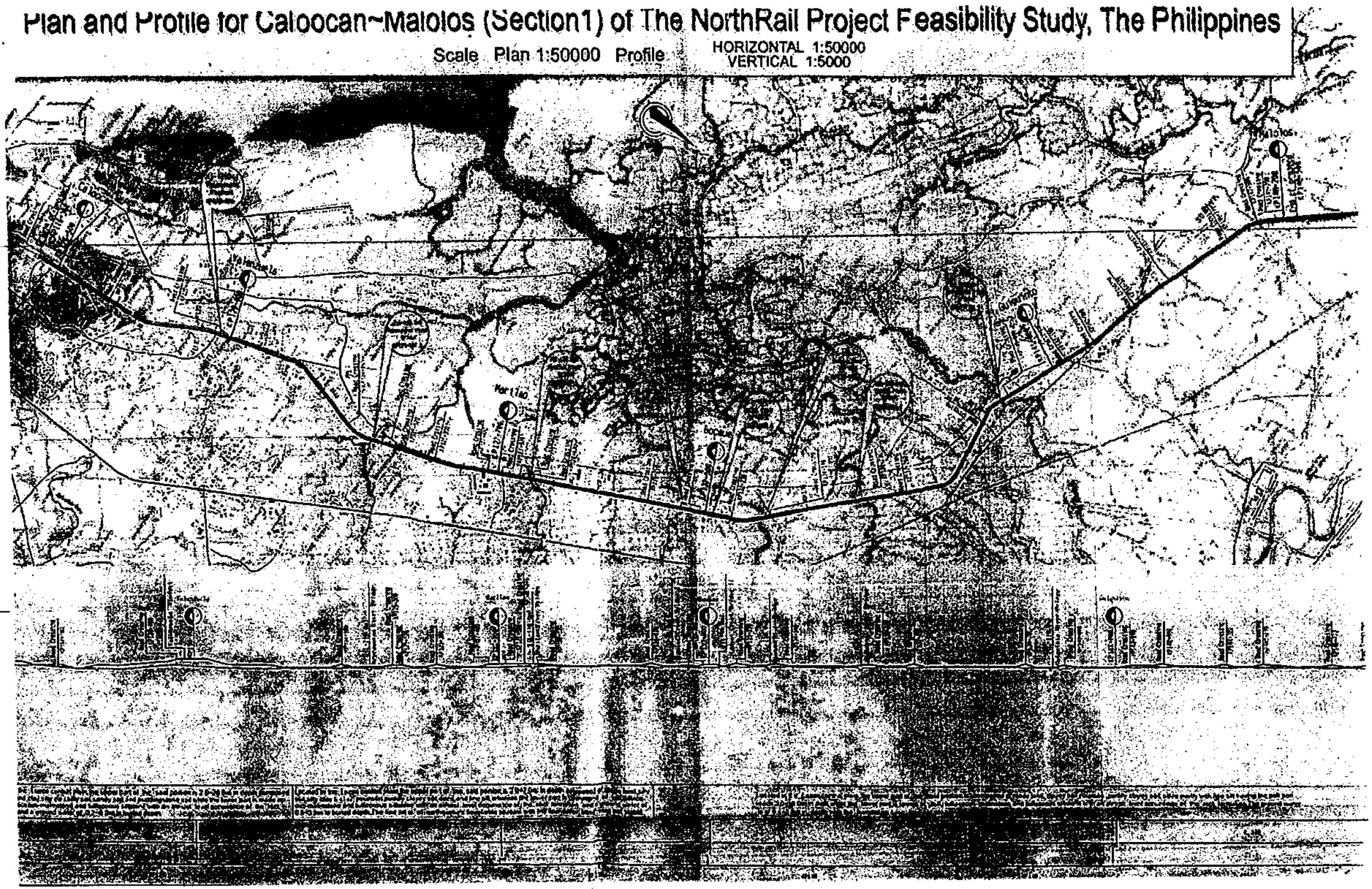


FIGURE 3.8: NorthRail Project Phase 1 Section 1 Plan and Profile
(Note: Figure NOT to scale)

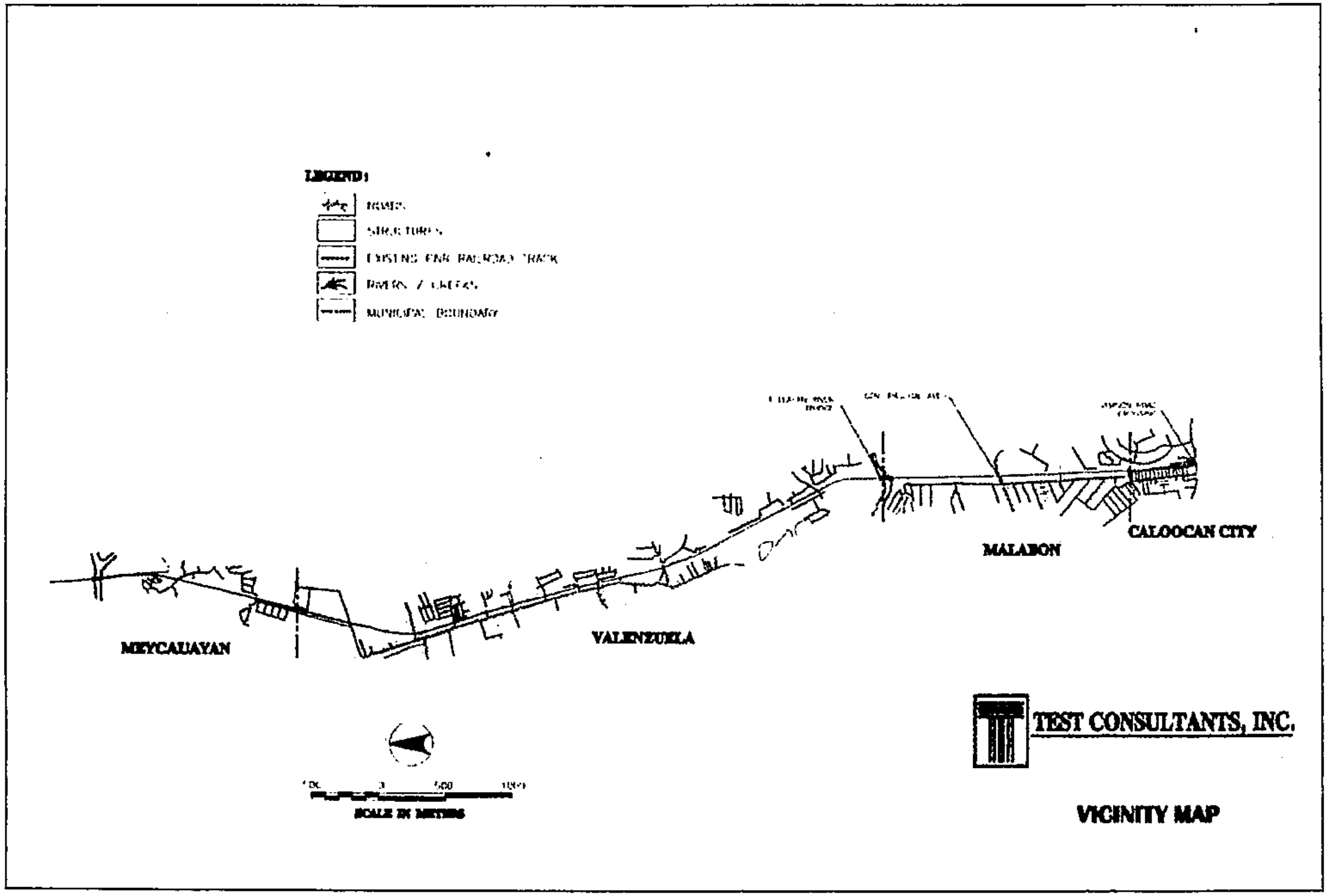


FIGURE 3.9: Vicinity Map
Source: Figure 2.1, EIS MCRRS Phase 1A-2 (Valenzuela – Kalookan City Segment), TCI, April 2000

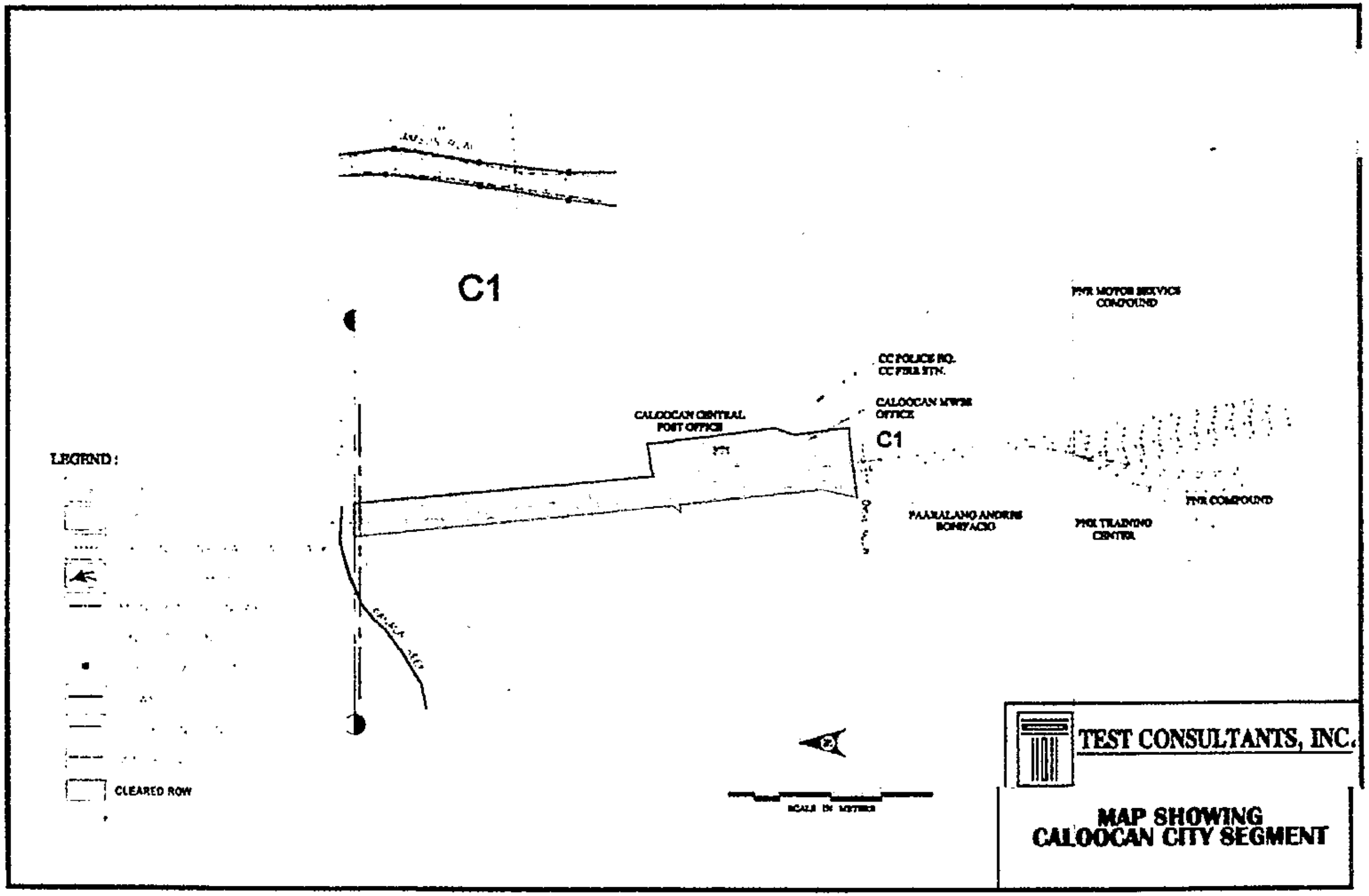


FIGURE 3.10: Map Showing Caloocan City Segment
Source: Figure 2.2, EIS MCRRS Phase 1A-2 (Valenzuela – Kalookan City Segment), TCI, April 2000

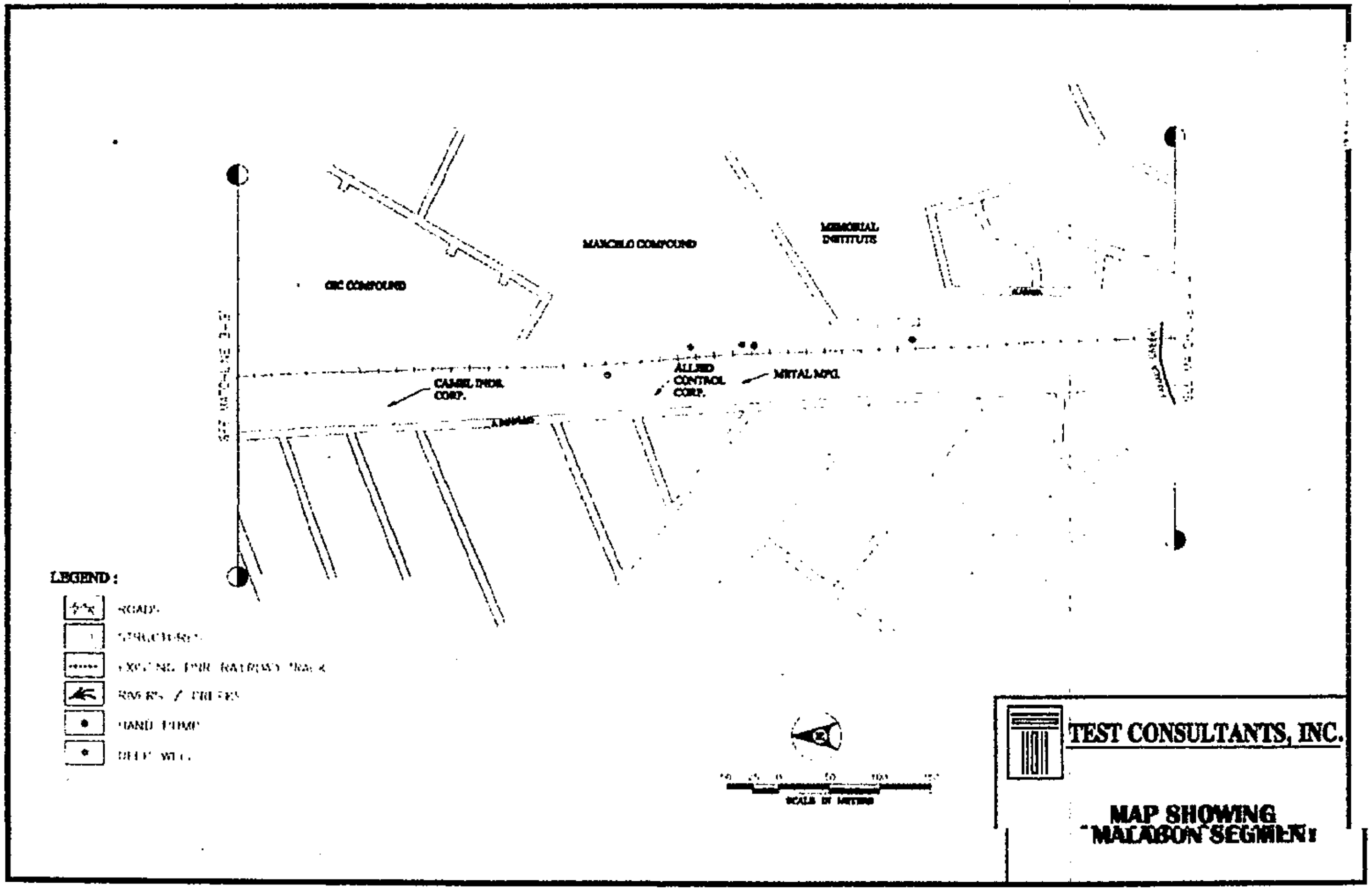


FIGURE 3.11: Map Showing Malabon City Segment (page 1 of 2)
Source: Figure 2.3-A, EIS MCRRS Phase 1A-2 (Valenzuela – Kalookan City Segment), TCI, April 2000

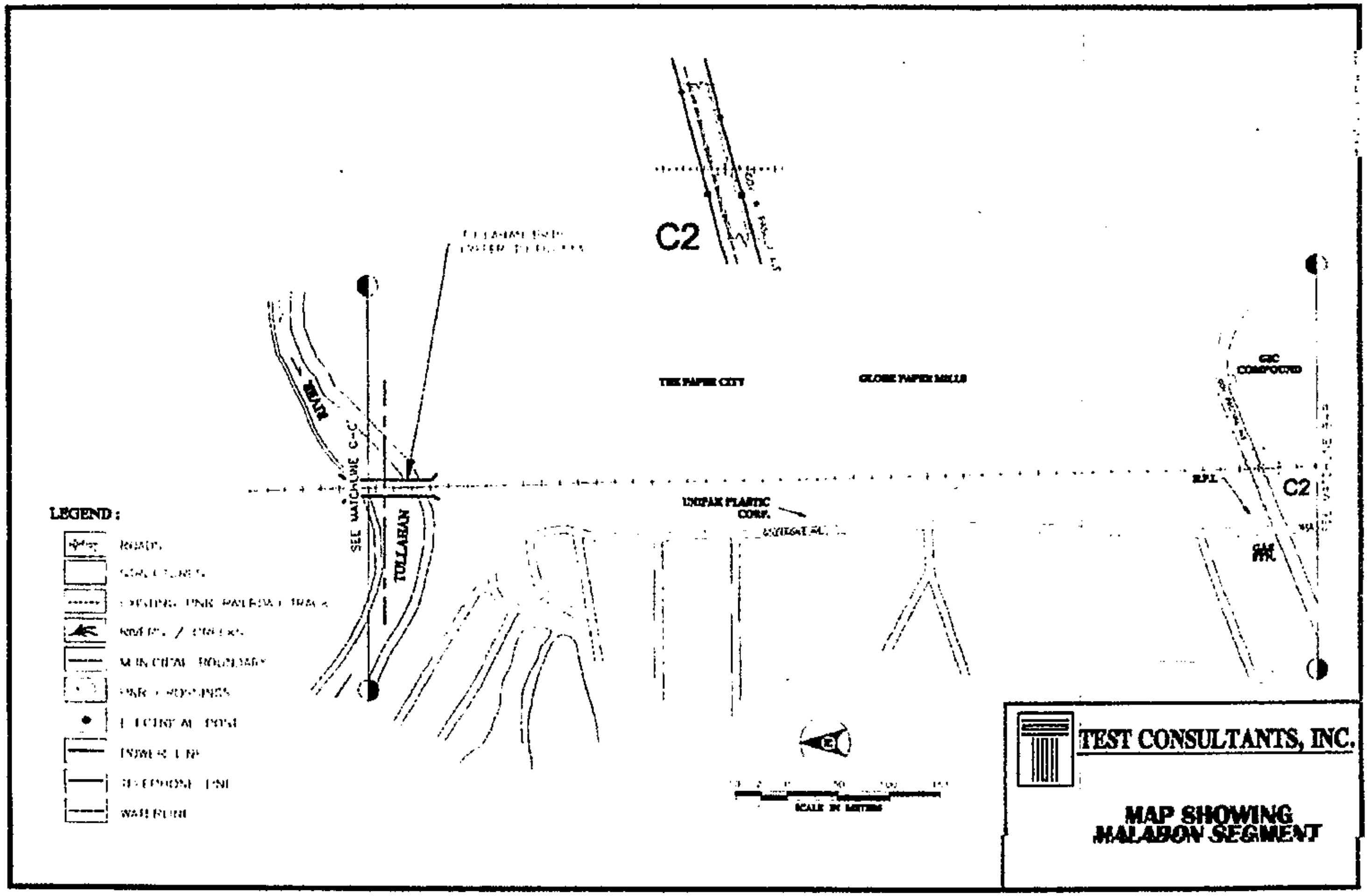


FIGURE 3.12: Map Showing Malabon City Segment (page 2 of 2)
Source: Figure 2.3-B, EIS MCRRS Phase 1A-2 (Valenzuela – Kalookan City Segment), TCI, April 2000

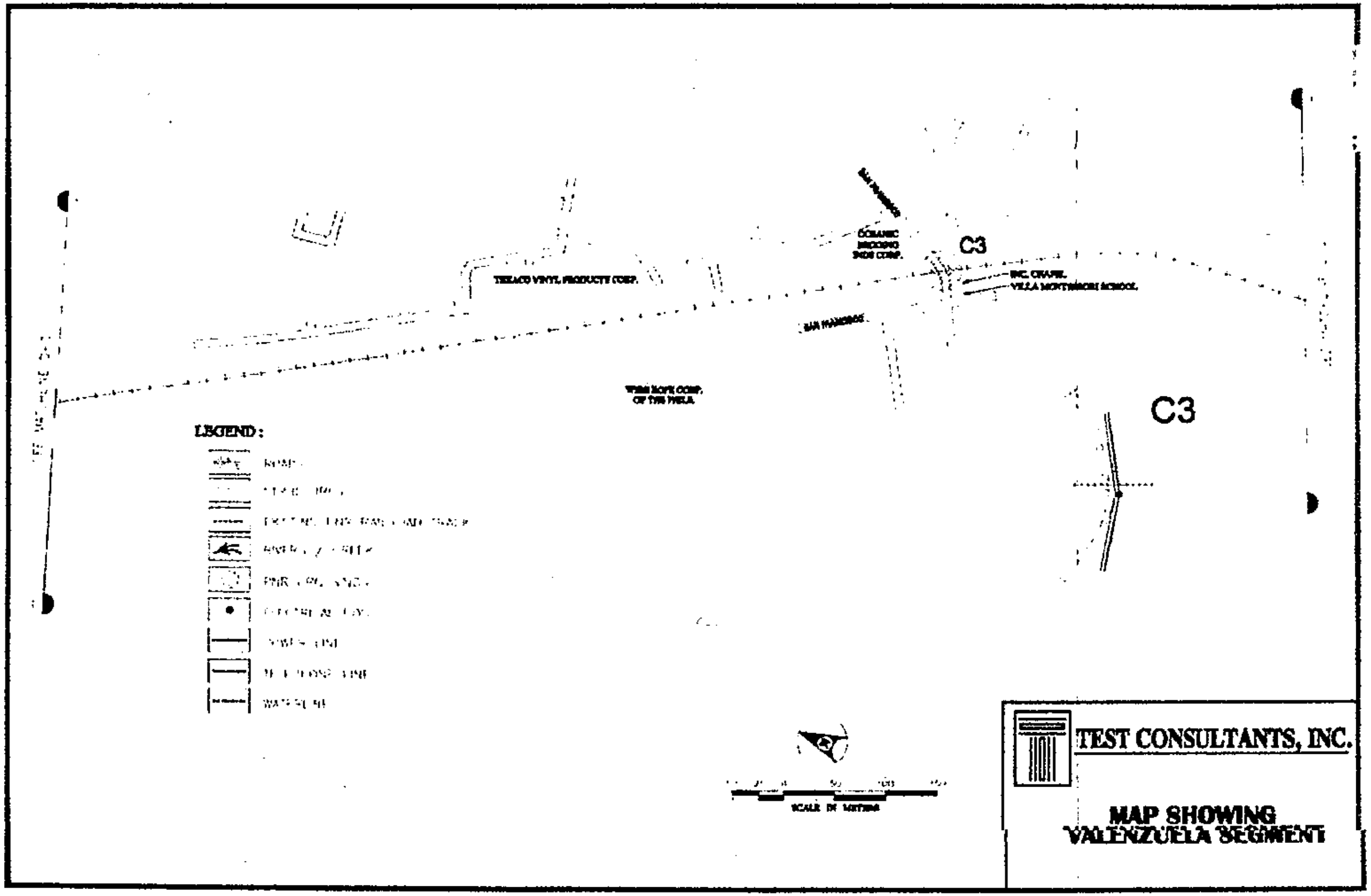


FIGURE 3.13: Map Showing Valenzuela City Segment (page 1 of 4)
Source: Figure 2.4-A, EIS MCRRS Phase 1A-2 (Valenzuela – Kalookan City Segment), TCI, April 2000

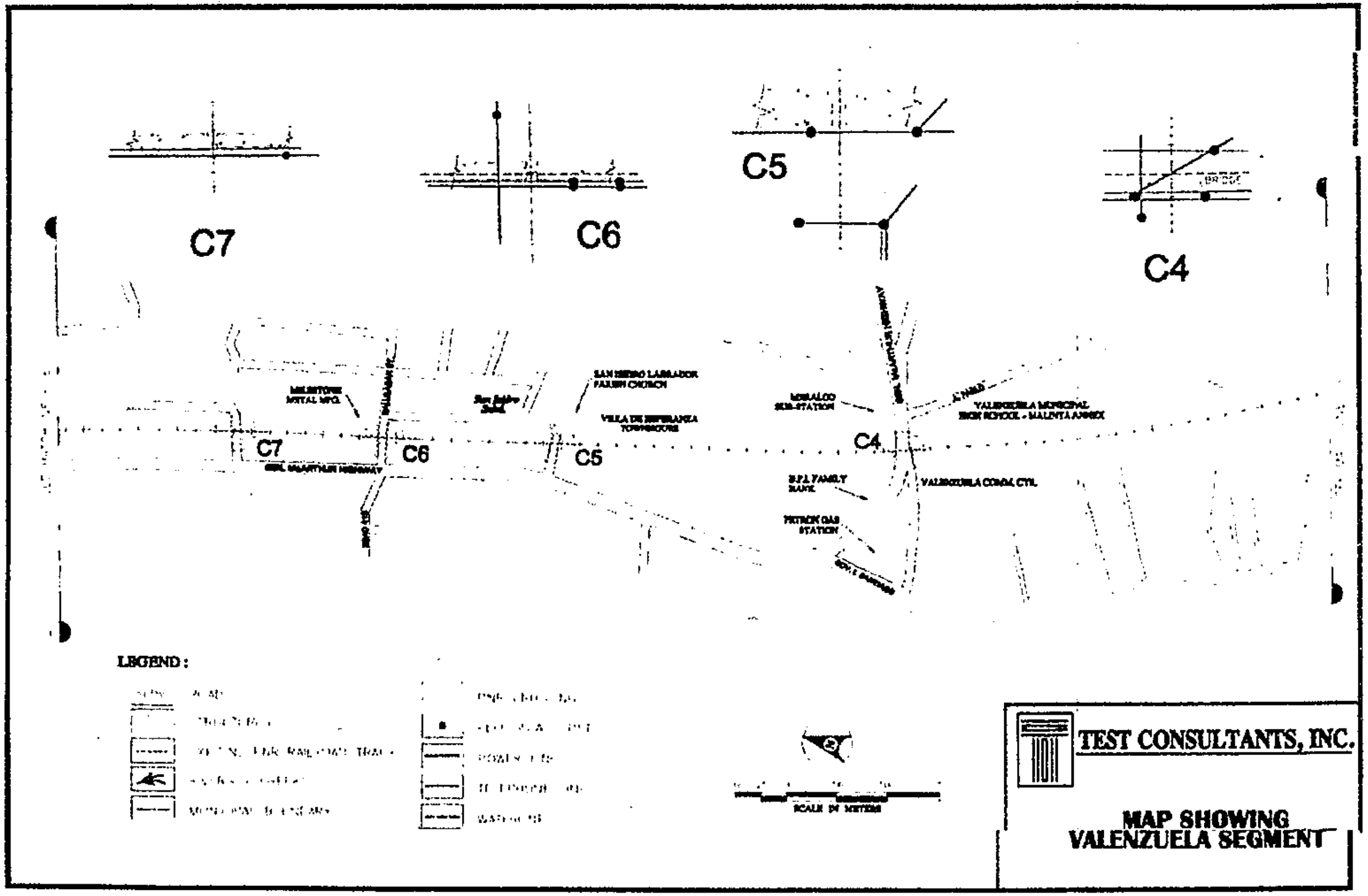


FIGURE 3.14: Map Showing Valenzuela City Segment (page 2 of 4)
Source: Figure 2.4-B, EIS MCRRS Phase 1A-2 (Valenzuela – Kalookan City Segment), TCI, April 2000

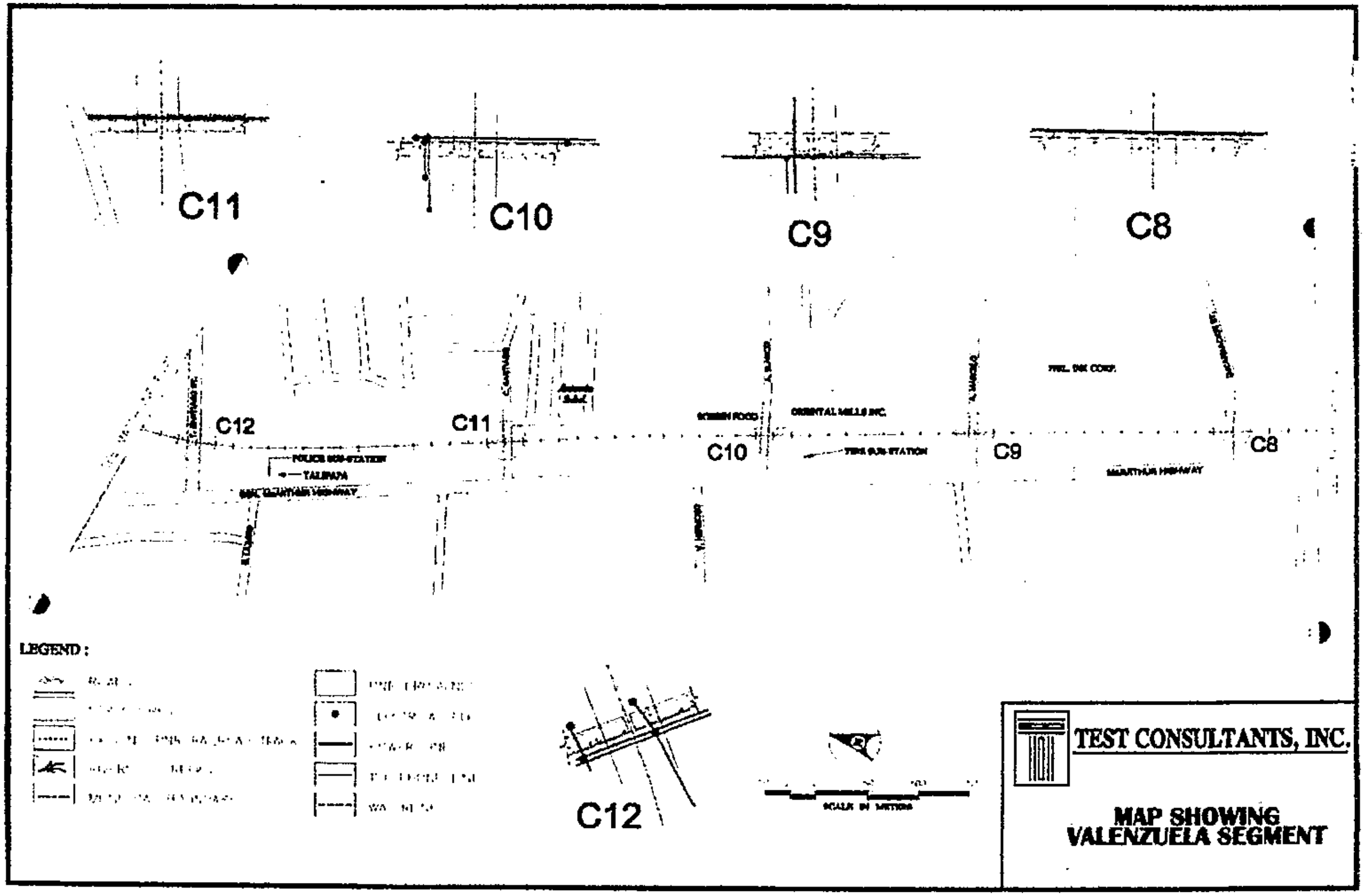


FIGURE 3.15: Map Showing Valenzuela City Segment (page 3 of 4)
Source: Figure 2.4-C, EIS MCRRS Phase 1A-2 (Valenzuela – Kalookan City Segment), TCI, April 2000

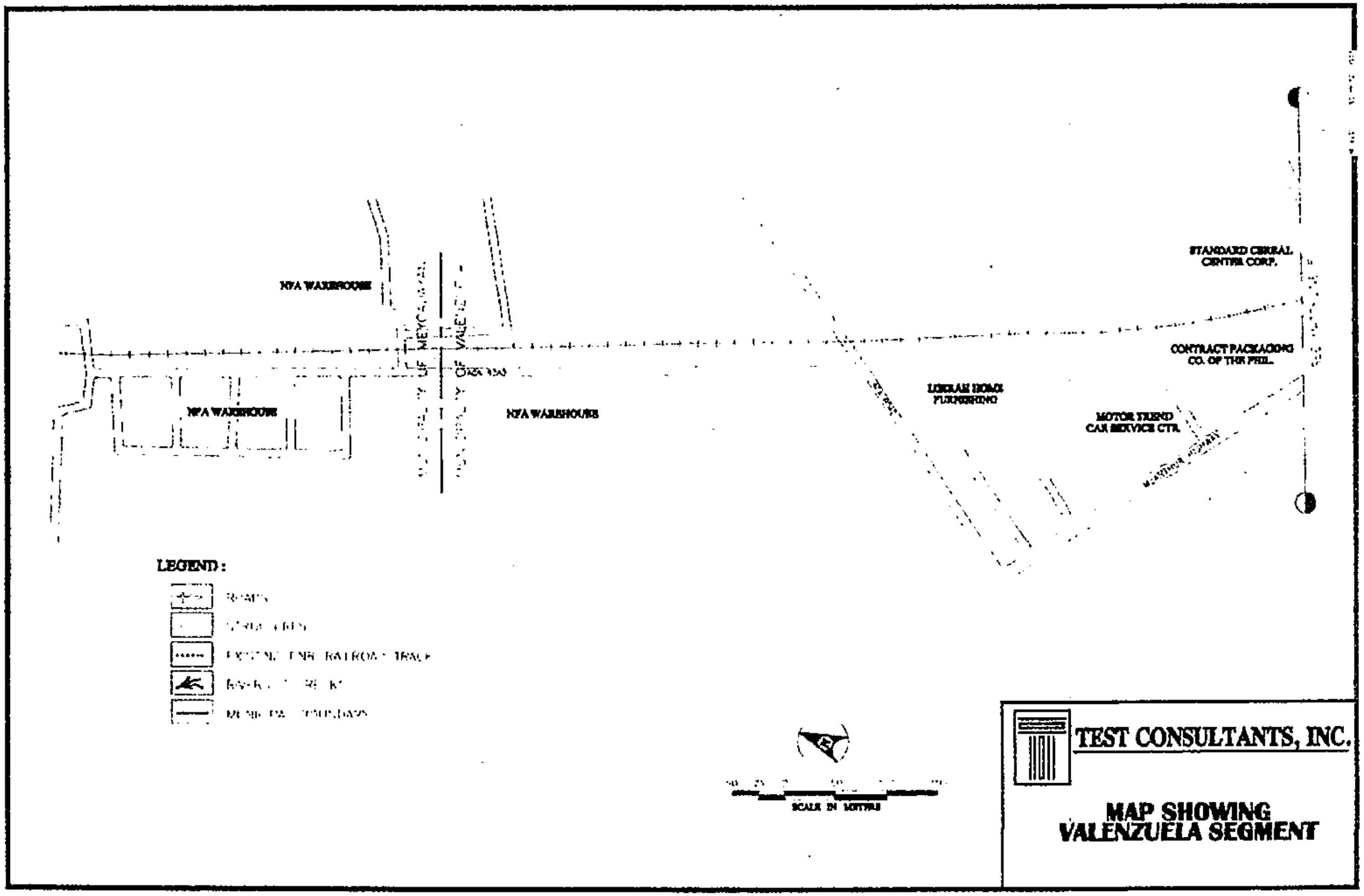


FIGURE 3.16: Map Showing Valenzuela City Segment (page 4 of 4)
Source: Figure 2.4-D, EIS MCRRS Phase 1A-2 (Valenzuela – Kalookan City Segment), TCI, April 2000

3.4 Project Rationale

3.4.1 *Environmental Impact without the Project*

The current transport situation in Metro Manila is characterized by severe congestion, long travel times, and often unpredictable delays. There are many plans to improve the transport network (rail included), affecting both public and private transport modes that will significantly improve the existing conditions. However, these proposed improvements seem likely to only keep pace with the demand and not outstrip it.

Private vehicle ownership in Metro Manila is increasing rapidly as the economy grows, worsening existing levels of congestion. This trend likely to continue despite recent falls in the value of the peso against the dollar, which may result in lower economic growth in the short term. An increase in the number of vehicles will mean an increase in emission levels, creating adverse environmental and health impacts to urban residents.

Along McArthur Highway and NLE, heavily congested points are already evident. Most of the proposed improvements like the recent expansion of NLE only benefit private vehicle owners. This rail project aims to improve the public transport modes and is considered as a primarily traffic management measure rather than a provision of new infrastructure.

3.4.2 *Environmental Impact with the Project*

Indirectly, the Project is expected to reduce the demand for more vehicles, thereby reducing the emission levels of air pollutants. With reduced travel time (in view of lighter traffic), fuel consumption and the number of accidents on the road will also be reduced.

Several studies have shown that rail transport has many positive environmental impacts compared to other modes (especially road transport):

(a) Energy Consumption

Rail transport is two to three times as energy efficient as road transport both for passengers and freight.

(b) External Costs

The monetary cost of external effects (e.g. pollution, greenhouse effect, etc.) is more than 100 times greater for road transport than for rail transport.

(c) Land Take

The mean width of the railway track formation for a normal double-track line is 30 meters whereas it is 28 meters for a two-lane motorway and 55 meters for a large gauge waterway canal. Despite the lower land take, the capacity of a double-track line is far greater than that of a roadway.

(d) Safety

Road transport accident victims account for around 40 times more than rail transport victims in recent years. Because of its high safety level, rail transport is very suitable for the conveyance of dangerous goods, both for those living in the vicinity of infrastructure and for the environment.

3.5 Project Components

The following sections below describe the major facilities of the Project. Most of the data presented in this report were taken from the Technical Document of Contract for the NorthRail Project Phase 1 Section 1 (Caloocan – Malolos).

Table 3-5 below are the system specifications to be adopted for the Caloocan – Valenzuela segment of the NorthRail Project.

TABLE 3-5: PRELIMINARY TECHNICAL DATA FOR THE CALOOCAN – VALENZUELA SEGMENT OF THE NORTHRAIL PROJECT

Length of the Line	7.23 km
Length of track alignment at grade	Tentatively 3.73 ~ 4.67 km
Length of track alignment on viaduct	Tentatively 2.56 ~ 3.5 km
Min. horizontal curve radius	450 m
Max. Design speed	120 km/h
Max. gradient	2.50%
Vertical Clearance of road crossing	4.35 m in general
Clearance of crossing Gov. Pascual	5.00 m
Track Gauge	1067 mm
Tracks	double track
Rail of tracks	rail-welded 50kg/m
Track spacing	4 m
Sleepers	pre-cast concrete monoblock with some wood sleepers at switches
Sleeper spacing	600 mm in general
Fastenings	elastic type
Depth of ballast	450 mm (on normal subgrade) & 300mm (on permeable material subdgrade)
Traction	Internal combustion engine
Trains	DMU (1motor car + 2trailer cars + 1trailer car with cab)
Telecom	

TABLE 3-5: PRELIMINARY TECHNICAL DATA FOR THE CALOOCAN – VALENZUELA SEGMENT OF THE NORTHRAIL PROJECT

Transmission Network	fiber optic based
Telephone System	PABX
Radio Communication System	private mobile system installed in DMUs and control center
Signaling	wayside signals & cab signals
Interlocking & block	computerized auto system
Ticketing	AFC system
Depot	1
Stations	2
Effective Length of Passenger Platform	90m for Caloocan Station and 130m for Valenzuela Station
If a tunnel will be put up	There will no longer be a tunnel that will be put up for this segment of the Project. The Caloocan station will be a ground station
Length of Segment	The length of the segment has a total of 6.482 kilometers. (See Annex AM. Site Development Plan)

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

3.5.1 *Alignment*

(a) Plan of the Alignment

(i) Minimum Radius of Curves

The maximum speed to be designed is 120km/h, with minimum curve radius of 850m. According to the existing PNR ROW, some small radius curves of 450m will be considered.

(ii) Transition Curves

Thrice parabola type of transition curve will be adopted. The length of the transition shall not be less than values as described in Table 3-6. Converse transition will be considered at both ends of stations where necessary. No transition will be arranged for the radius exceeding 5,000m.

TABLE 3-6: LENGTH OF TRANSITION CURVES

Radius of Curves (m)	Length of Transition (Curves (m)			
	120km/h		80km/h	
	Normal	Minimum	Normal	Minimum
2000	80	60	20	20
1200	90	70	40	30
1000	100	80	40	40
800			60	50
600			60	50
500			60	50
450			70	60

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

(iii) Minimum Length of Circular Curves and Intermediate Straight Line

The length of circular curves and intermediate straight line is generally not less than 80m, with the minimum of 50m at extreme location, if any.

(iv) Tracks Spacing and Curve Widening

Tracks spacing in the section is not less than 3.75m. However, 4 meters is recommended for the convenience of passenger and the future development of higher traffic speed, freight traffic and extra kinetic envelope of trains operation.

(b) Profile of the Alignment

The maximum gradient is about 2.5% without considering the compensation of gradient caused by plane curve resistance.

The slope will not be less than 200m.

Algebraic difference between two slopes will be less than 5.0%.

Vertical curve set-up condition, type and radius of vertical curve: At places where the algebraic difference between two neighboring slopes exceeded 0.2%, the circular type of vertical curve connection will be adopted. To reduce the construction cost, the vertical curves shall generally be 5,000m or 3,000m at extreme location, if any. Vertical curve should not be superposed with transitions and turnouts. Intermediate straight line between vertical curves should not be less than 50m.

The stations will be located on the plane area. Provisions for length expansion of station yard will be preserved to accommodate two coupled DMUs in future.

The elevations of railway shoulder are to be designed to meet requirement of river and road crossings.

(c) Road Crossings (RC)

NorthRail is currently looking at two scenarios:

1. Locating the depot within the existing PNR depot area (see Annex AN. Scheme Design of Caloocan Depot), as stated in the 2nd Additional Information; or
2. Locating the depot within the 13-hectare NFA property in Valenzuela (See Annex AO. Layout of Depot in Valenzuela)

In both cases, there will be a road crossing provided at Governor Pascual Avenue in Malabon. There will be grade-separation between the rail and road based vehicles – the rails will be elevated to a height of 7.07 meters to allow the passage of road based vehicles under the structure, with a vertical clearance of 5.0 m.

Originally, the road crossing is designed as a frame bridge. However, considering the effect on traffic during construction, the design for a single span bridge is now being considered.

With regard to the location of the depot, if the depot is located within the PNR Caloocan depot area, then the rails will traverse Samson Road and therefore a road crossing will be provided. See the Annex AP (Flyover along Samson Road) of the proposed road crossing solution for this option. The road crossing currently envisioned is a road-over-rail crossing. A fly-over will be constructed along Samson Road to allow unimpeded flow of traffic (both for rail and road vehicles). See Annex AQ. Scheme Design of Caloocan Depot and Proposed Station Layout showing Flyover in Samson Road.

However, if the depot is located in Valenzuela, there will be no need for NorthRail to provide a road crossing in Samson Road. It should be noted, however, that the NorthRail – SouthRail Linkage Project under the Philippine National Railways should provide the appropriate road crossing.

As the project will be on viaduct structures where the other road crossings are to be located, there is no need to provide for the same solution as the viaduct structure will already allow the passage of road based vehicles

Since the operation of the trains will be in high frequency, no level crossing will be considered. Based on initial estimate, there will be 2 road crossings for this section of the Project. Generally, the vertical clearance of the roadcrossings (rail over road) shall be 4.35 meters. This clearance may be increased to 5 meters only when it is absolutely necessary. The number and locations of additional road crossing(s), if any, shall be agreed upon by NLRC and the Supply Contractor prior to the commencement of Engineering Survey. It is envisaged that the Valenzuela section will be mostly in viaduct such that there is no requirement to provide RCs. However, should the design be significantly different, adequate number of RCs will be provided. Road crossing dimension for width shall be determined based on existing traffic volumes for vehicular and pedestrian accesses. The rail crossing (road over rail) shall be 6.55m taking account of future upgrade to electrified system. Particular height and width for each crossing will be finalized during Engineering Design.

TABLE 3-7: ASSUMED LIST OF ROAD CROSSINGS (CALOOCAN – VALENZUELA SEGMENT)

Location	Crossing Angle	Type of crossing	Dimension width * height	Pavement
KM117+780	74^{0}	Road crossing	9x4.35	Bitumen
KM123+260	90^{0}	Road crossing	7x4.35	Concrete

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

Attached as Annex AG are illustrations of the different alignment solutions being contemplated for the project (typical sections).

The least costly solution is the use of embankment to elevate the tracks to the desired level. However, should the PNR right of way not be sufficient to accommodate full embankment, retaining walls will be used. Should the right of way not even be sufficient to carry retaining walls, or for some other technical considerations, a viaduct solution will be adopted. This solution is considered the most costly (structure-wise).

Also included in Annex AG is the vertical alignment showing the natural ground elevation and design height of rail.

3.5.2 *Tracks*

(a) Track Gauge

The gauge of the existing PNR track is the narrow or *Cape* gauge (1067 mm), while LRT Line 1, MRT Line 2 and MRT Line 3, and for all future MRT lines, it is the standard gauge (1435mm). While the various rail lines within Metro Manila are of the same gauge, their electro-mechanical systems are not compatible as there is no need or intention for their trains to run on each other's tracks. MRT passengers in Metro Manila will be able to interchange with the various systems through interconnecting station.

Narrow gauge is more commonly found in Africa, Asia, and Australia, as it was originally adopted as the *Colonial gauge* when railways were developing incolonized countries in the latter half of the 19th Century. Specifically, it is used extensively throughout Japan. In the early years of railway development, the narrower gauge, being cheaper to construct, was a popular choice especially in geographical conditions requiring many sharp curves, tunnels, and steep gradients such as the Philippines. The reduced performance was not significant in view of the type and level of traffic, and the pioneering nature of many of these railroads.

While the 1435mm gauge is the most common, it does not follow that equipment for this gauge is the more widely available. The Japanese rail industry has extensive capacity for the production of narrow gauge rail vehicles and their associated spare parts. As a result, the early delivery of narrow gauge rail equipment can still be achieved, teething troubles are minimized, and spare parts can be readily available as long as NLRC adopts a proven narrow gauge design.

There is no doubt that a higher top speed can be attained on 1435mm gauge than on 1067mm gauge. This is a mathematical fact, which is derived from the formula that determines stability. This accounts for the fact that all the very high-speed rail systems (mostly in Europe) are based on the 1435mm gauge. However, several medium high-speed systems around the world are on 1067mm gauge, such as the Japanese National Railways (JNR) East in Japan, Queensland Railways in Australia, and the South African Transport Services (SATS) in South Africa.

Trains operating on 1067mm gauge can travel up to 200 kph, but in order to do so, they must make use of dynamic suspension systems or run on especially straight tracks. The entire track alignment of the NorthRail Project extended up to La Union would require an extensive investment if straightened (as it would no longer occupy the existing PNR ROW) just to meet the desired rolling stock speed of 200 kph. A similarly expensive capital expenditure would be required to produce a straightened track alignment for a rolling stock to run at 200 kph using standard gauge although it would offer an improved journey time over narrow gauge for the same given alignment. This therefore illustrates that the difference in speeds for both gauges does not have a significant impact insofar as the NorthRail Project is concerned.

The current needs of NLRC can be served by narrow gauge technology for its metro and interurban services, though journeys between Fort Bonifacio and the CSEZ would suffer a time penalty. To offset this, the construction cost for these sections would be reduced.

It is undeniable that in any single landmass (especially a single country) where the potential for interconnection exists, the gauge to which rail systems are built should be unified. Moreover, the electro-mechanical systems employed should be compatible throughout. This is evident through the extent in which investment is being made worldwide in gauge unification or in rolling stock that can run on different gauges. In Europe where standard gauge prevails, railway administrations have invested heavily in rolling stock that can run on pan-European services across a plethora of differing electro-mechanical systems.

Currently available traffic data shows limited potential for North Luzon to South Luzon through running services. It must be noted, however, that current travel patterns are formed in the absence of an operational rail service in North Luzon and a poor service in South Luzon. Additionally, the development of DMIA as a regional logistics hub will generate traffic through the corridor that might originate in the southern part of Luzon. If the potential through traffic is to be realized, then interconnection must be an important factor in the choice of gauge.

The NorthRail Project will replace PNR operations north of Manila. Existing PNR line will continue to operate Main Line South (MLS) and will undergo a series of progressive upgrades and renewals, none of which incorporates a change of gauge.

To facilitate the interconnection of the North Luzon and South Luzon rail line, the electro-mechanical systems of PNR must be upgraded and made compatible with that of the NorthRail Project. This can be achieved during the presently planned and future improvements that PNR will undertake as part of its overall program for development and renewal. If the NorthRail Project will be built at standard gauge, such PNR upgrades would have to additionally include a conversion of gauge, which is considered unlikely.

Based on the above, and recognizing the importance of compatibility with PNR south line with the NorthRail line, narrow gauge shall be adopted for the NorthRail Project.

During the operation of the project, there are not many differences in terms of comfort and stability when comparing narrow track gauges and standard gauges. These two are dependent on the track alignment (radii of curvatures along the alignment which may restrict speeds) and design. The safety and structural integrity of a narrow gauge track and a standard gauge track are also the same considering that the operating speeds for the project are not really that high. The basic advantage of standard gauge track over the narrow gauge is its inherent wider base, which provides a more stable platform for performance. However, at higher speeds, a narrow gauge track can compensate this disadvantage on comfort and stability by using modified rolling stock (compensators, tilting bodies, etc.) or by modifying the track design.

However, it must be pointed out that the choice of narrow gauge tracks against a standard gauge track was primarily dictated by the need to interconnect the Northrail and the Southrail lines. The DOTC has a standing policy on adopting narrow gauge tracks for these projects.

(b) Standard and Height of Track
Thermal-stress welded track will be applied on the ballasted track bed of the railway alignment. The standard and height of track is detailed in Table 3-8.

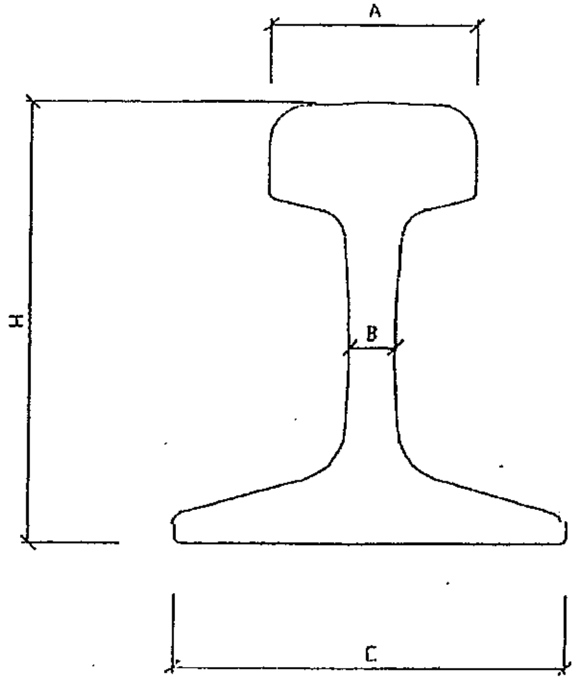
TABLE 3-8: STANDARD AND HEIGHT OF TRACK

Description			Unit	Main Line	Passing line in station	Receive/ Departure line	Other station line[3]	Secondary station line[4]
Rail	Type		kg/m	50	50	50	50	50
	Length of rail		m	welder rail	welder rail	25	25	25
Sleeper	reinforced concrete sleeper		piece/km	1667	1667	1520	1440	1440
	wood sleeper		piece/km	1667	1667	1600	1440	1440
Track Bed	material			crushed stone	crushed stone	gravel	gravel	gravel
	width on top level		m	2.9	2.9	2.5	2.5	2.5
	Side slop			1:1.75	1:1.75	1:1.5	1:1.5	1:1.5
	thickness	on normal subgrade	m	0.25/0.20	0.25/0.20	0.35	0.25	0.20
		on permeable subgrade	m	0.30	0.30	0.25	0.20	0.20
Height of track	[1]on normal subgrade	RC sleeper	m	0.977	0.977	0.73	0.63	0.63
		wood sleeper	m	0.955	0.955	0.68	0.58	0.58
	[2]on permeable subgrade	RC sleeper	m	0.662	0.712	0.63	0.58	0.58
		wood sleeper	m	0.640	0.690	0.58	0.53	0.53

Note:

1. [1] reflecting the height from subgrade to the top of rail for single cant subgrade at the transverse slope.
   [2] reflecting the height for the subgrade at plane.
   [3] is referred to the connection between station to Depot;
   [4] is referred to lines other than platform track and other station track.
2. The track for link between mains is the same with main line track.
3. The proposed height of reinforced concrete sleeper is approx. 0.2m.

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003



50kg/m Steel Rail

Item	Unit	50kg/m steel rail
Mass	kg	51.514
A	mm	70.00
B	mm	15.50
C	mm	132
H	mm	152
Total sectional area	cm^2	65.8

FIGURE 3.17: Cross-section of 50 kg/m Steel Rail
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

(c) Steel Rail and Fitting Parts

Rails for both main line and station line will be 50 kg/m (see Figure 3.17).

The 50kg/m 6-hole steel rail fish plate, fixtures (screws and bolts) and high tensile flats washer are used as joint for welded rail.

(d) Sleepers and Fasteners

Generally, pre-cast concrete monoblock sleeper (approx. 2.1m) shall be applied to support the 50kg/m rail along the main line. Specific concrete sleepers will be used for anti-derailing rail on the bridge.

(i) Stretches Wood Sleepers to be used

- At curves with radius of less than 300m.
- Within the range of bridge abutment including 15 pieces for both approaches (plus at least 5 pieces at the extension of anti-derailing section).
- At turn-out including 15 pieces for both extension
- Preliminary estimate of the number of sleepers per kilometer is 1,667 for the main line, 1,520 for receive / departure line and 1,440 for other station tracks. These values are for the entire section of the NorthRail Project Phase 1 Section 1 (Caloocan – Malolos).

(ii) The Stretch for Additional Sleepers

- At curves with radius less than 500m (including the transitions)
- At slopes exceeding 2.0%

Only one additional sleeper will be applied if both two cases mentioned above are encountered. The additional quantity of sleepers for each 1,000m on the above stretches will comply with the specification provided in Table 3-9 below:

TABLE 3-9: ADDITIONAL SLEEPERS

Type of Sleeper	RC Sleeper	Wood Sleeper
Additional Number	80	160

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

(iii) Fastener

Elastic fastener type I with rubber plate will be adopted in conjunction with concrete sleeper. For sections with wood sleepers, cleft rail fastening set and screws will be used for main line and station tracks, respectively.

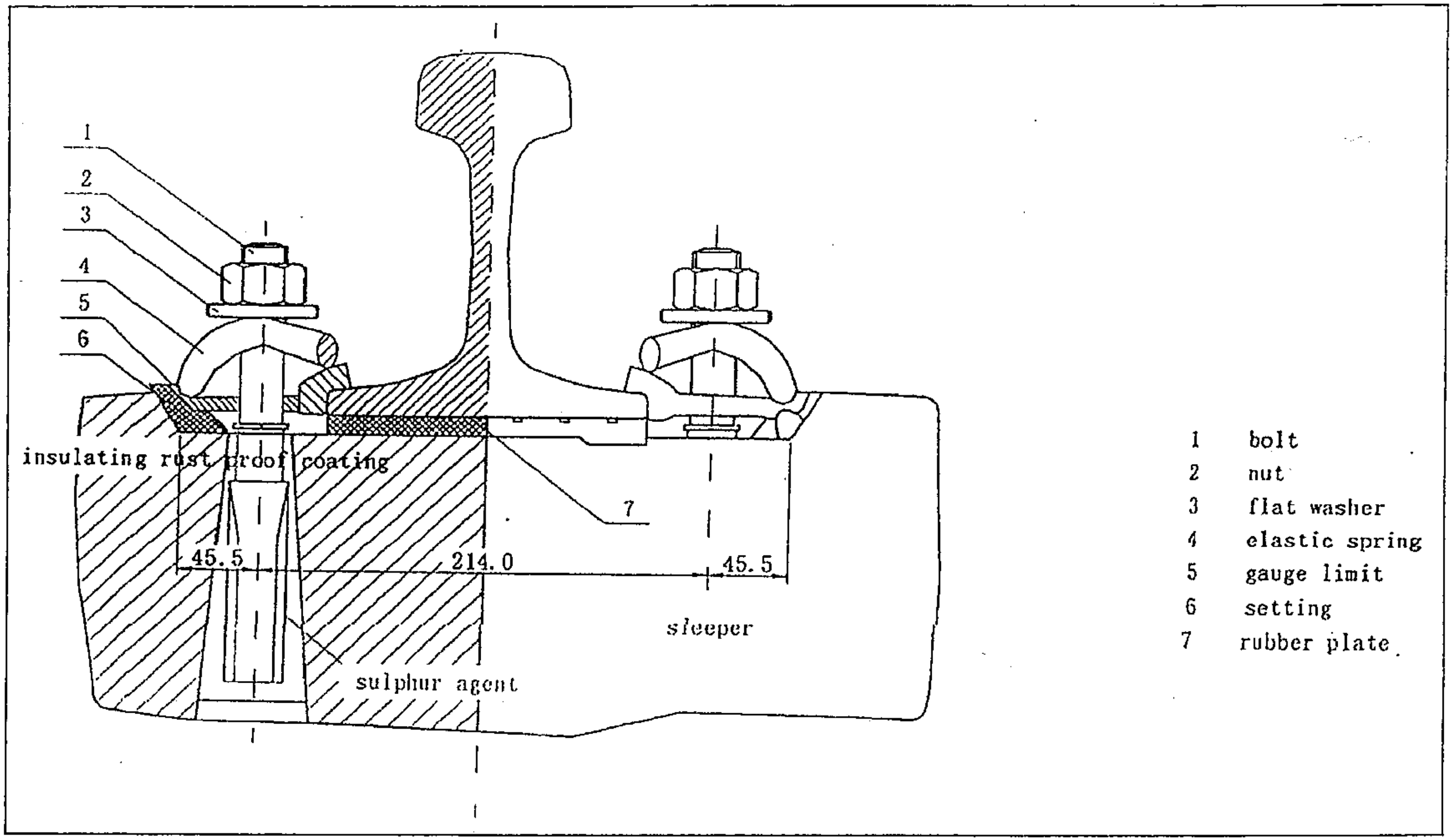


FIGURE 3.18: Elastic I Fastener
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

(c) Track Bed

(i) Ballast

Grade I crushed stone ballast will be applied to form the track bed.

The source of materials for ballast and fill are provided in Annex AH and the location of construction camps/staging yards are still being studied.

(ii) Layers

Double layers (250mm and 200mm) of ballast will be applied to the railway foundation of normal sub-grade. Single layer (300mm) of ballast is for that of permeable sub-grade. The thickness of ballast on the bridge deck will not be less than 250mm. The difference of "between ballast on bridge" and on the approaches will be within the range of 30m to the abutment.

Single layer of ballast 350mm, 250mm and 200mm will be applied to receiving/departure line, other tracks and secondary tracks, respectively, in all stations.

(iii) Ballast track bed

Table 3-10 below details the specifications for ballast track bed.

TABLE 3-10: BALLAST TRACK BED

	For welded continuous rail	For normal rails	in stations
Width	2.9m	2.6m	2.5m
Slope	1:1.75	1:1.75	
Shoulder	250mm	250mm	
Should super height	150mm	/	

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

Additional 100mm to the outer portion of the track bed will be considered for the curve radius less than 800m of continuous rail or less than 600m of normal rail. No super width will be taken into account to the curves in the station area.

(iv) Ballast Surface

The surface of ballast will be in line with the mid-level of concrete sleeper.

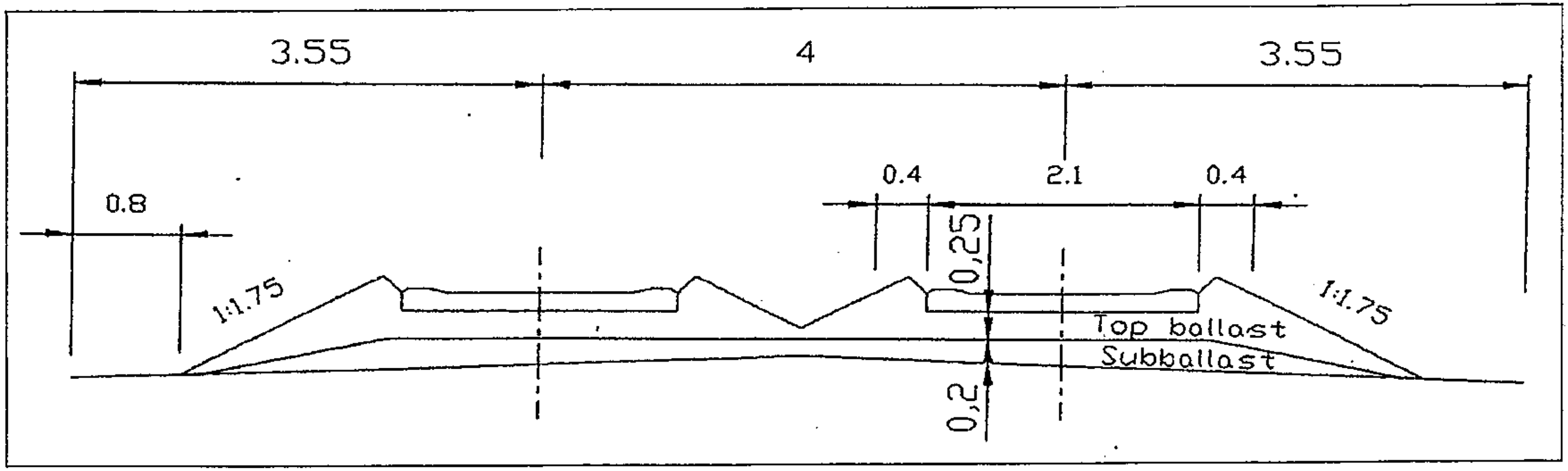


FIGURE 3.19: Cross-section of Ballast Bed (I) - Normal Soil Subgrade
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

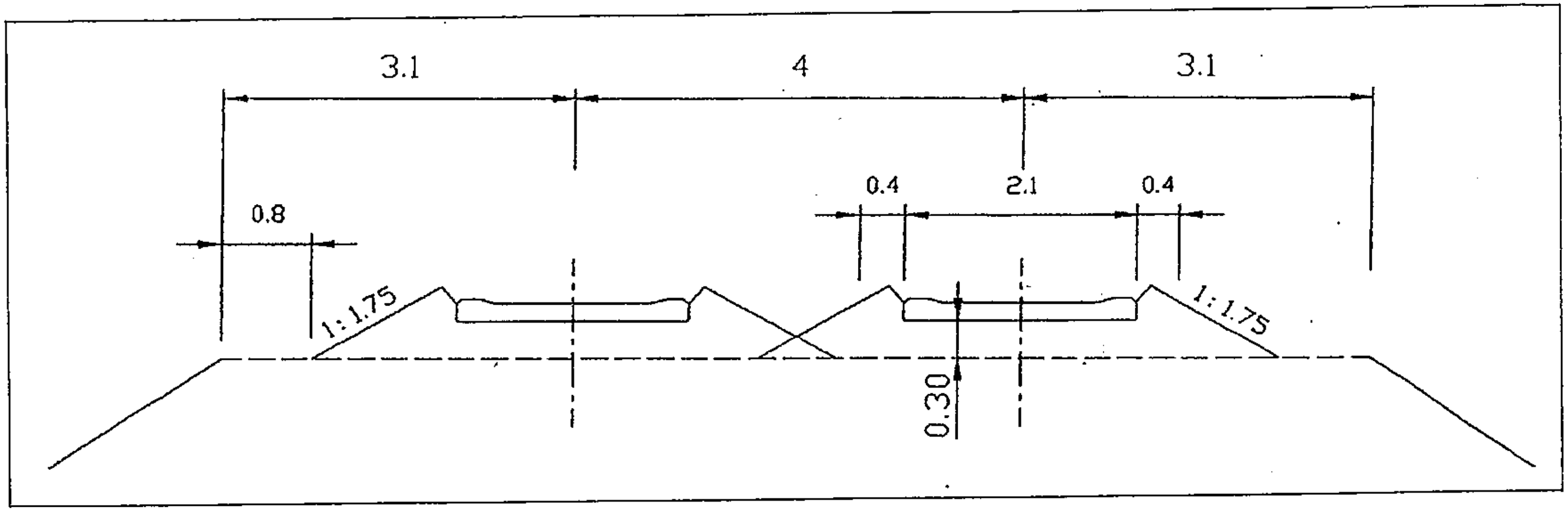


FIGURE 3.20: Cross-section of Ballast Bed (II) - Permeable Soil and Rock Subgrade
(Note: Figure NOT to scale)

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

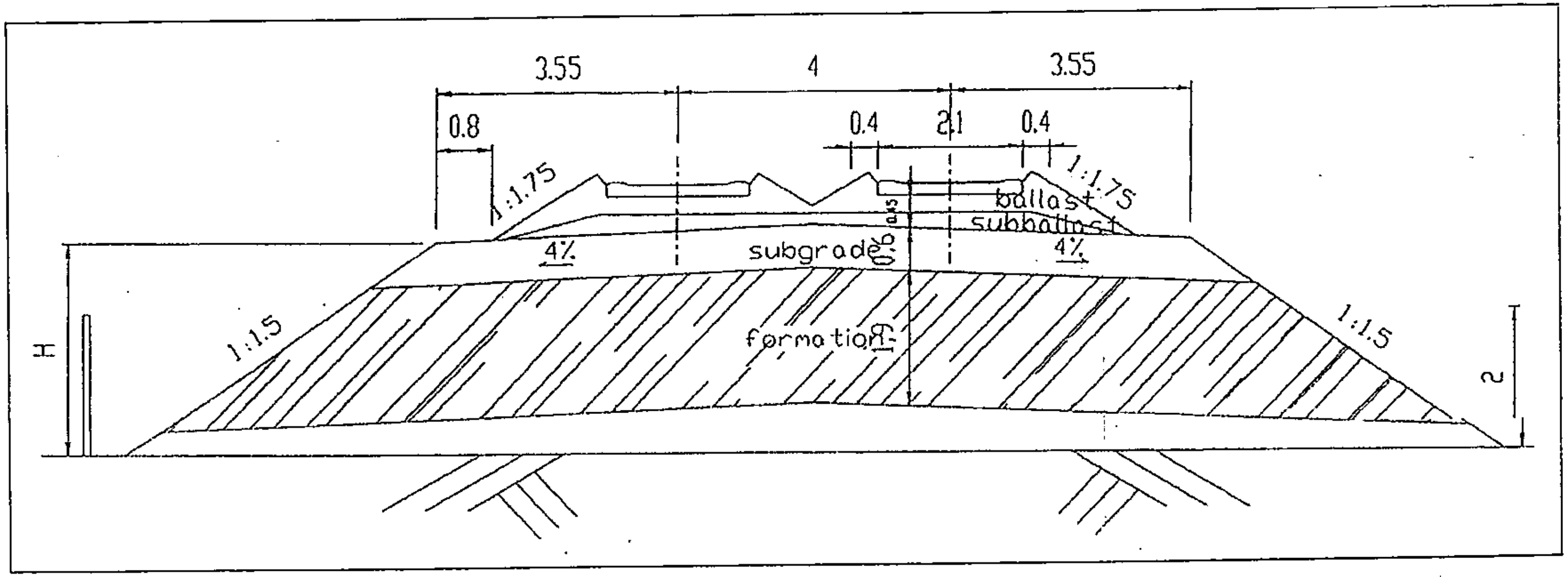


FIGURE 3.21: Cross-section of Common Subgrade
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

(f) Turnout
No. 12 (50 kg/m) turnout set with concrete sleepers will be installed in the alignment and in stations with the exception of the Depot where the No. 7 turnout set with wood sleepers are to be designed.

Additional track crossings, if necessary, will be considered in the Preliminary Design.

(g) Other Track Fixtures

(i) Gauge Tie
Gauge tie (Φ 32mm) will be installed (400pcs/km) to the track fastened by screws in the event that the curve is less than or equal to 450m.

(ii) Anti-creeping
Anti-creeper (320 pairs/km) and anti-creep strut (960 pcs/km) will be installed to the track with wood sleepers.

Anti-creep installation for switches is described in Table 3-11 below.

TABLE 3-11: ANTI-CREEP INSTALLATION FOR SWITCHES

Switches (group)		Anti-creeper (pair)	Strut (piece)
Simple Switches	50 kg/m No. 12	20	21
	50kg/m No. 7	16	18
Intersecting crossing	50 kg/m No. 12 with spacing 5.0m	102	168
	50kg/m No. 7 with spacing 5.0m	84	132

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

(iii) Anti-derailing Rail
Anti-derailing rail (43 kg/m, 25m in length) will be installed in the track where necessary and fastened to the sleeper using specific screw and bolt. Location of anti-derailing rails is normally installed on the bridges along the alignment which will be specified in the Design.

(h) Stock of Track Furniture for Maintenance
Table 3-12 below details the stock of track furniture for maintenance

TABLE 3-12: STOCK OF TRACK FURNITURE FOR MAINTENANCE

Description	Quantity
Steel Rail	1 piece is prepared for each buffering section (plus 1 extra in case of existing shortened rail)
Fish Plate	4 sets / maintenance stretch
Emergency Clamp	1 set / km
Emergency welding kit	1 set / km
Bolts and Washers	12 sets / km
Short Rail	1 piece (6m with holes) & 1piece (7m without holes) / maintenance stretch
Sleeper	2 pcs / km
Fastener and rubber plate	5 sets / km

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

(i) Welded Track

(i) General Provisions

Thermal-stressed welded track is generally considered for the alignment

The railway sub-grade, foundation, bridge and culvert will be in line with the requirement for this kind of permanent way installing welded track in sequential operations.

Railway sub-grade and foundation will be constructed in layers so that the density, bearing capacity, and the longitudinal/transverse resistance of the permanent way are sufficient for installing the welded track.

(ii) Welded Track

Length of welded track segment is 900 – 1500m in general and not less than 200m in minimum. Sections of continuous track see Table 3-13 & 3-14.

Displacement post made of RC concrete or steel is recommended for the inspection of thermal-stress of welded rail. Position of the post is set for the segment according the Figure 3.22 below. More numbers of posts will be considered at the transition of slope exceeding 2%. The top of the post shall be higher than the track level.

TABLE 3-13: ASUMED SECTIONS OF WELDED TRACK (LEFT TRACK)

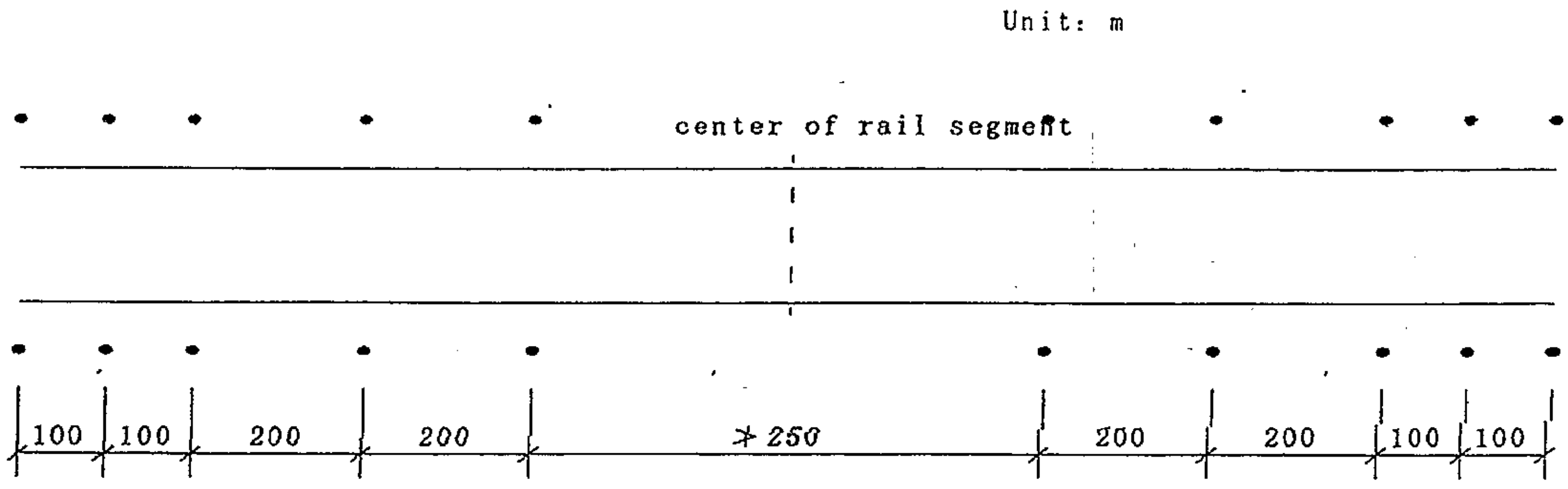
Station		Track fixing status		
From	To	Breathing area (m)	Stabilized area (m)	Breathing area (m)
KM116 +795	KM117 +124	100	129.00	100
KM117 +224	KM119 +300	100	1876.00	100
KM119 +400	KM120 +445.41	100	845.41	100
KM121 +464	KM123 +100	100	1436.00	100
KM123 +200	KM125 +000	100	1600.00	100

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

TABLE 3-14: ASSUMED SECTIONS OF WELDED TRACK (RIGHT TRACK)

Station		Track fixing status		
From	To	Breathing area (m)	Stabilized area (m)	Breathing area (m)
KM116 +795	KM118 300	100	1305.00	100
KM118 +400	KM120 +024	100	1424.00	100
KM120 +124	KM120 +445.41	100	121.41	100
KM121 +140	KM123 +000	100	1660.00	100
KM123 +100	KM124 960	100	1600.00	100

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003



Note: "• " is the position of displacement post.

FIGURE 3.22: Plan of Displacement Post for Rail Segment
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

FIGURE 3.23: General Layout of Tracks (Caloocan – Valenzuela segment)
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos)
Technical Document Contract between NLRC and CNMEG, November 2003

3.5.3 *Rolling Stock*

(a) Purchase of 19 New DMUs

NLRC will utilize DMUs for the NorthRail Project. DMUs shall have one motorized coach with driving cabin and three intermediate haul coaches (the last coach shall also have a driving cabin). Each DMU unit shall have a capacity of 900 persons. The minimum headway shall be five minutes. Based on the calculated 90% load, transit capacity shall be 9,720 persons per directions during peak hour, which is adequate to meet the projected passenger volume.

The shift from Electrified Multiple Units (EMUs) to DMUs was mainly due to lower capital cost and for compatibility with PNR south line. NLRC will incorporate in its DMU design new rail technologies in order to minimize negative environmental impact relating to rail operations.

NLRC will purchase a total of 19 new DMU units for its initial operations.

It should be noted that NLRC will eventually upgrade its rolling stocks from DMUs to EMUs. Facilities needed to enable subsequent upgrade will be considered in the Design.

(b) Acquisition of Donated Coaches from Japan

An inspection and assessment team composed of Engr. Dennis Jugueta of NLRC and Engr. Ruben Besmonte of PNR was sent to Fukuoka, Japan on July 10-13, 2003, to inspect the condition of the coaches being donated by INOUE Co., Ltd. and assess whether the costs to be incurred to Philippine Government in transporting the coaches from Japan to the Philippines can be justified.

The following are the findings and recommendations of the Team:

There were a total of 12 coaches inspected:

- 3 coaches with generator set (which can supply power to two or three more coaches the necessary electrical power for air-conditioning, lighting public address system, etc.)
- 9 trailer coaches

- All coaches are more or less 30 years old. Prior to their retiring, the coaches were nearing their respective scheduled overhaul and general maintenance works (every 8 years). Although based on their individual maintenance histories, the coaches have low utilization ratios (meaning the coaches undergo through their maintenance cycles based on schedule and not on usage). This means that the coaches were kept in very good condition.
- There are no prime movers, or locomotives, to be donated. This implies that the NLRC will borrow locomotives from the PNR.

Attached as Annex K are: (1) tabulated summary of the coaches for donation; (2) the maintenance history sheets of the donated coaches; and (3) selected pictures taken during the site inspection.

All coaches have air-conditioning (and heater) system, lighting, public address system and other electrical devices. Other observations made by the Team during the inspection tour are the following:

- All coaches have double pane glass windows with draw-down sunshade and/or curtains.
- All coaches have a lavatory and a toilet (separate cubicle).
- The floors are all in very good condition, with no sign of damages.
- Seats are in good condition and have very minimal signs of stains, tears or pulls. Seated capacities range from 56 to 64 passengers, with pair of seat on either side of the central aisle. Each pair can be revolved 360° and each seat can be individually reclined. Estimated average capacity for the coaches is 100 passengers per coach (seated and standees). The coaches have been designed to cater more for seated passengers than standees. Added to this is that seat configuration were modified to allow for more leg room and provide better comfort.
- Electrical panels appear to be in good condition.
- Under frame, bogies, piping, etc. are well maintained. Repair requirements are seen to be minimal.

The inspected did not include testing the coaches while running on tracks, nor did it allow for checking the working condition of the generator sets, air-conditioning units and lighting.

The basis for assuming that the units would be track-worthy after their re-conditioning is that all units were operational prior to their retirement. The main reason for retiring them was the current shift toward electrification of the railway system. Were it not for this shift, the coaches would have undergone their periodic maintenance and would still be operational today.

The electrical system was also not tested if operational. The Team was assured, however, that the electrical and air-conditioning systems were working prior to their retirement.

It should be noted that the coaches to be donated had been retired about a year ago. It is therefore reasonable for the body shells to rust, as they are exposed to the elements. It is also possible for some degree of deterioration to occur to other mechanical and electrical components. It is therefore necessary to recondition the coaches prior to using them for operations.

The coaches are underwent a thorough systems check by JR Kyushu. This is necessary since the coaches were transported via active rail up to the port of departure.

The donated coaches from Japan will be compatible with the new system inasmuch as rail gauge and motive power is concerned. However, the donation did not include prime movers (locomotives, as differentiated from trailer-wagons) for the train construct. NorthRail envisions that it will borrow or lease from PNR the needed prime movers to use these donated coaches. These trains will only be used during off-peak hours.

In order to maximize the utilization of the coaches, NorthRail is considering the possibility of handing over to PNR the said donated coaches. The handing over of the coaches will be charged against the equity contribution of PNR in the on-going discussions for a Joint Venture between PNR and NorthRail.

In this regard, benefit-cost analysis is unnecessary as the previously used coaches will no longer be utilized.

The coaches from Japan had been in active service for more than 20 years. They were properly maintained during their respective periods. The coaches were retired prior to their last scheduled maintenance, as would be expected of coaches to be retired. It was at this time that the coaches were chosen to be donated to the Philippines.
In the course of the planning for the transport of the coaches from Kyushu, Japan to Manila, it was determined that the coaches be transported through rails from the inland area where the coaches were stored to the port area. However, these rail lines are in active use, and the donor would not risk having problems in its operations due to a breakdown of one of the coaches. It was therefore necessary for refurbishment and mechanical and manual checks on all 12 coaches before they were allowed to travel along the active rail line. Upon their arrival in Manila, these coaches have therefore passed rail-worthiness from Japanese standards.

Upon their arrival, the Philippine National Railways (PNR) conducted ocular inspection on all the coaches and found the same to be rail-worthy. It is by this fact that the PNR had been using some of the coaches on peak seasons to augment their existing capacity. Some of these occasions are during opening of classes, special festivities in the Bicol Region and the Christmas season. The coaches undergo ocular checks by PNR maintenance personnel prior to their discharge to passenger service.

Maintenance of the coaches to ensure safe operation will be conducted periodically. However, at the moment the PNR does not have specialized equipment for testing mechanical and electrical components of the coaches. The PNR rely on ocular inspection and years of experience on these matters. Upon completion of the NorthRail depot, the NLRC will have the necessary equipment and facilities to conduct tests on these coaches. Proper maintenance will then be done on the coaches to ensure their rail-worthiness.

One aspect that may become an issue, however, is the availability of spare parts. In the future, this issue may be a crucial factor in determining the viability of making repairs to the coaches through the use of made-to-order parts or the eventual retirement of the same.

3.5.4 *Stations*

(a) Station Plan

The station will be located as far as possible on the straight line except those under critical conditions, where the curve radius will not be less than 800m. The curve radius for the chord line of receiving-departure in the station will not be less than 200m in principle, and will not be less than 150m in particular section. The curve radius for track line within station will not be less than 150m.

The minimum length of circular curve on receiving-departure track line for passing train will not be less than 20m. In general, the length of tangent between curves will not be less than 50m and not less than the axle distance of one vehicle in some particular cases. In general, the length of tangent between curves within station will not be less than 3m the distance between curve/turnout to the end of the platform will not be less than 20m (in general) and not less than the distance between center pin on the front bogy to the back-end of train in particular case.

The straight length between turnout and its jointed curve within station track line will be determined in accordance with Table 3-15. The radius of jointed curve after turnout will not be less than the radius of lead curve adjacent to the turnout.

TABLE 3-15: STRAIGHT LENGTH BETWEEN TURNOUT AND ITS JOINTED CURVE

No.	Radius of Circular Curve front and back of the Turnout	Straight Length (m)	
		Front of the Turnout	Back of the Turnout
1	$R \geq 350$	0	2
2	$350 > R \geq 300$	2	4
3	$R < 300$	5	7

Note:
1. Tangent section may not be inserted in case transition curve is set on the jointed curves at two ends of turnout
2. When it is necessary to set super-elevation for jointed curve, straight section will be set according to the over-height.

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

(b) Station Profile

The station will be generally located on level/flat area except for some particular sections where the slope shall be less than 0.5%. Provisions for length expansion of station yard will be preserved to accommodate two coupled DMUs in the future. Timeout will be installed on the area where the slope will be less than 0.5%. Vertical curve will be set for connection in case the difference between two adjacent slopes is $\geq$0.2%. The radius of vertical curve at the end of the station will not be less than 3,000m and not be less than 2,000m in some particular cases. The maximum slope for inbound-outbound section may be 2.5%, where the radius of vertical curve will not be less than 2,000m. The vertical curve is not allowed to be set within the station platform area and the distance between vertical curve and end of the platform will not be less than 5m.

(c) Station Pattern

The stations will be designed based on the projected NorthRail ridership without inter-connection with MRT3 as assumed in the FS submitted to NEDA.

The station is to be designed to ensure the platform, station hall, route way, exit and entrance, escalator, staircase, and similar infrastructures will meet the requirement of passenger flow. Stations will be installed with two main lines except for Valenzuela Station, which will be connected to the Depot and will be installed with two additional sidings.

(d) Distance between main tracks in the station

(i) Station with island platform

The distance will be the width of platform plus the distance between two edges of platform side to the center of track line.

(ii) Station with side-running platform:

- 5.0m in case No. 12 single crossover is designed
- 5.0m at sections where No. 12 scissor crossing is designed
- 4.0m in case no crossover is designed

(e) Sub-grade Extended from Valenzuela Station Viaduct

Valenzuela station, which is designed with receiving-departure tracks, will be built on viaduct. The connecting line between Valenzuela Station and Depot is designed as single track subgrade. Non-permeable soil subgrade will be set as triangular road crown with 0.15m high. The width of the top of sub-grade is 5.6m. Subgrade bed (formation) filling course is 0.6m thick filled with A.B. Group earth. Transverse grade of subgrade is 0.02, side slope is 1:1.5.

For most of the Valenzuela segment, the alignment will be on viaduct structure. The viaduct will be from RDK 118+516.18 to RDK 122+411.91. (See Annex AM. Site Development Plan). The other segments of the alignment will either be on embankment or retaining wall structures.

(f) Station Platform

The length of platform for the Caloocan Station will be designed at 90m. On the other hand, the Valenzuela Station will be based on the combined length of 4-car trains plus distance for safety stop. The Design has provisions for length expansion of station yard and platform to provide safe and orderly service to the passengers in future when two DMUs will be coupled. The direction for designed preserving condition of expanding platform for future development of the Caloocan Station will be at the North end while the Valenzuela Station will be at the South end.

Width of the Platform: 4.5m for side-running platform; 8.0m for island platform

Height of the Platform: approx. 1,230mm above track top level

Distance between edge of the platform and the center line of track is 1.75m, and will be widened according to the clearance limit at curve section.

Specifications of the materials, equipment, fixtures, etc. to be used in the stations shall be set out in the Preliminary Design.

(g) Station Features

With the provision of a viaduct solution for the Valenzuela segment, there remains only the Governor Pascual Avenue in Malabon that would need a crossing to be provided. In the event that the Valenzuela section will not be entirely on viaduct, the corresponding road crossing for affected areas will be provided. The Caloocan segment does not have a road crossing as the project terminates before Samson Road.

(i) Caloocan Station

Caloocan is the station origin of this Project. Its center location is at KM116+500. It is an at grade station. Two lines are designed. The two lines are extended to the KM116+362 (the beginning of the Project). The extension is used for temporary stop checking during operation and parking at night. The effective length of the tack along the platform is 110m. The distance between two tracks varies from 11.5m to 5m after the departure end of the main line goes through one set of No. 12 scissor crossing with 50kg/m.

Station building is to the right of the tracks. An island platform (90m x 8.0m) will be constructed. One passenger underpass (5.0m wide x 2.5m high) will be constructed to connect station buildings and platform.

Concrete fence will be set up around the station yard to prevent trespassing. A concrete paved access (160m long and 9.0m wide) will be constructed to connect McArthur Highway and station building.

(ii) Valenzuela Station

Valenzuela is the second station of this Project. Its center location is at KM120+800.

Valenzuela station is constructed on viaduct. The station building will be constructed below the tracks. Two main lines and 2 receiving-departure lines are designed. There is a link to the Depot from the Valenzuela station.

Two island platforms with the same dimension (130m x 8.0m) will be constructed. Extension of the length about two DMU for future development will be considered from the north end. A mechanical maintenance crew will be arranged in this station. The 50m x 9.0m concrete station access road connected to the McArthur Highway is also considered.

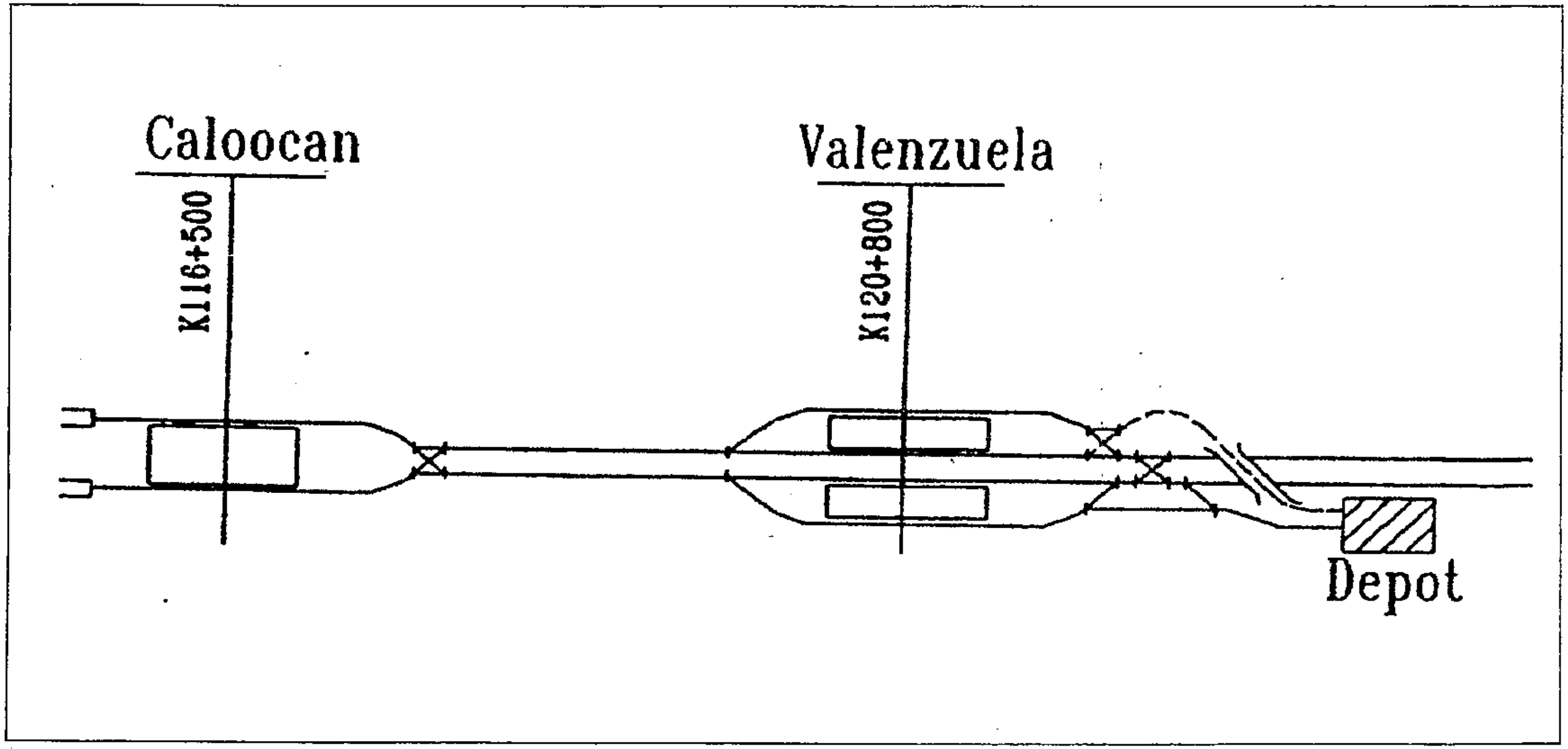


FIGURE 3.24: Assumed Arrangement of Stations
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

3.5.5 *Depot*

(a) General Description of the Depot

The Depot is near KM123+000 of the main line, with a distance of 2.2 km from Valenzuela Station and 6.5 km from Caloocan Station. The Depot is comprised of the DMU pool and the maintenance complex base. Accommodation for administration staff and night shift workmen shall be considered in the Design. Facilities for the proper security shall also be considered. Recreational facilities may be considered in the Design. The facilities in the Depot shall be arranged in the Design for the purpose of optimal utilization of the Depot area.

For the expansion of the Caloocan depot (for stabling and maintenance), there are two designs that were considered:

1. Constructing an entirely new depot east of the existing tracks; and
2. Co-locating a limited depot within the existing PNR depot (to be upgraded) and stabling area within a limited area east of the existing tracks

Please see Annex AN (Scheme Designs for the Caloocan Depot) for the preliminary plan lay-out of the two alternative designs. A more comprehensive discussion on the facilities within the depot is discussed in the First Addition Information Report.

It is evident that should the first alternative be adopted, relocation of 354 families from Samson Road to the Panaca Creek will have to be implemented by NHA. As for the second alternative, a slight compromise on the functionality of the depot (and assuming that the full depot in Clark will be constructed soon with the construction of Phase I Section 2 of the NorthRail Project) and a limited area for stabling will avoid necessitating the relocation of most, if not all, of the said families.

(b) Functions of Depot

The Depot is the base for parking, operation, maintenance inspection and repair of vehicles allocated for this line. It will:

- undertake the scheduled maintenance / repair and unscheduled repair works for all DMUs,
- undertake daily regular parking, washing, inspection, cleaning etc of the DMUs
- undertake the re-profiling of the DMU wheels on the track without lifting,
- undertake traffic management including shift handing over / taking over of duty, and
- undertake emergency rescue task in case of accidents during

operation.

(c) Calculation of Depot Work

Length of operation line and trains during peak hours is calculated taking into account the length of 32.138 km. Of the entire line from Caloocan – Malolos utilizing 12 pairs per peak hour for the initial stages (4-car trains). Components of trains are 1motor car, 2 trailer cars and 1 trailer car with cab.

Traffic speed simulation of the DMU shall be included in the Preliminary Design. CNMEG shall provide the simulation results for approval / validation of NLRC during Preliminary Design.

(d) Main Indexes for Repair

Table 3-16 below is the assumed schedule of inspection and repair indexes:

TABLE 3-16: ASSUMED SCHEDULE OF INSPECTION AND REPAIR INDEXES

Item / Type of Repair	Inspection and Repair Cycle (10^4 km)
Lift Repair	30
Scheduled Repair	10
Maintenance	1

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

(e) Preliminary Lay-out of Depot

(i) General

The following tracking facilities are assumed in the pool:

- locomotive running tracks;
- 1 round about line;
- 1 washing siding, effective length 510m;
- 1 lead track, effective length 110m;
- 8 stabling sidings, straight length not less than 225m;
- 4 tracks for schedule inspection, and 1 standby for future development, straight length not less than 130m;
- 1 entrance line, straight length not less than 125m
- 3 coach inspection tracks, straight length not less than 190m
- 1 wheel re-profiling track, effective length 490m;
- 1 coach interior cleaning track, straight length not less than 125m;
- 1 painting track, straight length not less than 125m;

- 1 material line, effective length not less than 140m;
- 2 emergency rescue tracks, effective length not less than 130m;
- 1 stand-by stabling siding, effective length not less than 160m;
- 2 shunting tracks in the Depot, 2 tracks for pre-reserved, straight length not less than 85m;
- 1 fueling siding, straight length not less than 80m;
- 1 test line, effective length not less than 1300m;
- 2 lines for track maintenance rail vehicles, effective length not less than 80m.

The path between working areas within the Depot is 3.5m wide. Flower terraces, bushes, flowers and other landscaping will be arranged within the Depot. Facilities to load and unload the major equipment from road vehicles to the workshop by providing storage area craning will also be designed.

(ii) Main Industrial Facilities

Multiple DMU Inspection and Repairing Bay

The scheduled inspection, lift repairing and unscheduled repairing of DMU wagons will be in one multiple bay. The main bay (162 x 27m) has 3 sidings, i.e., scheduled inspection siding, lift repairing siding and unscheduled repairing siding. A workshop (162 x 27m) west to the bay is comprised of sections for taking care of bogie and wheel, axle, motor, air conditioner, testing etc. Another workshop (162 x 12m) east to the bay is comprised of sections for taking care of electronic/electric machine, air compressor, braking system, spare parts, flaw instrument etc.

Maintenance / Inspection Bay

An end-close bay (102 x 33m) with 3 tracks is built for this work. Depressed floor for easy access for the inspection of underslung equipment and bogie components including the arrangement for access to interior of coaches for inspection & repairs will be considered. A 6m wide workshop with machines is attached to the bay.

DMU Care Bay

The roof bay (102m x 78m) is to clean the cabin including the tertian technical inspection, the easy worn parts replacement, battery recharging in order to maintain the vehicles clean and in good condition. DMUs will be parked in this bay after the daily operation.

According to the number of trains allocated in recent period and the trains under inspection, 8 sidings are planned (1 siding is for parking of 2 trains) in this zone. The stretch with depressed floor for train inspection will be roofed. There is also a 6m wide workshop to this.

Static Testing Bay

The repaired train should be tested static in this bay (102m x 9.6m).

Coach Washing Point

The outside body of the trains will be washed here in schedule. The dimension of the flushing bay is 60m x 9m with an attachment 27 x 6 m to accommodate the auxiliaries.

Wheel Re-proofing bay

A bay with the dimension of 36 x 12 m is designed equipped with machines to trim the wheel profile when necessary so that the noise and vibration will be minimized during the operation of trains. This can be done without lifting the DMUs.

Standby Emergency Rescue Zone

Rescue engines, track maintenance vehicles etc will be parked and cared in this zone. Two bays (60m x 15m) can accommodate these equipment and necessary auxiliaries.

Fuel/ Oil Storage Tanks

Location: The Fuel / Oil Storage Tanks are to be located in the southern portion of the property (See Figure 1).

Capacity: The final capacities for the fuel tanks are still being studied.

Delivery: The delivery of the fuel is similar to existing gas refilling stations. The fuel delivery truck of the fuel supplier company will handle the supply and delivery of the fuel.

Fuelling Scheme: The fuel delivery truck will transfer the fuel to the gas tank situated beneath ground level. Transferring fuel to the gas tank is by an ejector pump through a flexible hosepipe connected to the vehicle tank storage to the gas tank. The fuelling scheme for the depot is similar to the gas refilling station.

Domestic Wastes: Domestic solid and liquid waste generated by the passengers will be simultaneously disposed on the sewage treatment plant located in the depot station. The system of disposal will be undertaken by the Waste Management Unit, which will be created on the operational stage of the Northrail Project. Comprehensive study measures will be considered specifically on the waste and sanitation standard guidelines (plumbing code) for the disposal of domestic wastes.

Sump wastes from train/car wash bays are made up of water, detergents, salts, glycols, hydrocarbons (from gasoline, lube oil, and grease), and solids (dirt, grit, rust, and paint chips) resulting from the cleaning of trains.

Metals from rust, used oil or anti-freeze are often present but rarely at levels that render these wastes hazardous. Hydrocarbons, from gasoline washed off vehicles, may occasionally render the waste hazardous when benzene, ethyl benzene, toluene, and xylene (BTEX) exceed the hazardous limit of 0.5 milligrams per liter. Glycols and BTEX, at low levels, readily degrade within the wastewater system.

The disposal scheme is similar to Airport Passenger Terminals where the passenger airlines solid and liquid waste is directly discharged to an attached mobile waste storage. The passenger train maintenance's personnel will regularly monitor the discharge of the domestic waste. The routine monitoring / check-up is designed to avoid waste spillage and leakages.

The passenger train waste storage will discharge the solid and liquid waste directly to sewage treatment plan by siphoning or an ejector pump.

For the railway station and the station building, a septic tank will be considered for the deposit of solid and liquid waste. The disposal of the solid waste will be digested in the digestive chamber and the leaching chamber will discharge liquid waste directly distributed to existing sewer line. For the depot station, depot buildings, maintenance repair shops and washing area were technically considered in the study. All liquid wastes will be treated with chemical compound elements

Other facilities

Other facilities including compressed air supply, battery recharging, fuel supply etc are also considered in the pool.

(iii) Complex Base

The Complex Base includes general warehouse and maintenance / repair center.

Maintenance and Repair Center

Tasks of the Center

This center is the maintenance and repair center for all of the fixed equipment and building facilities of this Project. It mainly undertakes inspection, repair and management of all machinery and electric equipment, power supply system, telecom & signaling system, building construction, track furniture and water supply, drainage etc. Detailed functions are as following:

- Undertaking the scheduled inspection, maintenance and repair of all vent/air-conditioning equipment, pumps, escalators/elevators, water supply/drainage pipes and all machinery and electric equipment.
- Undertaking the scheduled inspection, maintenance and repair of all equipment / facility of power transforming & transmission.
- Undertaking the scheduled inspection, maintenance and repair of traffic boards and signs, viaducts, tracks, turnouts etc.
- Undertaking the scheduled inspection, maintenance and repair of telecom / signaling system, computer network etc.

Facilities in the Center

The center is comprised of the following sections with particular tasks respectively:

- electrified machinery and equipment inspection and repair
- power supply machinery inspection and repair
- machinery testing and calibration
- telecom and signaling equipment inspection and repair
- automatic equipment inspection and repair
- track furniture inspection and repair
- rail welding
- spare parts inventory, highway vehicle garage
- offices and staff accommodation
- canteen facilities for the Depot and workshop and railway operating staff
- welfare amenities and first aid room for the staff, including train operatives
- provision for the training of staff of all disciplines, technical & operational

General Warehouse

The general warehouse is the base of logistic purchase, storage and supply of all materials and equipment, spare parts, safety protection packages, office equipment etc needed by the operation of this line. Included in this warehouse are spare parts storage for unit exchange spares such as parts for engine, bogies, wheels, axle, transformer, pantograph, compressors, etc.

The chemical (including its MSDS) to be used for the maintenance of cars and engines is provided in Annex AI.

3.5.6 *Signaling System*

(a) Signaling
Combination of wayside signal and cab signal will be designed. For all stations, multi-lenses signal will be adopted. In principal, high signals will be used for home signal, starting signal from the main line and shunting signal for switching lead entering into interlocking area. Otherwise, dwarf signals will be utilized.

(b) Blocking
The multi-information three-aspect frequency-shift automatic block system will be applied to the design of the section from Caloocan to Malolos.

(c) Interlocking
(i) Interlocking System
The works covered in the Caloocan - Malolos section includes the signaling works for the 6 stations on the main line and in the Depot, all the stations and the Depot are initially non-electrified traction. As the line is designed for passenger transport system, with the maximum design speed of 120km/h and headway of 5 minutes, the signaling interlocking equipment in station, being one of components of the safety system for signaling, shall not only be safe, reliable and practical, but also be highly efficient and swift. On the other hand, the signaling interlocking equipment in station is one of information sources of the DMUs, so the equipment should not only have the ability to process information swiftly and efficiently but also have the interface easy to extend its capacity. In order to match with the above-mentioned parameters, the computerized interlocking concept will be adopted in this Project.

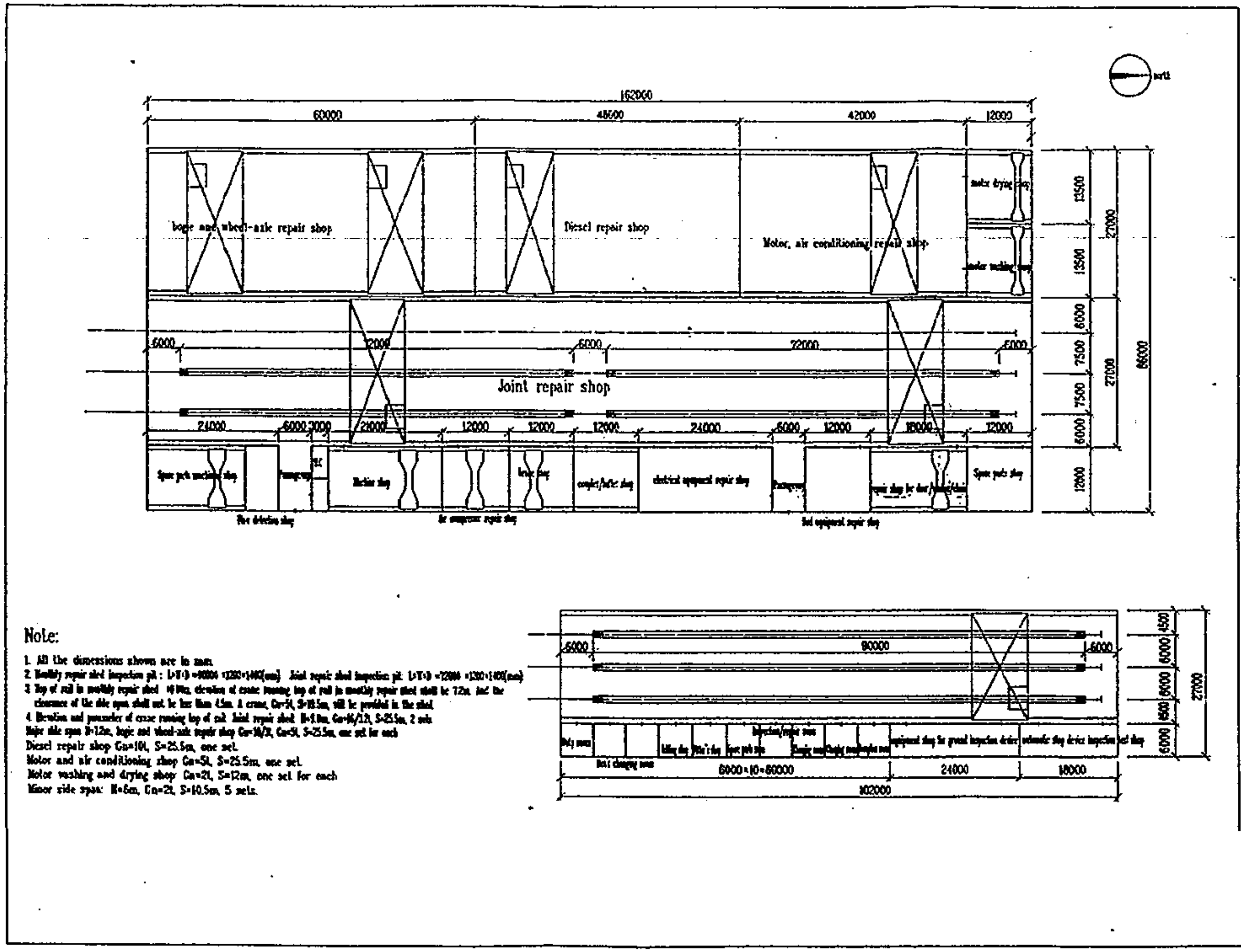
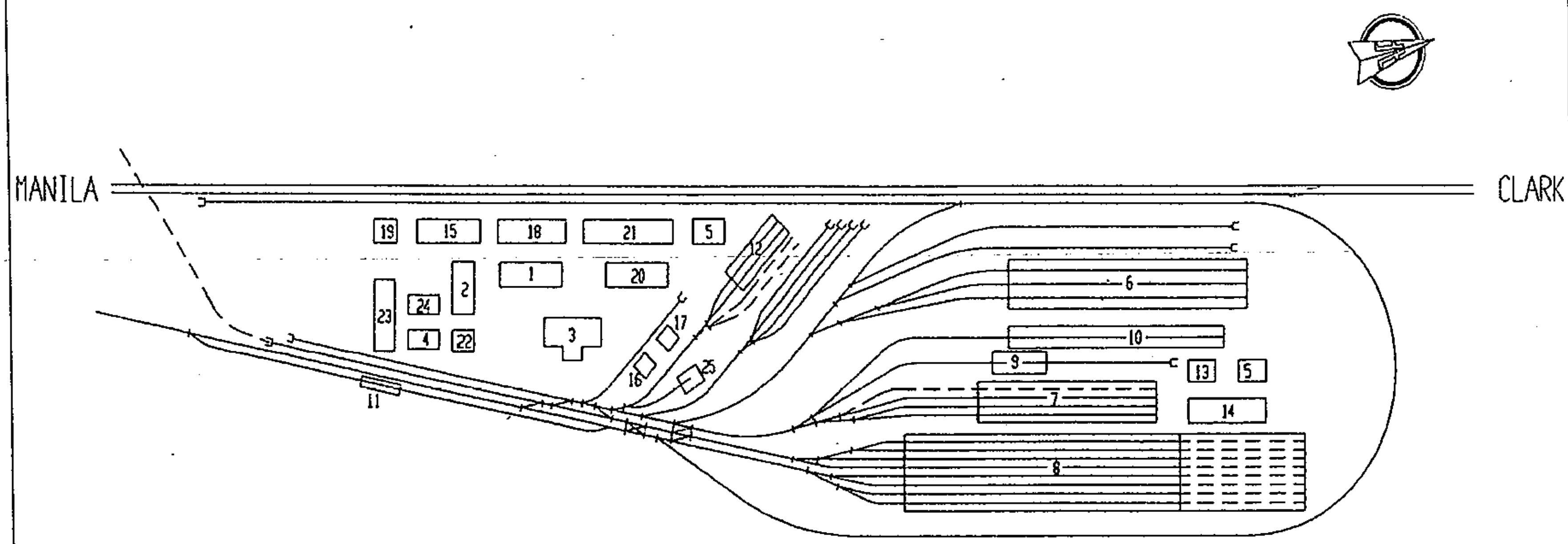


FIGURE 3.25: Inspection and Repair Bay (Lifting Repair)
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003



Reference No. and Name of Building

1 – Telecommunication Sta. of Depot
2 – Signal Inspection and repairing Center
3 – Telecommunication Sta. of Depot
4 – Sewage Treatment Sta.
5 – Step-down Substation
6 –Multiple wagon Inspection Shed
7 – Monthly Wagon Inspection Shed
8 –Parking train check shed & siding
9 – Wheel Profiling Shed
10 – Static Testing Shed
11 – Wheel Profiling Shed
12 – Special Car Shed
13–Air Compressor Room
14 –Storage Battery Room
15 –Complex Building of Offices and Education
16 – Stuff-on-duty Room of Fuel Sta.
17 – Fuel Pump Room
18 –Canteen
19 – Gate Keeper's Office
20 – Material Warehouse
21 – Multiple Maintenance/repair Center
22 - Boiler Room
23 - Repair house for maintenance team
24 - Housing for work assignment and power supply
25 - Shed for rail car

FIGURE 3.26: Assumed Sketch Map of Depot Layout
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

(ii) Track circuit and coding

Alternate Current (AC) continuous track circuit, Model 480 will be adopted in the Caloocan-Malolos Section. Pre-coding mode will be used for the intra-station main lines, with coding equipment consistent to the equipment installed in sections. Occupancy coding mode will be used for sidings.

(iii) Console

The special designed computer interlocking unit console with adequate visible illumination will be adopted in each station.

(iv) Points switch equipment

Electric switches will be adopted for every station.

(d) CTC and Computerized Monitoring Equipment

(i) Centralized Traffic Control (CTC) System

CTC system will be provided for the Project, the center of which will be installed in the Depot. As a temporary consideration, it will be jointly established with signal building. Field equipment of CTC will be equipped at each station.

(ii) Computer Monitoring System

A computer monitoring system will be installed in each station and connected to the center. The system will collect data of train operation to transmit into the central master computer for controlling the safety of train movement and giving the order to the on-board protection sub-system in the DMU.

(e) Power Supply Equipment

An intelligent power screen will be installed in each station to facilitate monitoring, interconnection and alarms.

(f) Power Circuit

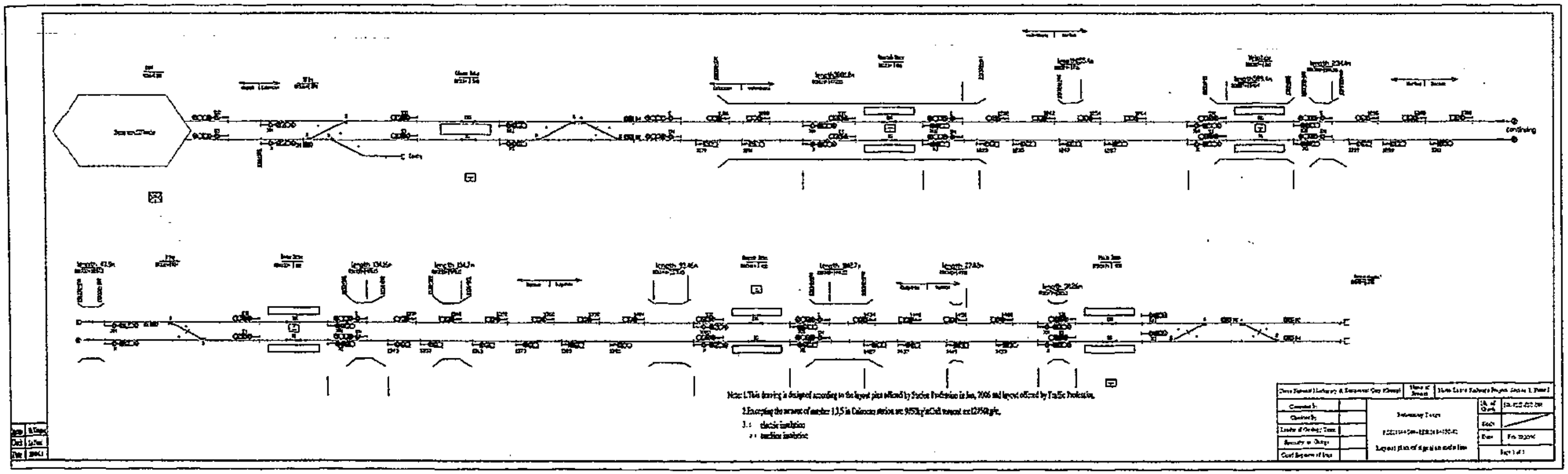
The cables for all sections, intra-station main lines and branch lines will be of synthesized kink cables with aluminum sheath.

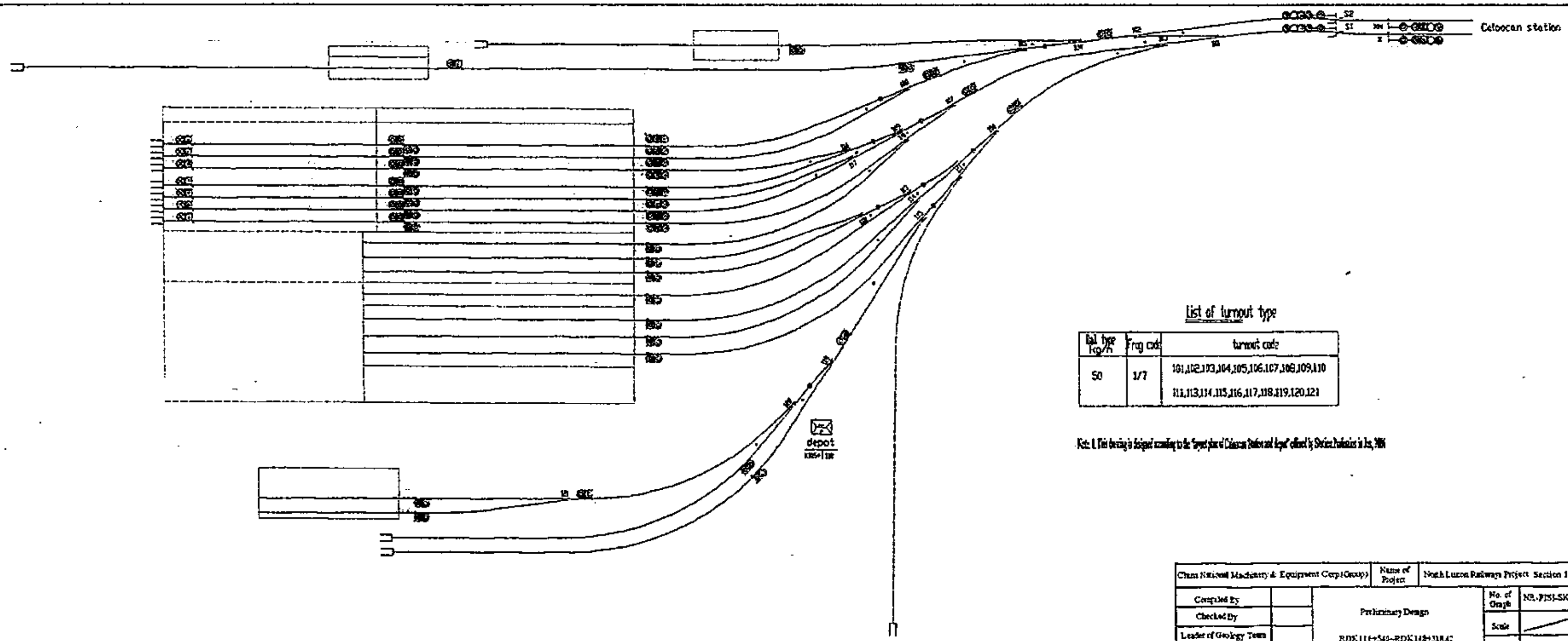
(g) Other Signal Equipment

(i) Cab Signal

General type signal for DMU will be used, to be configured by the DMU manufacturer.

FIGURE 3.27: General Layout of Signaling Equipment (Caloocan – Valenzuela segment)
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos)
Technical Document Contract between NLRC and CNMEG, November 2003
PLEASE SEE ATTACHED DRAWING


Note: 1.This drawing is designed according to the layout plan offered by Station Profession in Jan, 2006 and layout offered by Traffic Profession.
electric insulation

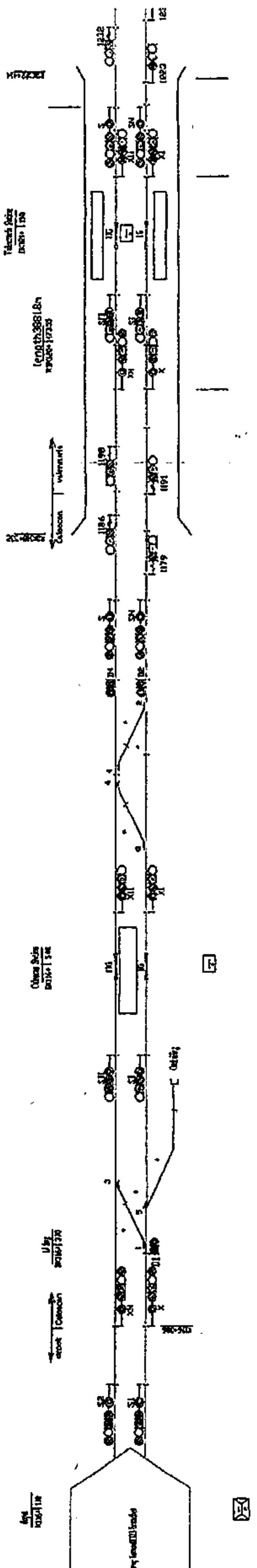


List of turnout type

Rail type kg/m	Frog code	turnout code
50	1/7	101,102,103,104,105,106,107,108,109,110 111,113,114,115,116,117,118,119,120,121

Note: 1. This drawing is designed according to the "layout plan of Caloocan Station and depot" offered by Station Profession in Jan, 2006

China National Machinery & Equipment Corp (Group)			Name of Project	North Luzon Railways Project Section 1, Phase I	
Compiled By		Preliminary Design RDK116+540~RDK148+338.42 Layout plan of signal in depot		No. of Graph	NR-PIS1-SIG-002
Checked By				Scale	
Leader of Geology Team				Date	Feb.10,2006
Specialty in Charge				Page 1 of 1	
Chief Engineer of Dep.					



(ii) Signal inspection equipment

Inspection and testing center will be established in the Depot, to be in-charge of scheduled maintenance and management on all signal equipment and fixtures.

(iii) DMU number transmission equipment for CTC

At appropriate position of entrance of each station, car number recording and transmission equipment will be installed on ground. Associated equipment will be installed in the locomotive of this Project.

3.5.7 *Telecommunications*

The cable used in the proposed project is copper core, bubble polyethylene insulated, ointment filling, aluminum cover metal band, polyethylene jacket, long distance transmitted, low frequent symmetrical communication cable.

Fiber optic cables will also be used for telecommunications. They will be laid along the length of the project development.

(a) Telecommunications
   (i) Composition of Telecommunication Network and Selection of Equipment Type

Composition of Transmission System and Selection of Equipment Type

To satisfy the need of dispatcher telephones, program controlled telephones, audio frequency and digital data communications required by and between the Control Center and all stations, a 155 Mb/s Synchronous Digital Hierarchy (SDH) transmission and access system is to be established along the entire Section. A self-healing ring will be achieved by the four-core optical fibers in the newly laid optical fiber cables. 155Mb/s SDH transmission and access equipment will be installed in all the stations and the Depot.

A new synchronization system will be laid with a Global Positioning System (GPS) receiver & Binary Digits (BITS) equipment to be set in the communication station of the Depot.

The network management system will be set up along the entire section to manage the long-distance communication transmission and access network.

Composition of Telephone Switching Network and Selection of Equipment Type

A 500L/240T program-controlled switchboard will be set in the communication station of the Depot, which will be connected with Post, Telegraph and Telephone (PTT) by 2M interface.

Composition of Railway Special Communication System and Selection of Equipment Type

Special Communication Network for Dispatching System

Combining with different administrative district, a new dispatcher telephone system will be set in digital particular communication system.

Communication within Each Station

A private digital communication subsystem will be installed in each station to provide the communications within the station itself.

Other Private Communication Systems

- Radio communication system: Radio Dispatching Communication System of 400 MHz type will be adopted in the Project.
- Closed-circuit Television (CTV), public address system, and synchronized clocks shall be considered for the stations in the Preliminary Design.

Selection of Power Supply Equipment for Communication System

One complete set of power system consisting of 48V High-frequency switch power supply equipment, Valve Regulated Lead Acid (VRLA) battery, power and environment monitoring subsystems shall be respectively provided in the Depot and every station.

(ii) Communication Cables and Capacity

Long Distance Communication Line

For the long-distance communication line, one single-mode optical fiber cable of 16-core and one toll low-frequency oil-filled cable (7 x 4 x 0.9) will be laid along the railway alignment. Optical fiber cables shall be designed according to the future expansion input provided by NLRC prior to the commencement of engineering survey.

Communication Lines within the Station

The oil-filled armored cable HYAT53 and HEYFLT23 will be installed within the range of every station.

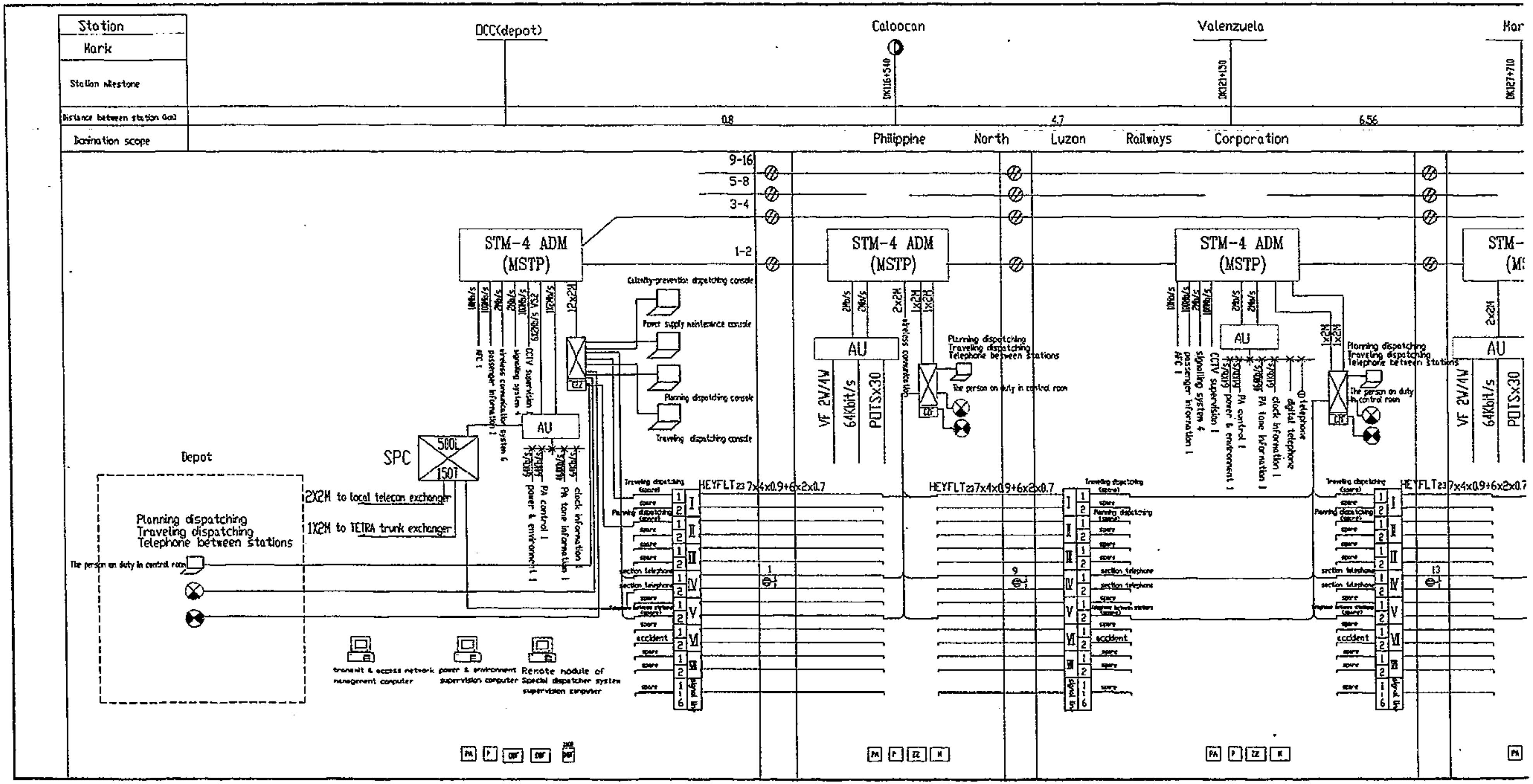
(iii) Establishment of Organization and Scope of Management
A maintenance section for communication facilities, with devices and instruments, will be based in the Depot responsible for the maintenance works of communication equipment and lines.

(b) Automatic Fare Collection (AFC)
AFC with the distance related fare structure shall be designed. It will be compliant with the requirement for the Unified Ticketing System of the SRTS.

(i) Design Principles

- AFC and terminal equipment at stations will be equipped based on the traffic volume in the near future;
- Distance related fare collecting system will be designed;
- One-off magcard will be used for single ticket, which will be sold with ATS machine after initialized coding;
- Inspection machine will mainly be door-type, to improve passing capacity;
- Calculation basis for equipment quantity of AFC system is:
    - Semi-automatic ticketing machine's capacity is assumed as 10 persons/min per set;
    - Inspection machine's capacity is assumed as 40 persons per minute per set.

FIGURE 3.28: Telecommunication Network (Caloocan – Valenzuela segment)
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003
PLEASE SEE ATTACHED DRAWING



Station
Mark
Station milestone
Distance between station (km)
Domination scope
DCC(depot)
Caloocan
Valenzuela
DK116+540
DK121+150
DK127+710
0.8
4.7
6.56
Philippine North Luzon Railways Corporation
9-16
5-8
3-4
1-2
STM-4 ADM
(MSTP)
AU
SPC
Depot
Planning dispatching
Traveling dispatching
Telephone between stations
The person on duty in central room
2X2M to local telecom exchanger
1X2M to TETRA trunk exchanger
clock information 1
PA tone information 1
PA control 1
power & environment 1
CCTV supervision 1
signalling system 4
wireless communication system 6
passenger information 1
AFC 1
Calamity-prevention dispatching console
Power supply maintenance console
Planning dispatching console
Traveling dispatching console
transmit & access network management computer
power & environment supervision computer
Remote module of Special dispatcher system supervision computer
VF 2W/4W
64Kbit/s
POTSx30
wireless communication
telephone
digital telephone
HEYFLT23 7x4x0.9+6x2x0.7
Traveling dispatching (spare)
Planning dispatching (spare)
spare
section telephone
accident
signal line

(ii) Configuration of AFC System

AFC system is composed of central computer system, stations computer system and stations AFC terminal equipment. A 100M/10Mbps Ethernet Local Area Network (LAN) will be set up between the host computer of the central computers system and every operational site, and another 100M/10Mbps Ethernet LAN will be established between the stations computer system and the AFC terminal equipment of the railway stations; Communication between stations computer system and the central computers system will be achieved via equipment by means of point to point, with digital access of 64 Kbps.

Central Computer System

Configuration System

The system is composed of central computer, operational sites (for maintenance of the system, statistic of passengers volume, financial management etc.), printers, coding machines, Uninterrupted Power Supply (UPS) and communication interface devices and so on. The system is set in the Control Center where the central computers will be of dual hot standby system with and diskette array for data storage, so as to ensure the safety of data storage and system operation. The main function of the system is to:

- Monitor AFC system equipment of the whole alignment;
- Access and egress control between unpaid and paid areas and efficient throughput of passengers
- Collect and store information of inspection equipment's maintenance and status at each station;
- Establish and maintain operation parameters, and download to computers at every station;
- Receive and handle the event of illegal intrusion and give an alarm in case of any emergency failure;
- Collect and store data of ticket inspection at every station, complete the report on operation income and statistics on passenger volume;
- Provide report to operation and management department for reference on organization and decision analysis;

- Make and publish the data formats of all kinds of tickets applicable to the system, and conduct initialization coding on tickets, verify and record the coded tickets accordingly;
- Release clock information to the stations computer;
- Ensure a continuous working 4 hours of central computer system by UPS in case of power-cut.

Station Computer System

Composed of station computers, communication interface equipment, printers, UPS and so on. The system is set in every station, with main function as follow:

- Real-time monitoring on AFC terminal equipment in the station;
- Collecting and making statistics on the station's AFC equipment status information & ticket inspection data;
- Transferring statistics data to the central computer;
- Receiving & implementation of the operation data (such as dates, price lists etc.) downloaded from the central computer, and download the same to AFC terminals accordingly.
- Ensure a continuous working 30 min. of computer system by UPS in case of power-cut.

Station AFC Terminals Equipment

It is mainly composed of semi-automatic ticket selling machine, automatic ticket inspection machine at entrance and exit respectively. Ticket inspection machine at exit of station is turn style. Except their own function, the AFC terminals will have the following functions:

- Capable of receiving operation parameters given by the central computer;
- Transmitting data of equipment status to the station's computer;
- Timely alarming to the station's computer in case of abnormal circumstance, and transferring abnormal information;
- Capable of self-diagnostic;
- Remain operation and save the data when communication to the station's computer is malfunctioned. All saved data will be

transmitted to the station's computer after communication is reinstated.

- Able to complete the last operation and store the related data when power-cut is encountered.

3.5.8 *Power Supply*

Diesel traction will initially be used for this Project. Its structures will be designed and constructed to allow an upgrade to an electric traction with the least impediment to operation of the line. The upgrade will be implemented once the operation of the line can sufficiently finance it, or when Government can finance it, whichever comes earlier and if warranted by the service life of the DMUs. Evaluation of the different options for the electric traction is therefore not included in this Report; rather it will form part of the evaluation once the said upgrade is already possible.

(a) Depot Area

Local electricity power supply will be transmitted to the indoors substations of 13.8 kV or 25 kV for Depot.

(i) Source of Power Supply

Local electricity power supply will be transmitted to the indoors substations of 13.8 kV or 25 kV for Depot.

(ii) Principle and Scheme of Power Supply

<u>Load grade power supply</u>

The power supply proposed for the Depot includes the power supply to the production buildings for the purpose of production and lighting, of which the power supply for communication, signaling, fire fighting, illumination, etc. is the key load supply, and the others belong to ordinary load supply.

<u>Principle and scheme of power supply</u>

Three substations of 13.8 kV / 0.4 kV or 25 kV / 0.4 kV will be installed in the Depot, with one circuit of 13.8 kV or 25 kV connected to the local network. In order to strengthen the liability, one diesel generator is also provided for each substation for standby in case of power failure. The local network will supply power when it is normal. When a failure is encountered, the generator will be operated for key load supply in Depot.

UPS system capable of supplying the required power for traffic control equipment (signals, telecom and emergency lighting only) for 4 hours shall be considered in the Design apart from the stand-by generators.

Equipment for substation

The indoor substations will be equipped with high voltage cabinet, low voltage cabinet, transformer and diesel generator.

Design adopts dry-type transformer. Specification of electrical equipment will be supplied by the manufacturer, after the electrical equipment has been designed. The equipment will be PCB-free.

The dry-type transformer will be installed for this project (3 phases, cast resin) and aluminum alloy enclosure provides further protecting to transformer. None of the electrical equipment is the oil-insulation type. The dry-type transformer of electrical equipment complies with ISO9001, ISO14000 and OHSAS18000 standards and have specifications that are acceptable to EMB.

The power transformer to be utilized is a dry type transformer. The low voltage cable adopts PVC sheath power supply cable with vinyl tape and steel-tape armoring. The equipments and materials of the power supply do not include ointment filling and is PCB-free.

The energy-saving diesel generators can deliver higher power and occupy less space. Incorporating a heavy-duty radiator, integral header tank, and blower cooling fan etc., ensured that the generators operate at an optimum temperature (≤50°) at all times. The generator can run continuously for a long time and can stand rigorous temperature conditions. The generators will be provided with silencers that can mitigate noise, and it can guarantee that the noise of the generators is 95dB within 1m and 86dB within 7m. The smoke of generators reaches Europe II grade let standard.

(b) Station Area

(i) Source of Power Supply

Local electricity power supply will be transmitted to the indoors substations of 13.8 kV or 25 kV for each railway station. NLRC will be responsible for the connecting electricity from local grid to the designed points.

(ii) Principle and Scheme of Power Supply

The power supply proposed for the stations includes the power supply to the terminal buildings of railway stations, to the lodging and production buildings in the railway stations for the purpose of production and lighting, of which the power supply for communication, signaling, AFC, fire fighting, illumination, etc. is the key load supply, and the others belong to ordinary load supply.

(c) Emergency Generating Set

Technical conditions for diesel generating set.

1. Standard and codes

Technical indexes of generating set should conform to GB-755-81, GB-2819-81, GB2800-90, IEC34, BS800, BS4999, BS5000, BS5514, VDE0530 and DIN6271.

2. Operating conditions

1) Working condition: To be used as emergency power source in case of failure of commercial power.
2) Installation condition: Indoor
3) Height above sea level: Below 1000m
4) Ambient temperature: Maximum 40°C; minimum 5°C; average 20°C.
5) Relative humidity: Maximum 100%
6) Seismic intensity: Not exceeding 7 degrees

a. General Requirements

1) Rated output power: 200 KW
2) Maximum output power: 220 KW
3) Voltage: Rated voltage 230/400 (load voltage 220/380) VAC three-phase four wire system.

Regulation rate of steady-state voltage: ≤ 1 %
Regulation rate of transient voltage: ≤ +20 % ~-15 %
Recovery time: ≤ 0.5 seconds
Rate of fluctuation: ≤ 0.5 %

4) Rated frequency: 60 Hz

Regulation rate of steady-state frequency: ≤ 1 %
Regulation rate of transient frequency: ≤ 5 %
Recovery time: ≤ 3 seconds

Rate of fluctuation: $\leq$ 0.5 %

5) Rated Power Factor: 0.8 (lagging)

6) Rated rotation speed: 1500 rpm

7) Starting mode: 12V or 24 V electric starting, with automatic and manual operation modes, generating set is provided with emergency manual starting device and stopping device.

8) Noise: $\leq$ 95 dBA

9) Fuel consumption: 35.8 L/hour

10) Regulation range for no-load voltage of generating set is 92% ~105% of the rated voltage.

11) Generating set should be provided with proper speed reduction measure that the maximum amplitude of vibration will not be larger than 0.5mm during full-loading running.

The noise of the generator sets is 95dB within 1m, it is 86dB within 7m. The room of Generator sets is well constructed to reduce the noise of generator sets; the smoke of Generator sets reach Europe II Grade Let Standard, the position and length of the pipe is adjusted to reduce the smoke of generator sets.

3.5.9 *Buildings*

(a) Description

(i) Design Scope

The buildings of the Project include those for 2 stations and a Depot. The building for Valenzuela Station will be constructed on the viaduct. On the other hand, Caloocan will be constructed on the ground.

(ii) Principles and Quantity of Buildings

Buildings of production use shall be well designed as per the requirements of railway operation and the need of workmanship.

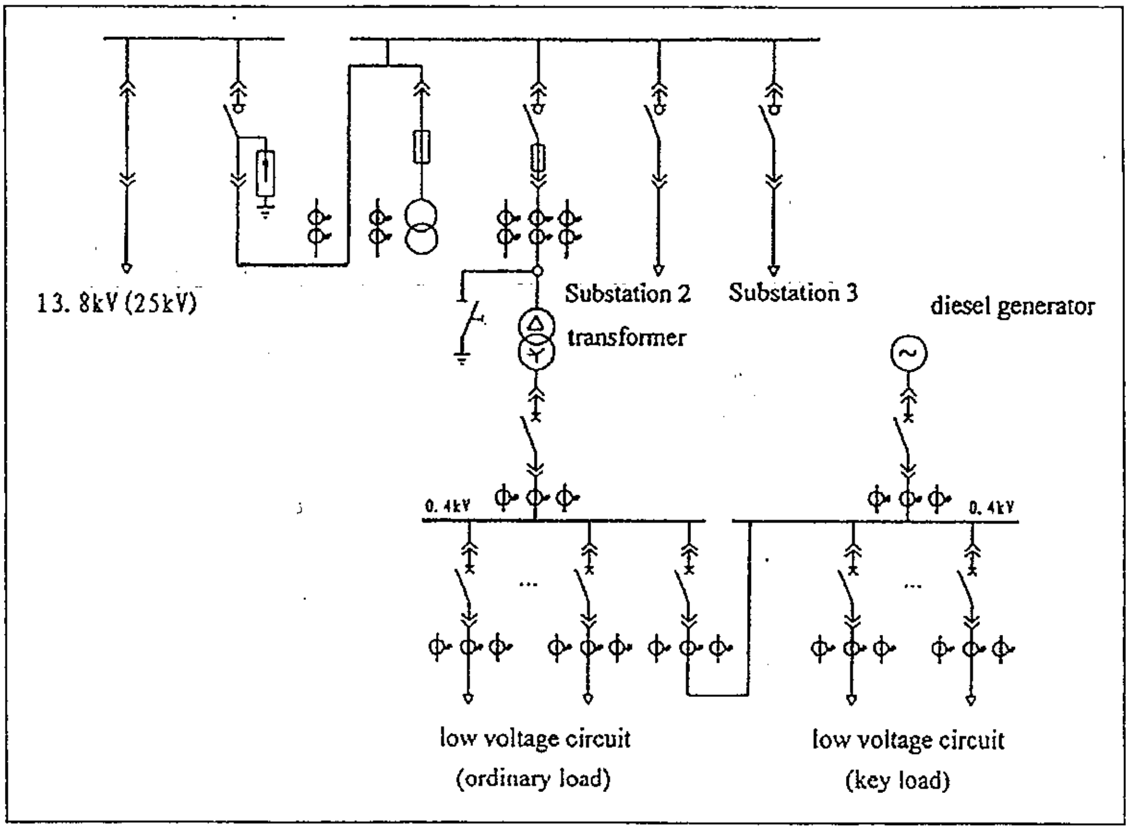


FIGURE 3.29: Assumed Sketch of Substation 1 for Depot
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

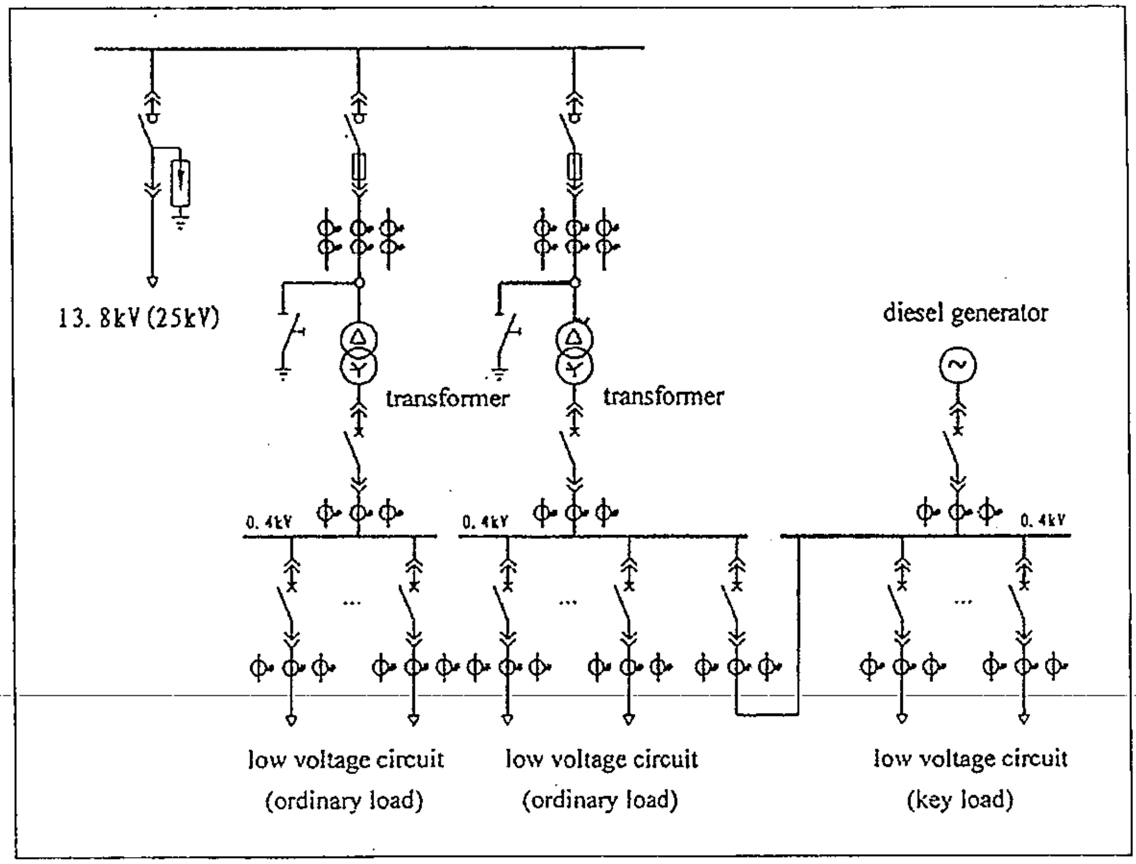


FIGURE 3.30: Assumed Sketch of Substation 2 for Depot
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

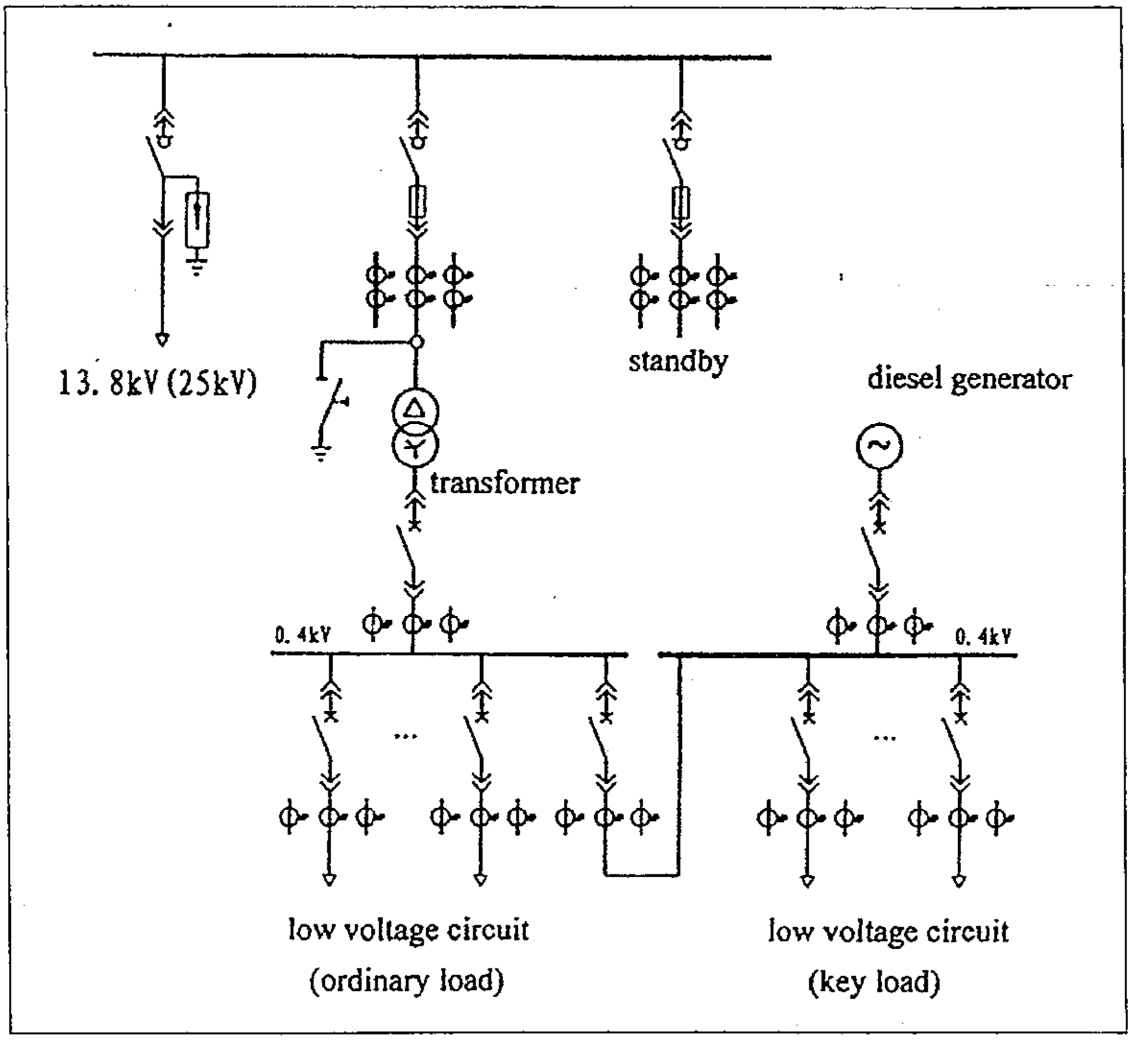


FIGURE 3.31: Assumed Sketch of Substation 3 for Depot
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

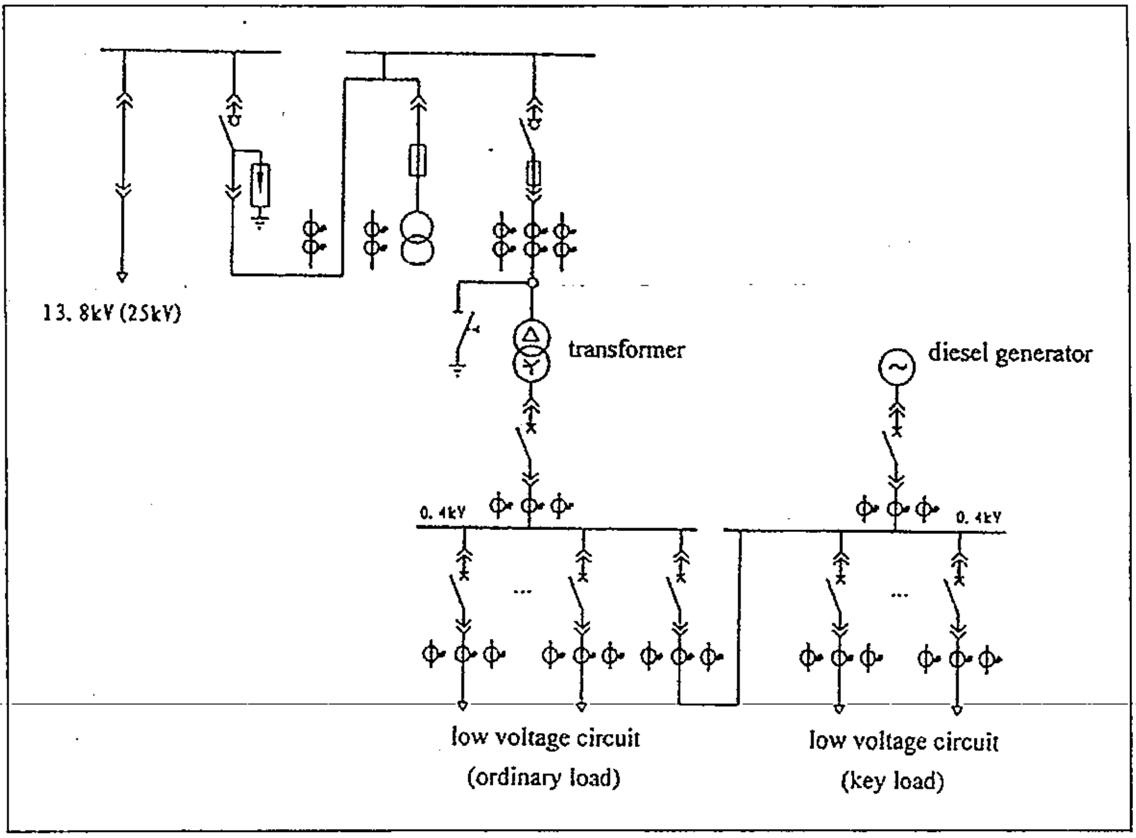


FIGURE 3.32: Assumed Sketch of Substation for Stations
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

The stations will be designed with regard to the ridership based on the absence of connection with MRT3 as assumed in the FS submitted to, and approved by, NEDA. The ridership figures from this study will be used for the Design of the stations.

The total construction area of the designed new building is about 32,000 m². All are buildings for industrial purpose. The build-up area in Table 3-17 is reference only and shall be subject to be determined in the Design.

(b) Architectural, Structure, Construction and Decoration
(i) Architectural

Station Buildings

The design of station buildings should create a visually appealing and comfortable space and environment for passengers with advanced technique, reasonable and convenient functions.

The function of stations shall play its role to the fullest extent to attract passengers. The intra-station facilities and streams of personnel will be reasonably arranged in connection with the scope and types. The stations will be well configured with complete facilities of ventilation, illumination, hygiene, hazard prevention so as to minimize inter-cross disturbance, to create pleasant internal and external environments and to provide the passengers with safe, comfortable and prompt services. With compact, distinct and appropriate layout, the stations will be easy to operate and control.

The space will be utilized as far as possible. When it is permitted, comprehensive development with adjoining and surrounding buildings may be conducted to minimize housing dismantling, removal of public utilities, and impact on neighbor buildings, traffic and people. The elevated station is to be designed with sufficient access to other communication facilities.

The design of station will be made based on simple, functional, well equipped, easy operation management and less cost as well. Passenger set-down areas shall be incorporated in the stations provided these can be accommodated within the ROW of the stations. The stations will be designed to provide safe and orderly flow of vehicles and passengers between road-based and rail and rail-based systems.

Depot Buildings

The buildings in the Depot are comprised of workshops, warehouse, multi-purpose inspection/repair bays, offices, storages, etc.

(i) Basic Construction Requirement

- General buildings roof will be sloping roof, covered with color profiled steel sheet.
- Waterproof material for roof will be membrane coating material.
- Heat insulating layer for roof will be 1:10 cement pearl rock.
- All floors will be made of cast-in-situ RCC slabs.
- Selection of wall material and thickness of exterior and interior wall:
    - When bearing concrete hollow blocks are applied, exterior wall shall be 200mm thick, and interior wall be 190mm thick. When frame structure is applied, wall material will be concrete hollow blocks, with outer wall thickness of 200mm and inner thickness of 200mm.
    - When bearing part is made of steel structure, wall material will be profiled steel plate, with wall thickness to be decided as per the different heat-insulating material inside the steel plate.
    - Aluminum alloy door and chlorinated polyvinyl chloride (PVC) plastic steel windows (80 series) with single frame, single glazing and sun shading device, will be used for general buildings. And PVC plastic steel windows with single frame and single glazing will be used for factory buildings. Aluminum alloy windows and doors will be used for large offices or production buildings facing station square and main streets. Screen windows will be used as required. Double-layer PVC plastic steel sliding windows will be used for all rooms with air-conditioners.

(ii) Decoration Requirement

Interior Decoration

Wall: Hemp-fibred plaster base will be applied to the wall of offices, and then applied with interior wall coating:

- Mixed surface with coating for production workshops;
- Ceramic tile or painting surface for walls with requirement of cleanness;
- Anti-acid (alkali) wall surface will be adopted for rooms with erosion operation;
- Ceramic tile wall will be used for rooms with humidity requirement.

Ceiling: Generally be the same as wall, except those walls with ceramic tile, for which the ceiling shall be plastered with hemp-fibred plaster base and then applied with interior wall coating.

Floor: Ground tile placing will be adopted for offices buildings. Terrazzo and concrete will be used for production workshop and storage house. Terrazzo or ceramics tiles or PVC synthesized erosion-proof floor and vitrified stone anti-static floor will be used respectively for houses with requirement of workmanship and equipment (communication Depot, signal building, main control room of traction substation etc.)

Skirt Board: Generally the application will be same as that for floor.

Windowsill Board: Generally terrazzo will be used.

Exterior Decoration

General buildings will be applied with Nippon paint coating. Exterior wall of buildings in the same station district will be finished with the same or consistent decoration standards.

Outdoor Works

Fence: Generally iron openwork fence will be used for common courtyard.

Path: Concrete road path will be adopted.

(iii) Type of Structure

Superstructure

For common small production and offices buildings, bricks and concrete composite construction will be used.

For industrial factory buildings (large house) in Depot, light steel structure will be adopted. Reinforced Cement Concrete (RCC) bent frame structure will be used for those with special requirement.

For stations, large complex production and offices buildings, RCC frame structure will be adopted.

Sub-structure

In case of a particular building is located on high embankment fill, natural soft soil or other bad ground, replacement fill, pile foundation, etc will be used as foundation accordingly, or effective measures for strengthening the ground foundation will be taken. Local experience and common practice will be considered and referred to this matter.

Air-conditioner (AC) Provision

In accordance with function requirement, MRV network frequency conversion central AC system is assumed in the office buildings of 6 stations, telecomm center, office buildings in the Depot.

In accordance with function requirement split type AC will be proposed for certain specific areas in signal building, substation, canteen, complex repair center and signal inspection center etc. in the Depot.

Industrial Ventilation

As per the requirements of workmanship and to maintain a wind flow, mechanical ventilation equipment may be installed in workshops, train parking & inspection bays, static commissioning bays, washing bay, air-compressor room, storage battery room, etc in the Depot.

Assumed Building Area

Table 3-17 below details the assumed number of buildings that will be constructed for the Caloocan – Valenzuela section of the NorthRail Project.

TABLE 3-17: ASSUMED BUILDING AREA (Caloocan – Valenzuela)

No	Name of Building	Number of Building	Assumed Build-up Area (m^2)
	Production Building		
	Building for passenger transport		
1	Caloocan Station	1	918
2	Valenzuela Station	1	3327
	Communication Building		
1	Communication spot in Depot	1	548
	Signal Buildings		
1	Signal Inspection & repair center	1	438
2	Signal building in Depot (CTC)	1	544
	Buildings for water supply and sewage		
1	Waste water treatment & repair workshop	1	157
	Buildings for electrical supply		
1	Substation	2	212
	Building for rolling stock		
1	Joint inspection & repair shed	1	8367
2	Monthly check shed	1	2634
3	Parking train check shed & siding	1	4288
4	Wheel lathe house	1	338
5	Static commissioning shed	1	766
6	Washing bay	1	704
7	House for special car	1	704
8	Air compressor room	1	127
9	Storage battery room	1	338
10	Complex building for office & education	1	1478
11	Office for fuel storage	1	17
12	Oil Pump room	1	56
13	Canteen hall	1	209
14	Bathroom	1	89
15	Guard Shed	1	22
16	Material storage building	1	745
17	Complex repair center	1	745
18	Boiler shed	1	298
	Housing for Machinery		
1	Repair house for maintenance team	1	292
	Site houses for maintenance team		
1	Mechanized maintenance site house	1	373
2	Shed for rail car	1	91

3	House for foreman section and power supply	1	192
4	Mechanized maintenance site house	2	684
	Total Quantity of Production Buildings	33	29,704

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

3.5.10 *Railway Subgrade*

(a) General Subgrade

(i) Width and Cross-section of Subgrade

The width of subgrade in straight alignment will be designed to meet the requirement of continuous rail. The detail is in Table 3-18 below:

TABLE 3-18: WIDTH OF SUBGRADE FORMATION (m

Double Track			
Normal Material		Permeable material and rock	
Embankment	Cutting	Embankment	Cutting
11.1	10.7	10.2	9.8

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

Outside of the subgrade on the curves will be widened according to Table 3-19, with degression on widening in the range of transition curve.

TABLE3-19: WIDENING OF SUBGRADE ON CURVES (m)

Radius of Curves (R)	Widened Value (m)
R<800	0.4
800≤R<2000	0.3
2000≤R<4000	0.2
4000≤R<10000	0.1

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

The camber will be in triangle with 4% slope for cross drainage from center line to both sides. This is also applied to the curves.

(ii) Thickness of Subgrade

The subgrade is divided in two layers. The thickness and filling material will conform to the requirements as described in Table 3-20 below:

TABLE 3-20: THICKNESS AND FILLING MATERIAL OF SUBGRADE

	Thickness (m)	Type of Filling Material
Top layer	0.6	Type A, B and improved type C
Bottom layer	1.9	Type A, B, C

*The type of material should be in accordance with Chinese Standard.

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

(iii) Mechanized Maintenance Bay

Maintenance bays (5x5m) will be constructed in conjunction with the subgrade to allow the access of the maintenance equipment. The interval of the bays is about 500m at each side of the alignment.

(iv) Retaining Wall

Due to the confined ROW inadequate for the embankment by sloping, retaining walls is to be designed at the place where the height of embankment exceeds 3 meters in order to draw back footing of side slopes. Tentative assumption of length of this kind of subgrade formation is approx. 12,477 linear meters. Pre-cast RCC slab wall is installed on the in-situ concrete foundation. Galvanized steel strip is placed between layers of compacted earth filling. In-situ reinforced concrete (RC) retaining wall is considered to maintain the footing within the ROW at cutting stretches.

(v) Specifications

Characteristics Specifications for all earthwork materials of the embankment shall be described in the Design.

The system will be designed to be within the PNR right of way as much as possible. There are three possible options being considered (in order of increasing cost), embankment, retaining wall and viaduct. The height of embankment (to avoid flood levels to reach the formation) and the width of the ROW affect which of the three options will be used.

For Section 1, the railway system will be elevated within the Valenzuela segment, due to the above reasons and also due to the proximity of several adjacent road crossings from one another within the segment. Depending on the outcome of the detailed design, it may start from anywhere between north of the Tullahan River and the MacArthur highway crossing, and will continue to be elevated until before the NFA-ACA property (See Annex AJ).

The likely option that will be adopted for the railway, specifically within the Valenzuela segment is an elevated type on a viaduct structure. This is due to the fact that the PNR ROW is very narrow within the southern portion of the Karuhatan McArthur Bridge and the Tullahan River Bridge areas. Also, with the presence of several adjacent road crossings within the northern portion of the alignment, it is more economical to provide a continuous viaduct structure than to provide grade-separation for all the road crossings within that section. At the moment, however, NorthRail is still awaiting the Preliminary Design which will confirm the starting point and ending point of the viaduct section.

Dispersion modeling is not necessary as advised by an air and noise specialist as the air pollution emitted by the coaches will be negligible.

3.5.11 *Bridges and Culverts*

(a) General Description

Most of the existing bridges are of steel girders, which have been heavily deteriorated due to lack of maintenance and the effects of atmosphere, particularly humidity, rain and wind. The existing bridges and culvers will be demolished and replaced by new structures with following particulars:

- Viaduct = 1, tentatively 2,560-3,500 m;
- bridge for river crossing = 1, with accumulative length of approx. 80 m;
- culverts = 96, with accumulative length approximately 2620 m (Caloocan – Malolos segment);
- passenger underpass / overpass = 1, 30 m
- road crossing = 2, with accumulative surface area of approximately 400 m^2

(b) Design Criteria

(i) Live load: UIC live load standard will be adopted for the design.

(ii) Speed: 120km/h

(iii) Frequency of flood: flooding frequency of 1/100Y is considered for bridge, and 1/50Y for culvert. Taking into account the existing ROW of PNR, the viaduct is designed for the section near Valenzuela station where the embankment height exceeds 6 meters.

(iv) Superstructure: RC structure (mostly assumed 24m and 32m) will be adopted for river crossing bridges. Other types of superstructure for these bridges may be considered during the Design. Road crossings and passenger underpass will be in-situ RC structure, and temporary access road will be constructed. The superstructure of the rail crossing is of pre-stressed RC hollow girder with the assumed span of

25m.

(v) Structure foundations of culvert will be improved by refilling suitable material as necessary, or by means of other type of reinforcement depending on particular situation encountered.

(vi) Inspection cages and guard-rails will be considered on abutments and piers of the bridge crossing constant water flow.

(vii) Checking stairs will be constructed on the approaching slope of bridge in case the height of embankment is more than 3 meters. The stairs will be designed at downstream side of each approach of large & medium sized bridge. One stair will be designed for small sized bridge or culvert. The width of stair is 1.0 m.

(c) Viaduct

Valenzuela Station will be built on the viaduct approximately 2,550m long. The section of viaduct in the range close to the station with a length of approximately 480m will be 4 tracks, and a length of 1457m from station towards Malolos will be 3 tracks, and others will be 2 tracks. Viaduct will be considered to the location where the embankment height exceeds 6 meters. The height of viaduct is about 14m. However, there is some possibility to reduce the height if rehabilitation of the existing rail crossing of McArthur highway at KM120+400 is taken into account. This will also be considered during the Design.

The viaduct will be comprised of 106 spans of 24m for each. Pre-stressed RC continuous girders will be adopted for the superstructure. The proposed center point of the viaduct is at KM121+225. Ultimate length of the viaduct shall be fixed upon completion of Preliminary Engineering Survey when the cost comparison between the viaduct and at grade embankment has been made. The cost comparison shall take into account the effects of shortening the previously submitted document of NLRC for the viaduct (3.75 kilometers), especially with regard to road crossings.

A relevant section of the McArthur Highway at km 120+400 may be lowered in order to reduce the height of viaduct.

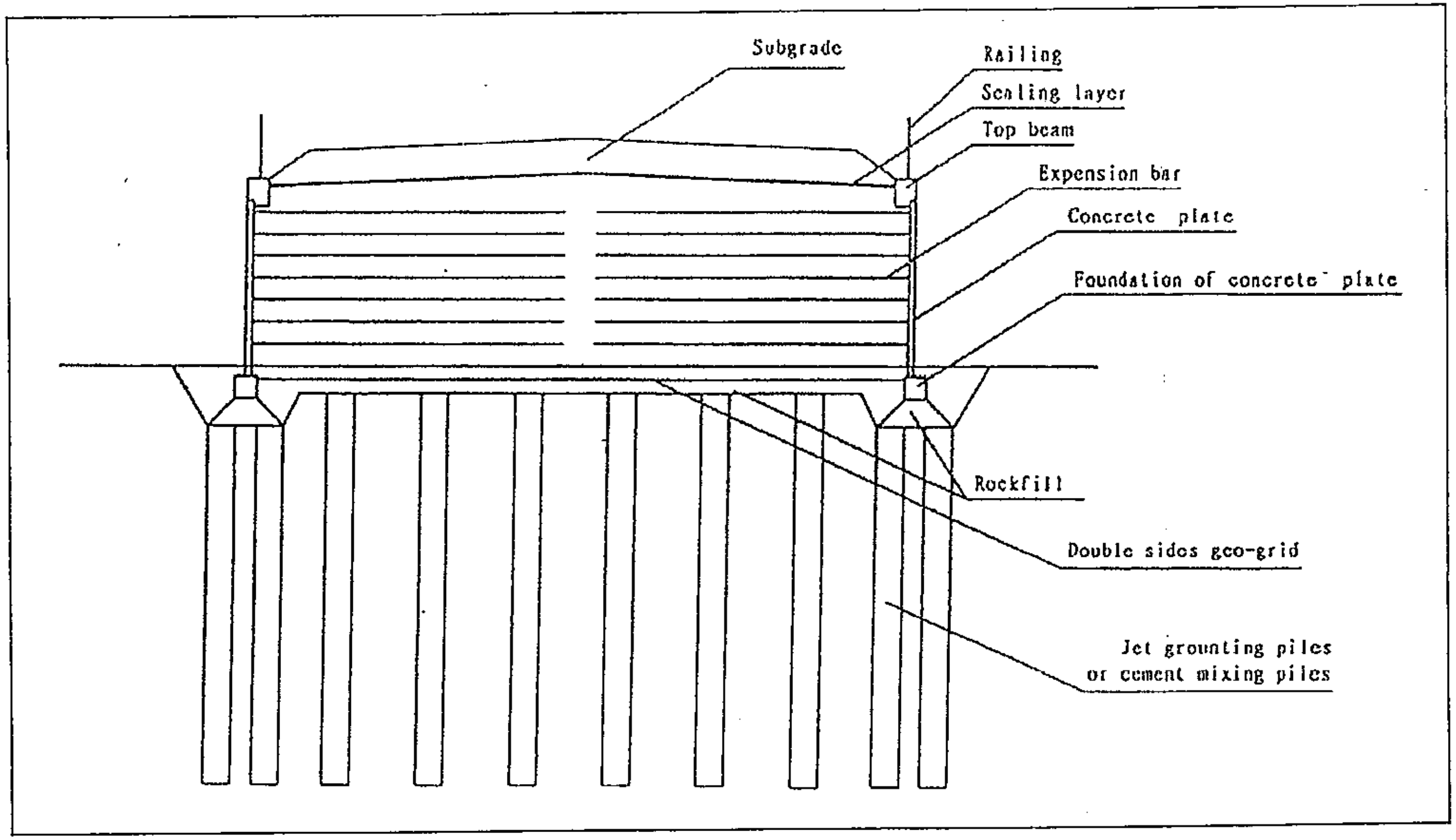


FIGURE 3.33: Retaining Wall in Embankment with Improved Formation
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

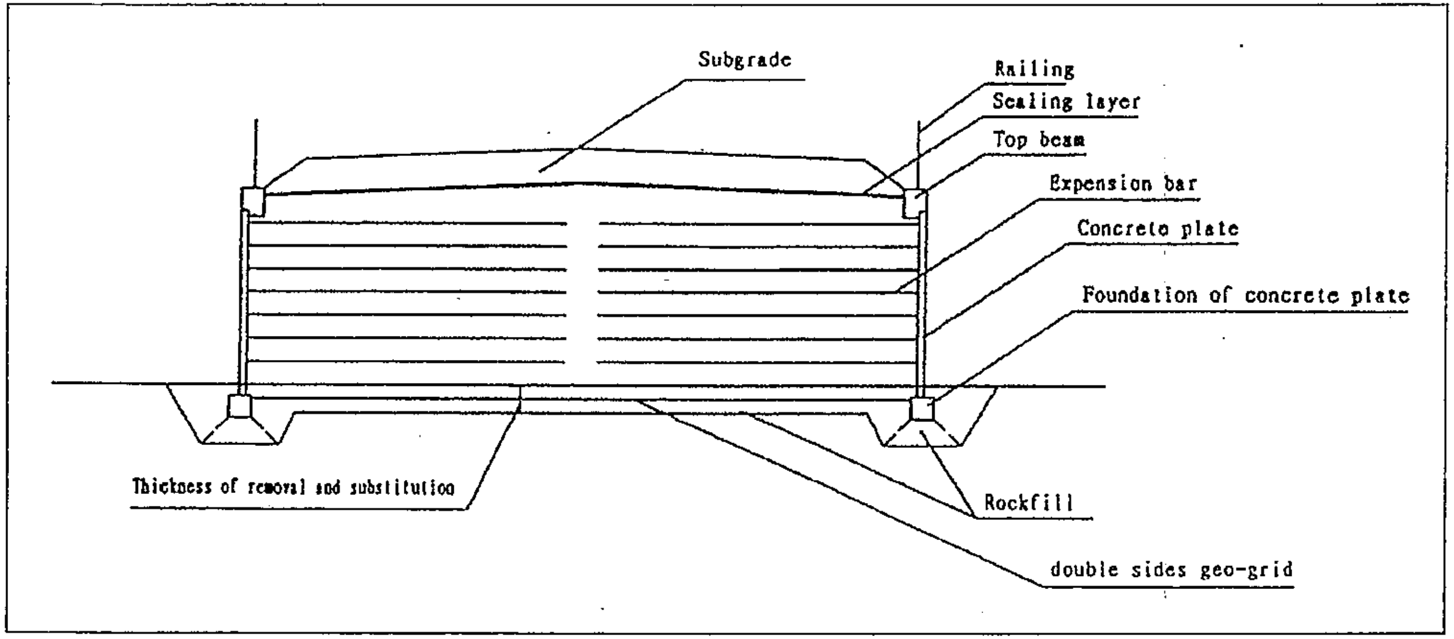


FIGURE 3.34: Reinforced Earth Retaining Wall on Common Formation
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

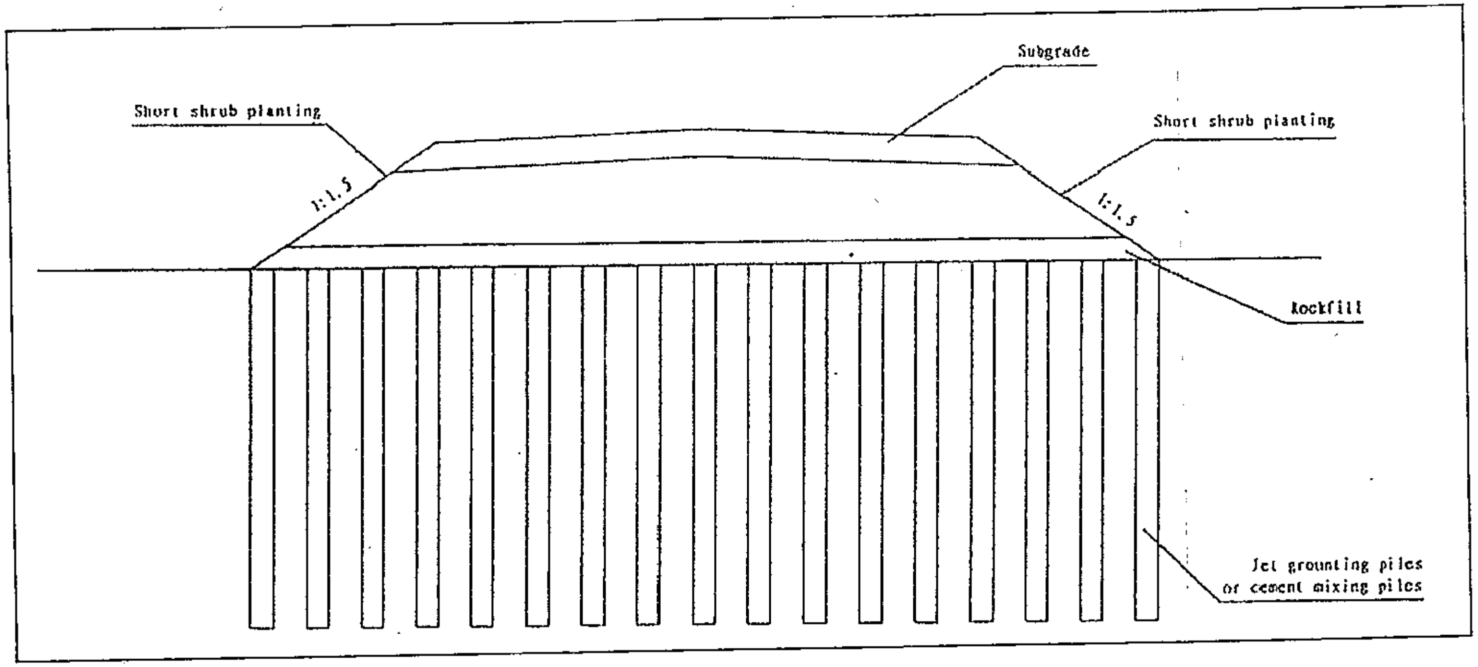


FIGURE 3.35: Embankment Improving
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

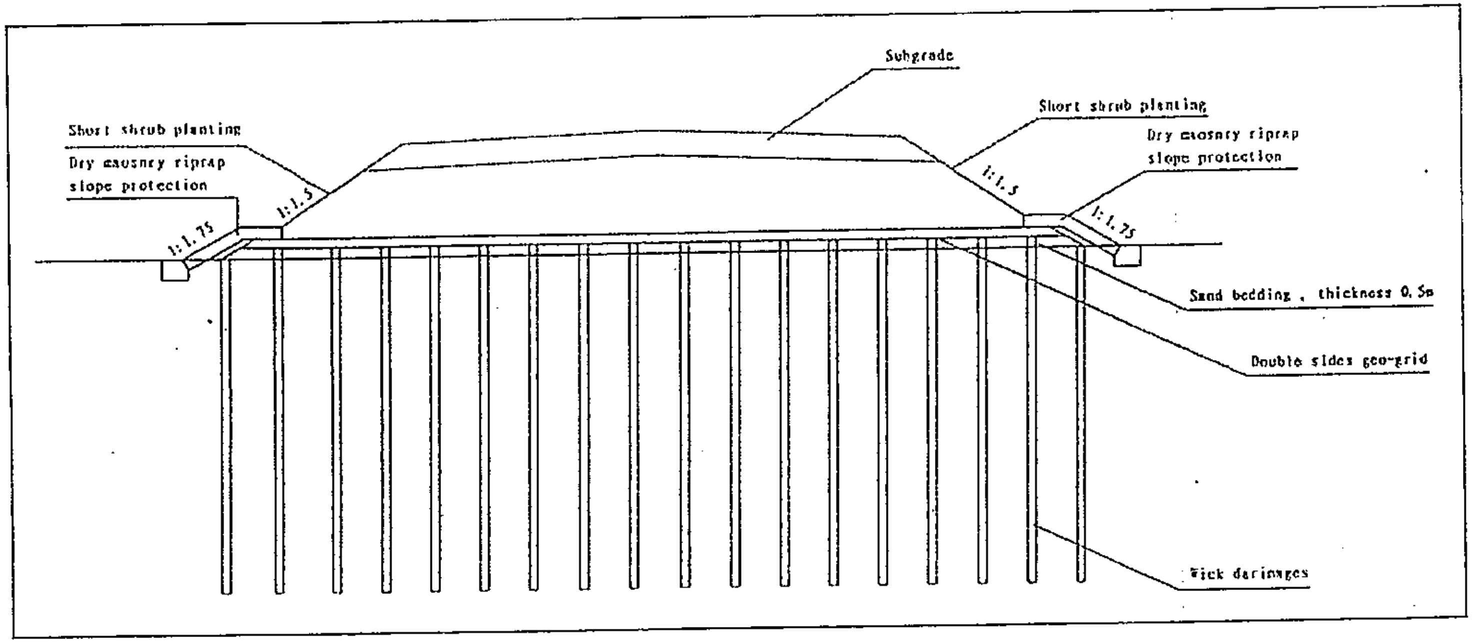


FIGURE 3.36: Embankment Improved by Wick Drains
(Note: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

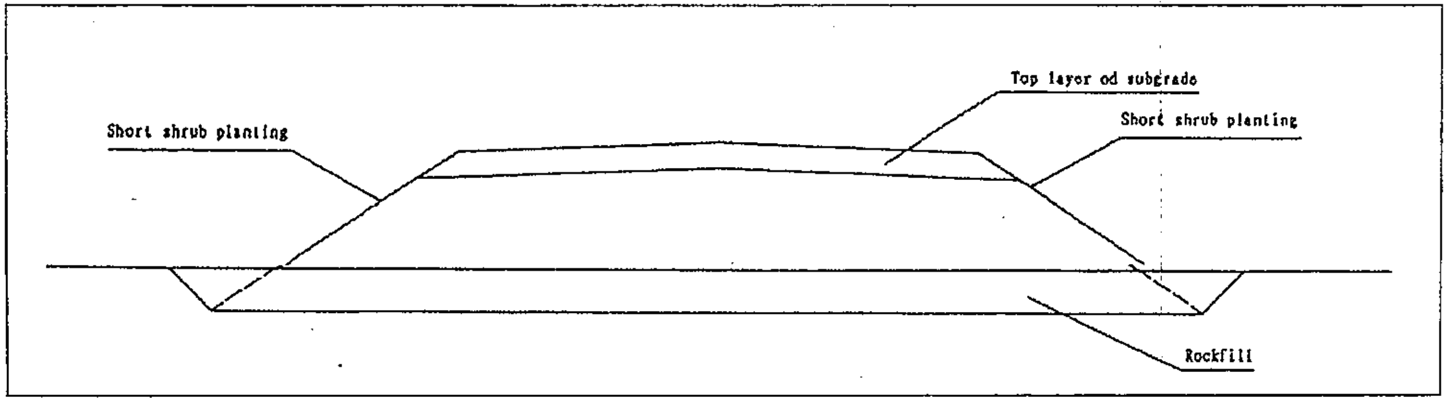


FIGURE 3.37: Embankment on Foundation Treated by Bad Soil Removal and Substitution
(Ncle: Figure NOT to scale)
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

TABLE 3-21: Assumed Summary of Viaduct (Caloocan – Valenzuela segment)

Item	Km station at center	Structure name	Type of Superstructure	Aperture No.	Span (m)	Total Length (m)	Length of anti-derailing rail (m)	Bridge gap station	Type of Foundation
1	KM121+225.0	Viaduct at Valenzuela Station	PC continuous girder	106	24	2546.0	2560	KM119+945-KM122+510	Piles

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

TABLE 3-22: Assumed Summary of River Crossing Bridges (Caloocan – Valenzuela segment)

Item	Km station at center of bridge	Bridge name	Type of Superstructure	Aperture No.	Span (m)	Total Length (m)	Length of anti-derailing rail (m)	Bridge gap station	Type of Foundation
1	KM118+600.5	Tullahan river bridge	PC girder	3	24	85.0	103.0	KM116+554-KM116+647	Piles

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

TABLE 3-23: Assumed Summary of Road Crossings (Caloocan – Valenzuela segment)

Item	Km Station at center of bridge	Type of Structure	Number of Span	Span (m)	Total Length (m)	Plan area (m^2)
1	KM117+780	Framed and braced	1	16	18.0	225
2	KM123+260	Framed and braced	1	12	18.0	175

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

TABLE 3-24: Assumed Summary of Passenger Underpasses (Caloocan – Valenzuela segment)

Item	Km Station at center of underpass	Type of Structure	Number of Apentures	Span (m)	Total Length (m)	Remarks
1	KM116+500	RC frame culvert	1	6	30.0	Passenger underpass (with mechanical drainage system)

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

TABLE 3-25: Assumed Summary of Existing Bridges & Culverts to be Dismantled (Caloocan – Valenzuela segment))

Item	Removing concrete/ brick/stone/steel structure	Removing existing steel girder and deck plate (span <10m)	Removing existing steel girder and deck plate (10m<span<22m)	Removing existing steel girder and deck plate (span>22m)	Removing existing bridge steel pier
Section	m^3	T	T	T	piece
CAL - VAL	608.7		160.35	114.4	24.00

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

3.5.12 *Water Supply and Sewage System*

(a) Depot Area

(i) General Description

The water supply system installed in the Depot is for both industrial and domestic uses, and the pre-treatment measures sewage system will be taken for the industrial waste water in Depot.

(ii) Estimated Daily Water Consumption and Discharge in the Depot

The water supply station in the Depot will be designed to take into account the following:

TABLE 3-26: ESTIMATED DAILY WATER CONSUMPTION AND DISCHARGE IN THE DEPOT

Water Consumption	Maximum	$812m^3/d$
	Allotted as fire-fighting standby	$198\ m^3/d$
Discharges	Industrial sewage	$373\ m^3/d$
	Domestic sewage	$56\ m^3/d$
	Total discharges	$429\ m^3/d$

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

(iii) Water Source Solution

Tap water will be the source of industrial and domestic water. It will be connected from local public pipeline. The capacity of the local supply will consider the future requirements for the volume and pressure of domestic, industrial and fire-fighting water for project facilities.

The Depot shall be designed to have independent water supply facilities for fire fighting and industrial purposes apart from its link to public pipelines. As a backup or supplementary source of water supply, water tanks shall also be provided in the Depot to store tap water from local supply.

(iv) Scheme of Sewage Treatment and Discharge

Treated wastewater of parking area treatment wastewater plant is recycled, and no wastewater is drained, so there will be no influence to environment. Productive wastewater will be treated respectively: oiled wastewater will be treated by oil-separator, acid & alkali wastewater will be treated by neutralizing water tank. A sewage treatment plant will be adopted in total drainage system. Domestic sewage, which is pretreated by secondary biological process, production wastewater and train washing wastewater are recycled after they are collected and treated by coagulation process, air-floatation process and filter process.

Treated wastewater of parking area treatment wastewater plant is recycled, and no wastewater is drained, so there will be no influence to environment. Productive wastewater will be treated respectively: oiled wastewater will be treated by oil-separator, acid & alkali wastewater will be treated by neutralizing water tank.

Surface run-off along the alignment will flow through discharge ditches provided along the sides of the structures (embankment, retaining wall or viaduct) and discharged to the community storm drainage system.

The service sewage from the Depot will be treated by two stage bio-chemical process (oxidation trench) and then to the waste water pumping stations for discharging. The waste water from train flushing and other production will be re-used after being processed by oil separation, sedimentation, coagulate, air flotation and filtering, etc.

Pre-treatment measures will be taken for the industrial waste water at Depot. One sewage treatment plant will be set up at the main discharge point. The domestic sewage water after treatment by two stage bio-chemical process (oxidation trench) together with the train flushing water and other industrial waste water treated by oil separation, sedimentation, dispersed air flotation and filtering can be re-used for train flushing, landscaping, etc.

TABLE 3-27: PROPOSED WATER QUALITY

Parameters	Domestic Sewage At Inlet	Domestic Sewage At Outlet	Production Waste Water At Inlet	Reclaimed Water
BOD5	≤120mg	30mg	400mg	≤10mg
COD	≤250mg	120mg	≤300mg	≤50mg
SS	≤220mg	≤30mg		≤5mg
PH	6.5 – 8.5	6 – 9	6.5 – 8.5	
Organic Matters			≤150mg	

Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

The sewage treatment process in depot and each station has been designed in compliance with the local standards of DENR Administrative Order NO 35 (series of 1990), and in combination with local drainage conditions, so potential water pollution is not expected to occur. The discharge ditch of NorthRail will not flow into surface water or any body of water, rather, it will be connected to the community waste water discharge system.

Discharge point and quantity of the sewage treatment plant, information on the drainage system, estimated run-off, discharge point and potential impact.

(v) Assumed Main Sewage Treatment Structures and Equipment

- one domestic sewage pumping station, dimension: diameter = 3 x 3 meters, RC structure; provision for 2 submersible sewage pumps including one standby;
- one flat flow sand sediment pond, RC structure, capacity: $Q=20m^3/h$;
- one oxidation trench, RC structure, maximum capacity: $Q=100m^3/d$, provision for 2 submersible aerators, $Q=50m^3/h$;
- one set of siphoning type decanter, $Q= 50m^3/d$;
- one industrial waste water pumping station, dimension: diameter = $3 \times 5m$, provision for 2 submersible sewage pumps, including one standby;
- one oil separation & sedimentation pond ($V=200m^3$), RC structure;
- one set of coagulating, air-floatation and filtering equipment, capacity: $Q=25m^3/h$;
- one set of automatic frequency control water supply equipment, provision for 3 vertical centrifugal pumps (65DL×3) and 1 stabilized pressure pump with performance of $Q=0 \sim 90m^3/h$, H=48m;
- one reclaimed water pool ($V=200m^3$), RC structure;
- one mud treatment and dewater lot, capacity: $Q=5 \sim 20m^3/h$

Domestic solid and liquid waste generated by the passengers will be simultaneously disposed on the sewage treatment plant located in the depot station. The system of disposal will be undertaken by the Waste Management Unit, which will be created on the operational stage of the Northrail Project. Comprehensive study measures will be considered specifically on the waste and sanitation standard guidelines (plumbing code) for the disposal of domestic wastes.

The disposal scheme is similar to Airport Passenger Terminals where the passenger airlines solid and liquid waste is directly discharged to an attached mobile waste storage. The passenger train maintenance's personnel will regularly monitor the discharge of the domestic waste. The routine monitoring / check-up is designed to avoid waste spillage and leakages.

The passenger train waste storage will discharge the solid and liquid waste directly to sewage treatment plan by siphoning or an ejector pump.

For the railway station and the station building, a septic tank will be considered for the deposit of solid and liquid waste. The disposal of the solid waste will be digested in the digestive chamber and the leaching chamber will discharge liquid waste directly distributed to existing sewer line. For the depot station, depot buildings, maintenance repair shops and washing area were technically considered in the study. All liquid wastes will be treated with chemical compound elements.

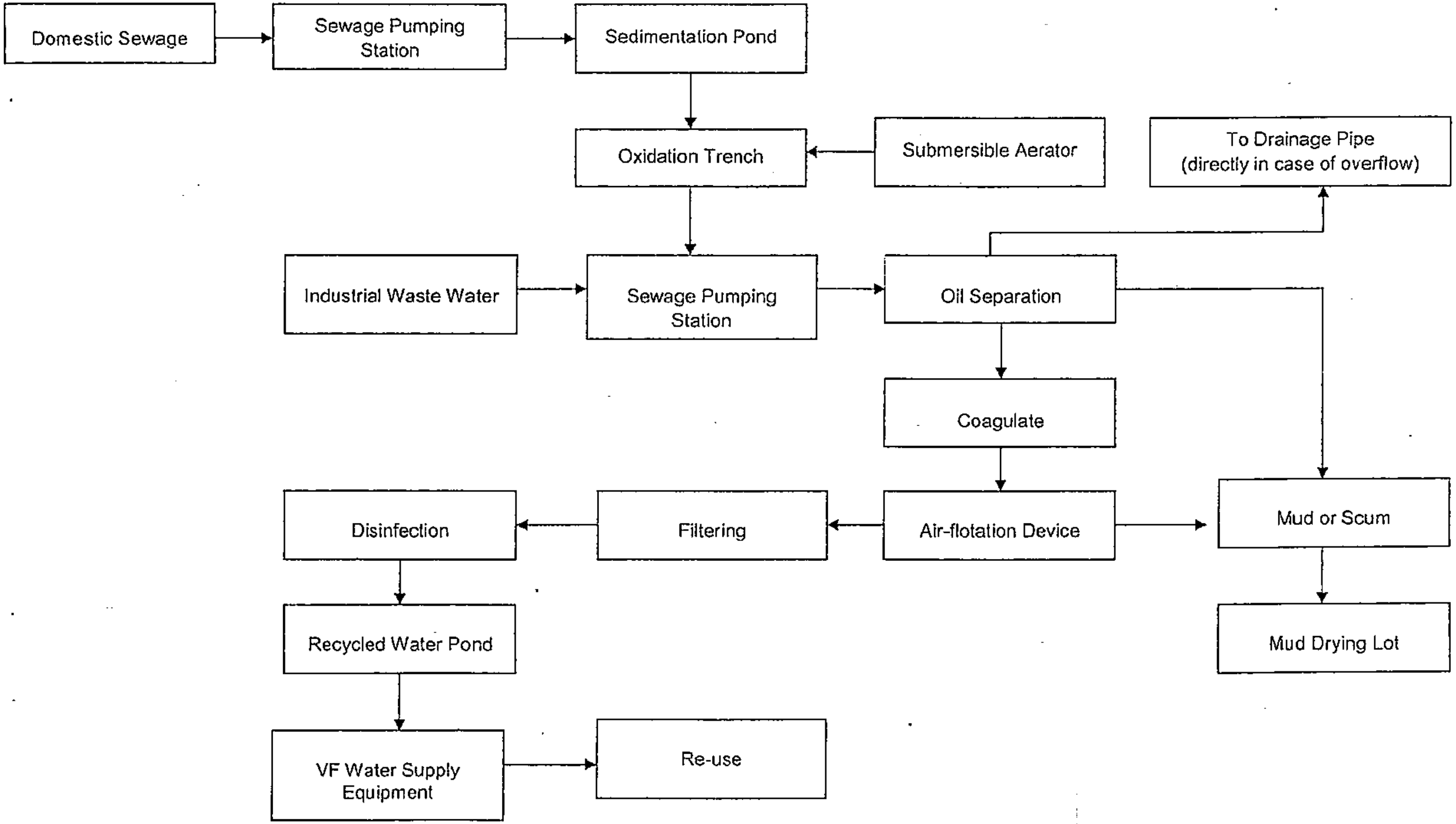


FIGURE 3.38: INDUSTRIAL AND DOMESTIC SEWAGE TREATMENT PROCESS FLOWCHART
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

(vi) Fire Fighting Facilities

Low pressure water supply system will be used for the outdoor fire fighting and fire hydrants will be provided as per the requirement in the Detailed Design. The intake for fire fighting pipelines and domestic and industrial water supply pipelines will be the same. Fire fighting water consumption in the train inspection bay will have a hydrant system of 10L/s and sprinkler system of 20L/s. The water pressure will be not less than 45m. In order to improve the safety and reliability of the fire fighting water supply system, an independent fire fighting water supply system will be provided in the train inspection bay as shown below:

Water Sup

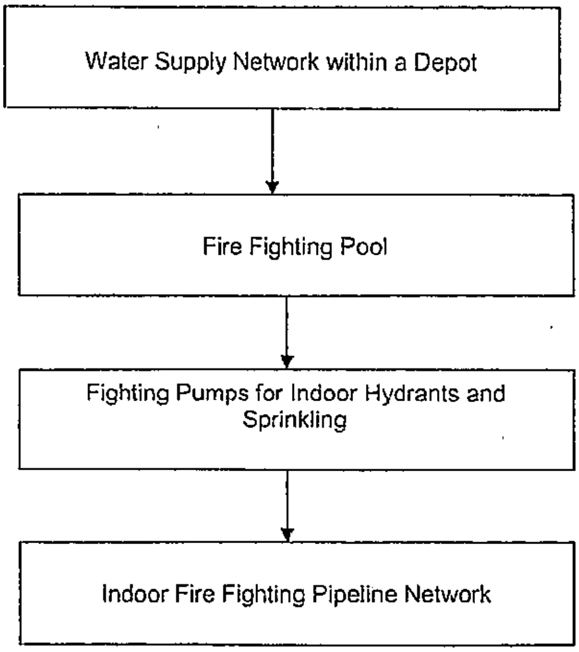


FIGURE 3.39: FIRE FIGHTING FACILITIES
Source: North Luzon Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003

The indoor hydrants and sprinkling system will share one 200m^3 RC fire fighting pool. There will be (3) vertical multi-stage centrifugal pumps (Q=5L/s, H=55m and N=5.5KW) to be used as the fire fighting pumps (for indoor fire hydrants, for operation and as standby). For indoor sprinkling system, 3 vertical multi-stage centrifugal pumps (Q=10L/s, H=53m and N=11KW) will be provided (2 for operations and 1 as standby).

The train stations will be installed with smoke detectors and also be provided with fire extinguishers and ceiling mounted water sprinklers. Water hydrants will be strategically located within the depot.

All stations will have fire hydrants, aside from overhead tanks which may also come as source of water for fire fighting.

CO_2 portable extinguishers will be installed in special buildings for signals, telecom and power supply.

Portable ammonium phosphate salt dry powder extinguisher will be installed in other buildings both of production and lodging use.

Movable foam fire fighting apparatus will be prepared for fire fighting at the fuel storage with the rolling stock depot where two (2) movable compacted liquid foam fire extinguishers and two (2) air foam tubes will be installed. Specification of fire extinguishers: 200 liters capacity, combined liquid flow: 4 L/s and ejecting time: 12.5 min.

(vii) Pipes

The feed-water pipes and pressure drain pipe will be of Polyethylene (PE) pipes, and the gravity drainage pipes will be of RC pipes.

(b) Station Area

(i) General Description

The water supply and sewage system is to be established to secure the requirement of operation for the Caloocan and Valenzuela stations.

(ii) Water Supply and Distribution in Stations

The water supply and distribution in the railway station is established for domestic use only.

(iii) Water Source

Tap water will be the source of industrial and domestic water. It will be connected from local public pipeline. The capacity of the local supply will consider the volume and pressure requirements of domestic and fire-fighting water during the operation of project railway. Water tanks connected to tap water pipeline shall be placed at each station as the supplementary in case the local supply is inadequate.

(iv) Fire Fighting and Facilities

Low pressure water supply system will be used for the outdoor fire fighting and fire hydrants will be provided as per requirement. The fire fighting water pipelines and domestic water supply pipelines will be combined together.

(v) Sewage Treatment & Discharge

The domestic sewage from each station will be treated through septic ponds before discharging. The Prime Contractor will construct discharging pipes connecting local sewers to the extent of the average length of the pipes extending beyond the existing PNR ROW will not be more than 50 meters.

(vi) Pipes

The water supply pipes and pressure drain pipe will be of PE pipes, and the gravity drainage pipes will be of RC pipes. Concrete conduits will be provided for the water supply pipes under the tracks in the station. On the other hand, those for drainage under the tracks will be ductile pipes.

3.6 Project Phases / Specific Activities

The following sections enumerate the Project activities.

(a) Pre-construction / Commissioning / Mobilization

(i) Pre-construction Stage

Pre-construction activities include:

- Feasibility Study / NEDA Approval
- EIA Study / ECC Application
- Signing of ODA Loan Agreement
- Design
- Traffic Management Study
- Securing Permit to Cut Trees
- Removal of structures and clearing of trees and other impediments within the PNR ROW
- Relocation of the households and other structures within the PNR ROW to agreed resettlement sites
- Site Investigation / Geotechnical investigation
- Utilities Diversion – removal/relocation of parts of utilities which have encroached in the ROW such as power line posts, etc.
- Land Acquisitions (if any)
- Securing other Permit Requirements

(ii) Construction

The preliminary project scopes (for the Caloocan – Malolos segment of the NorthRail Project) include:

- Construction of the double track railway sub-grade formation along the existing PNR ROW including considerations to accommodate the facilities for upgrading to electric traction in future
- Construction of the permanent way including the tracks in stations and Depot
- Replacement of 8 existing steel truss river crossings by new RC bridges
- Construction of approximately 24 road crossings (Note: actual number of the same will be confirmed during the engineering design)
- Construction of 1 rail crossing
- Constructions of CD structures and side drains
- Construction of a viaduct with total length of tentatively 2.56-3.5 Km
- Construction of the Depot in vicinity of Valenzuela Station to provide stabling, maintenance and repair of the trains
- Installation of the telecom and signaling system for operation
- Supply 19 units of DMU for passenger transportation
- Construction of 6 stations (Caloocan, Valenzuela, Marilao, Bocaue, Guiguinto and Malolos) with necessary facilities for operation
- The design and construction of Marilao station building will be carried out by NLRC. However the station building should be in accordance with general layout and function of the Project for operation. Major equipment listed in the Bill of Quantity for this station will be supplied and installed by the Contractor.

The above activities will be undertaken on the premise that designs are complete, the ECC and other construction permit requirements has been secured from DENR and other proper authorities.

Below is the tentative Schedule of Project Implementation specific to Caloocan-Valenzuela Route.

**TENTATIVE SCHEDULE OF NORTHRAIL PROJECT IMPLEMENTATION - SECTION 1-PHASE I
(CALOOCAN-VALENZUELA SEGMENT)**

WORK PACKAGE	ACTIVITIES	No. of Mos.	Year 1				Year 2				Year 3				Year 4			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Site 1 - Caloocan-Valenzuela Segment																		
	Site Preparatory Works	6																
	Utilities Diversion	6																
	Land Acquisition	6																
	Civil & Track Works	21																
	Detailed Engineering (Design, Review & Approval)	12																
	Preliminaries	18																
	Permanent Way	15																
	Earthworks	15																
	Bridgeworks	15																
	Trackworks	15																
	Stations/Buildings	18																
	Building Costruction	18																
	Architectural Finishes	12																
	Signalling, Communication and Electro-mechanical Installation	21																
	Design	6																
	Preliminaries	6																
	Signaling System	12																
	Information and Telecommunication System	12																
	AFC System	9																
	Power Supply	15																
	Rolling Stocks & Auxiliary Equipment	15																
	Testing & Commissioning	6																
	Defects Rectification	9																
	Warranty Period	12																

Note: Q1 -Year 1 of Project Implementation will commence once the right of way is cleared of informal occupants.
*** Target partial operation of the Caloocan-Valenzuela Segment: 2nd Year of Project Implementation

(iii) Operation

The operation stage includes the following activities:

- Testing and commissioning of the rolling stock
- Operation of the rail service
- Maintenance of the rolling stock at Depot
- Maintenance of other rail facilities
- Environmental Monitoring
- Commercial Development (if any)

(iv) Abandonment / Decommissioning / Demobilization

Please refer to Section 7.5 of this Report.

Fuel Consumption Rate and Emission Rates of Air Contaminants for diesel locomotives													
Period	Train pairs	Fuel consumption			Emission rate of air contaminant								
					Smoke dust			SO_2			NO_x		
	Pairs/day	t/a	$X10^3$ g/km/d	g/KWh	t/a	g/km/d	g/KWh	t/a	g/km/d	g/KWh	t/a	g/km/d	g/KWh
Initial stage (2009)	142	9,536.8	813.9	68.2	145.2	12,372	1.04	30.5	2,604	0.23	181.2	15,465	1.30
Short Term (2016)	138	9,268.1	791.1	68.2	140.9	12,024	1.04	9.7	2,531	0.23	176.1	15,029	1.30
Long Term (2031)	144	9,671.0	825.4	68.2	147.0	12,547	1.04	31.0	2,642	0.23	183.8	15,683	1.30

3.7 Project Cost.

The Project cost presented below is an extraction from the total cost estimate of US$ 503.04 Million. The station costs and the depot are as approved by NEDA while the other costs were pro-rated from the total cost. Costs for rolling stock, project management, taxes and other costs were not included as these pertain to the entire project and hence cannot be broken down into costs for the Caloocan to Valenzuela segment alone.

The project cost is estimated at US$ 122.78 Million as presented in Table 1.

Table 1. Estimated Project Cost (in US$ M) of the CALOOCAN – VALENZUELA SECTION of the NORTHRAIL Project	
Items	Cost
Civil Track Works	
Design	1.58
Preliminaries	6.38
Permanent Way (Caloocan – Valenzuela)	72.26
Stations	
	7.66
	4.51
Depot	14.35
Contingencies (5%)	5.35
Sub-Total (Civil Track Works)	112.09
Right-Of-Way	
Land Acquisition	1.69
Utilities Diversion	2.25

Table 1. Estimated Project Cost (in US$ M) of the CALOOCAN – VALENZUELA SECTION of the NORTHRAIL Project	
Items	Cost
Sub-Total (Right-Of-Way)	3.94
Signaling and Communications	
Design	0.17
Preliminaries	0.57
Signaling	3.04
Communications	0.88
Ticketing System	0.78
Power Supply	0.99
Contingencies	0.32
Sub-Total (Signaling and Communications)	6.75
TOTAL PROJECT COST (Caloocan – Valenzuela segment)	122.78

Source: Feasibility Study for NorthRail Project Phase 1 Section 1 (Caloocan – Malolos), NLRC, May 2003

3.8 Manpower Requirement.

During construction, the implementation of the project (Caloocan to Valenzuela segment) would more or less employ about 500 laborers – both skilled and non-skilled.

This figure does not include enterprising people who can provide goods and services during this construction period.

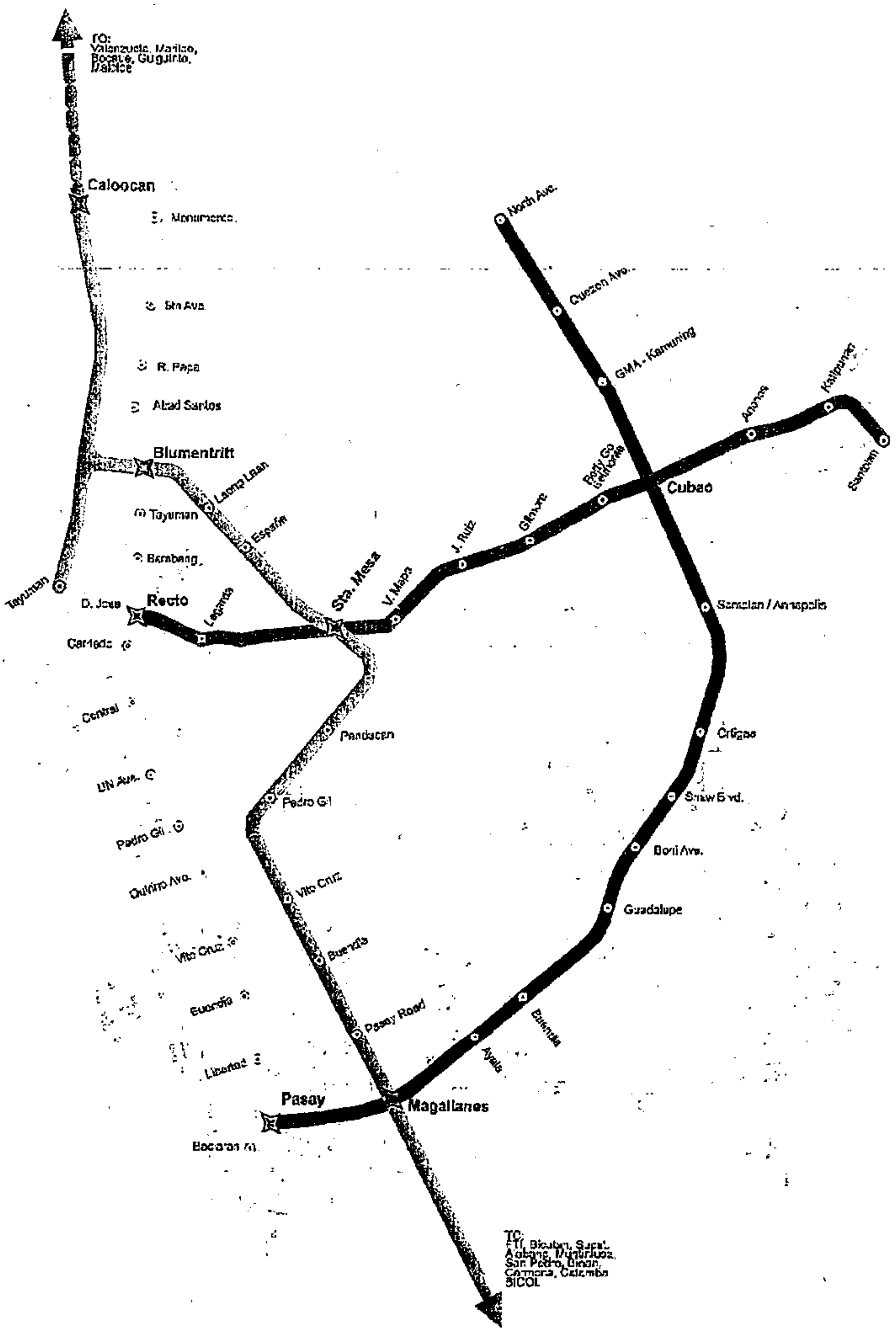
During operations, it is estimated that the segment will provide employment to about 160+ employees for the operation and maintenance of the system.

3.9 The interconnection of the project with the existing LRT and MRT project.

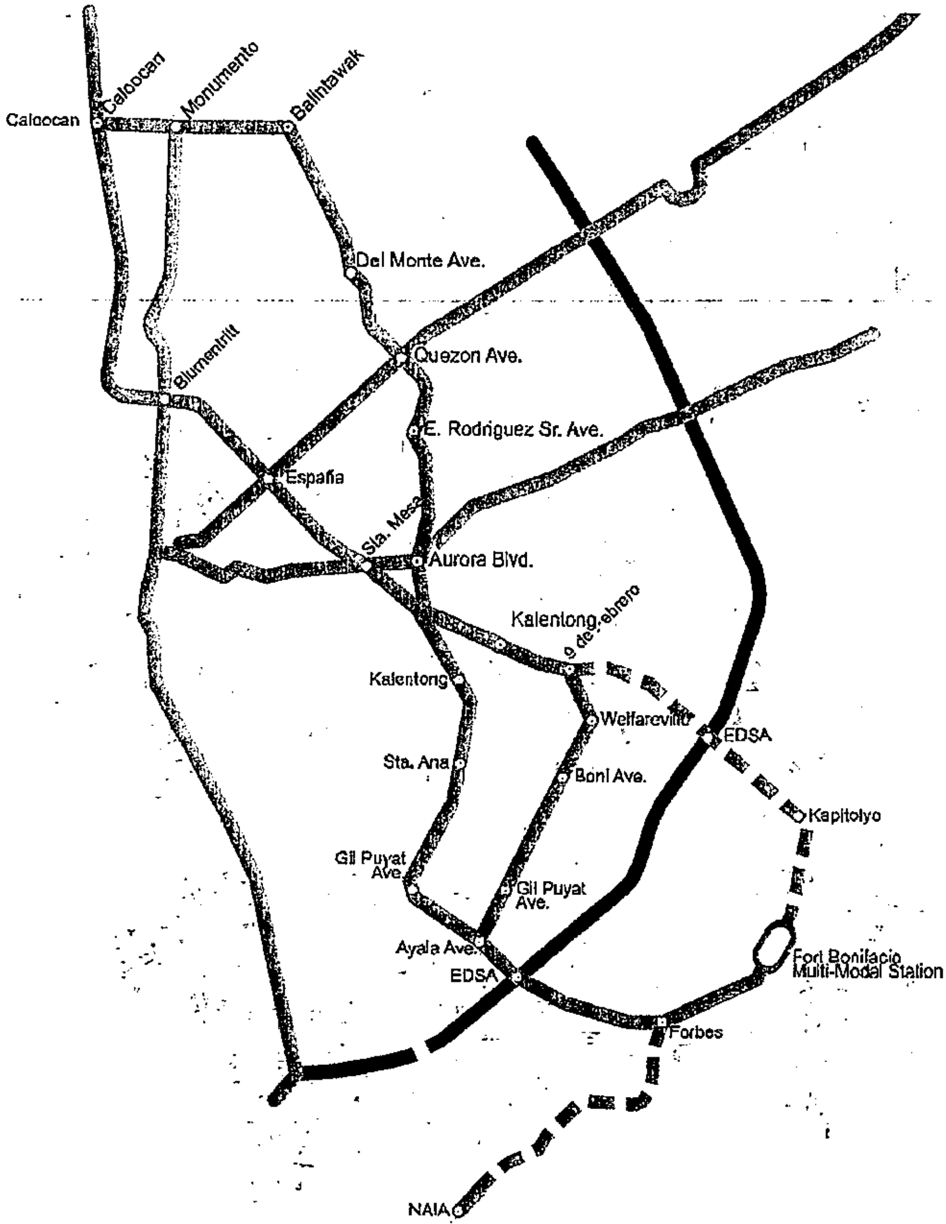
With the thrust of the government to provide a Strong Republic Transit System, the different rail systems currently operating and those that are in the planning stage will all be interconnected at stations where these lines are in proximity to each other.

As for the case of NorthRail, it is currently planned to further extend the MRT III from the previously planned extension from North Avenue to Monumento to the area where the NorthRail and South Rail stations in Caloocan will be constructed. With regards to the connection between NorthRail and South Rail lines, the Caloocan station for both lines will be co-located in the same area, and therefore both systems will be fully interconnected at Caloocan.

Please refer to the following diagram of the Strong Republic Transit System's proposed interconnecting stations.


TO:
Caloocan
Monumento
5th Ave.
R. Papa
Abad Santos
Blumentritt
Tayuman
Bambang
Tayuman
D. Jose
Recto
Carriedo
Central
UN Ave.
Pedro Gil
Quirino Ave.
Vito Cruz
Buendia
Libertad
Pasay
Baclaran
Laong Laan
España
Legarda
Sta. Mesa
Pandacan
Pedro Gil
Vito Cruz
Buendia
Pasay Road
Magallanes
V. Mapa
J. Ruiz
Gilmore
Cubao
Anonas
Katipunan
Santolan
North Ave.
Quezon Ave.
GMA - Kamuning
Santolan / Annapolis
Ortigas
Shaw Blvd.
Boni Ave.
Guadalupe
Buendia
Ayala
TO:

The Metro Manila alignment for the NorthRail Project is currently pegged to follow the MRT 5 route, passing from Caloocan, Monumento, Balintawak, C-3 / Araneta Avenue, San Juan, Shaw Boulevard, C-5 and into the Fort Bonifacio Global City. However, several other alignments are also being considered. (please refer to alignment drawing below). Please note that in all alignments being considered, there will be interconnection with all the existing (and planned) rail systems.


Caloocan
Caloocan
Monumento
Balintawak
Del Monte Ave.
Quezon Ave.
Blumentritt
E. Rodriguez Sr. Ave.
España
Sta. Mesa
Aurora Blvd.
Kalentong
9 de Febrero
Kalentong
Welfareville
EDSA
Sta. Ana
Boni Ave.
Kapitolyo
Gil Puyat Ave.
Gil Puyat Ave.
Fort Bonifacio Multi-Modal Station
Ayala Ave.
EDSA
Forbes
NAIA

4 Baseline Environmental Conditions

4.1 Introduction

The following sections discuss the environmental conditions of the project site prior to actual construction. Most of the data presented in this Section were taken from EIS of MCRRS Phase 1A-2 prepared by NLRC and TCI which, as previously mentioned in this Report, is the same project as the Caloocan – Valenzuela of the NorthRail Project. Where necessary, some of the data were updated. References to the data were made consistent for this Project.

The primary impact area considered as may be directly affected by the project implementation is the PNR ROW from Samson Road at Caloocan City up to the boundary of Valenzuela City in Metro Manila and Meycauayan in Bulacan including the NFA property where the Depot will be constructed. The secondary impact area or area of influence considered is some 250 meters from the center of the existing rail line. This is the extent of the area that will likely be most affected by noise generated by heavy construction equipment without noise barrier. For the socio- economic effect of the Project, the impact area could be all areas beyond the PNR ROW.

Taking into account the area that may be directly affected by the project implementation, it was decided that the area within the PNR ROW is considered the Primary Impact Area and the areas about 250 m from the center of the railway line as the influence or secondary impact area. The 250 m distance is chosen as this is the extent of the area that will likely be most affected by noise generated by heavy construction equipment without noise barrier.

It should be noted that relocation activities have already been completed in the Caloocan section of this Project.

Baseline information on air, water and socioeconomics were taken in areas near the proposed depot. In addition, NorthRail (through its contractor), will take baseline environmental data on air and water prior to construction. The result of these undertakings will be submitted to the EMB.

As documented in the initial EIS, the location of the depot was originally situated in Valenzuela for the following reasons:

1. It is a fairly vast area with enough length along the PNR ROW and is therefore easily accessible.

2. The land is government owned, and presumably, the project being an endeavor of the government, negotiations would have been straight forward between NorthRail and the National Food Authority (NFA).

Discussions and negotiations were conducted between NorthRail and NFA over 6 years (1997 to 2003) but no agreements were made. NorthRail then actively sought and identified 7 potential depot sites but due to budget constraints, NorthRail could not pursue the site which seemed the most favourable in Bocaue.

In 2005 NorthRail identified the east side of the tracks of the PNR Caloocan site as the potential depot site. When the site was identified, NorthRail contracted Halcrow to conduct a baseline environmental and social survey to comply with the EMB's requests and EIA requirements. Focused Group discussions were conducted in Valenzuela, Caloocan and Malabon as part of the public consultation component of the EIA.

It was later discovered PNR had already made a standard agreement with Shoe Mart to develop the land. Finally, NorthRail and PNR decided to share the use of the present PNR depot site and have entered into a MOA which specifically stipulates the following:

1. NorthRail will upgrade facilities by constructing a new depot

2. Heavy maintenance will not be conducted at the site

This is favourable as it reduces costs for the government and it enhances government property. NorthRail will, in the future, construct a larger depot in Clark once the line to Clark begins construction.

Please find attached the baseline study report as Annex AK.

4.2 Physical Environment

4.2.1 *Geology*

(a) Regional / General Geological Map

The Central Luzon area is described as covered by QAL overlying sediments and ultramafle complex (please refer to Figure 4.1). The local geology (please refer to Figure 4.2) along the proposed alignment is underlain by alluvium which is described as of recent origin and consists of boulders, gravel, sand and silt in riverbeds and flood plains.

The area between Valenzuela City and the City of Manila are underlain by the GF. The coastal area is underlain by QAL. The GF Pliocene (Tertiary) to Pleistocene (Quaternary) GF consists of a thick sequence of conglomerate, sandstone, clay stone and pyroclastic rocks. The upper member, Diliman Tuff is thin to medium, fine grained verified tuffs and welded volcanic breccias with subordinate amount of fuffaceous, fine to medium grained sandstone.

Based on the brief history of Caloocan City obtained from the city government, the geological structure of the whole Caloocan City is generally part of the Guadalupe Plateau consisting of GF. Novaliches clay is 27% of the soil and Novaliches clay loam and adobe is 37.8%. However, it could be assumed that surface soils are generally clay and silt with some sandy layers as could be expected in deltaic region.

(b) Geological Cross-sections

In 1996, the Spanish Railways Group (SRG) conducted a field campaign consisting of 12 boreholes, 4 test pits, and 3 cone penetration tests. Site geological reconnaissance were also undertaken to provide valuable information to contrast with characteristics layed-out from laboratory and in situ testing.

TABLE 4-1: SUMMARY OF BOREHOLES PERFORMED BY SRG

Borehole	Depth (m)	Water Level (m)	K.P.	Subject of Investigation	Date	Standard Samples	Undisturbed Samples
BH-101	10.00	0.50	122+020	Alignment	June-96	5	2
BH-102	10.00	4.10	121+040	Alignment	June-96	7	0
BH-103	10.00	1.50	120+380	Alignment	June-96	3	5
BH-104	10.00	0.11	119+100	Alignment	June-96	1	6
BH-105	20.00	0.50	118+650	Tullahan River	June-96	13	0
BH-106	20.00	0.50	118+650	Tullahan River	June-96	13	0
BH-107	10.00	1.26	117+800	Alignment	June-96	7	0
BH-108	30.00	5.70	116+660	Alignment	June-96	11	0
BH-117	16.00	3.96	117+060	Alignment	October-96	2	0
BH-118	36.00	4.50	116+350	Alignment	October-96	6	0
BH-123	11.50	0.00	118+600	Tullahan River	October-96	6	0
BH-124	18.00	2.70	118+200	Alignment	October-96	6	0

Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

Locations of the above site investigations are attached as Figures 4.3 – 4.9 of this Report.

The geotechnical longitudinal profiles of the alignment of this Project are shown in Figures 4.10 - 4.14.

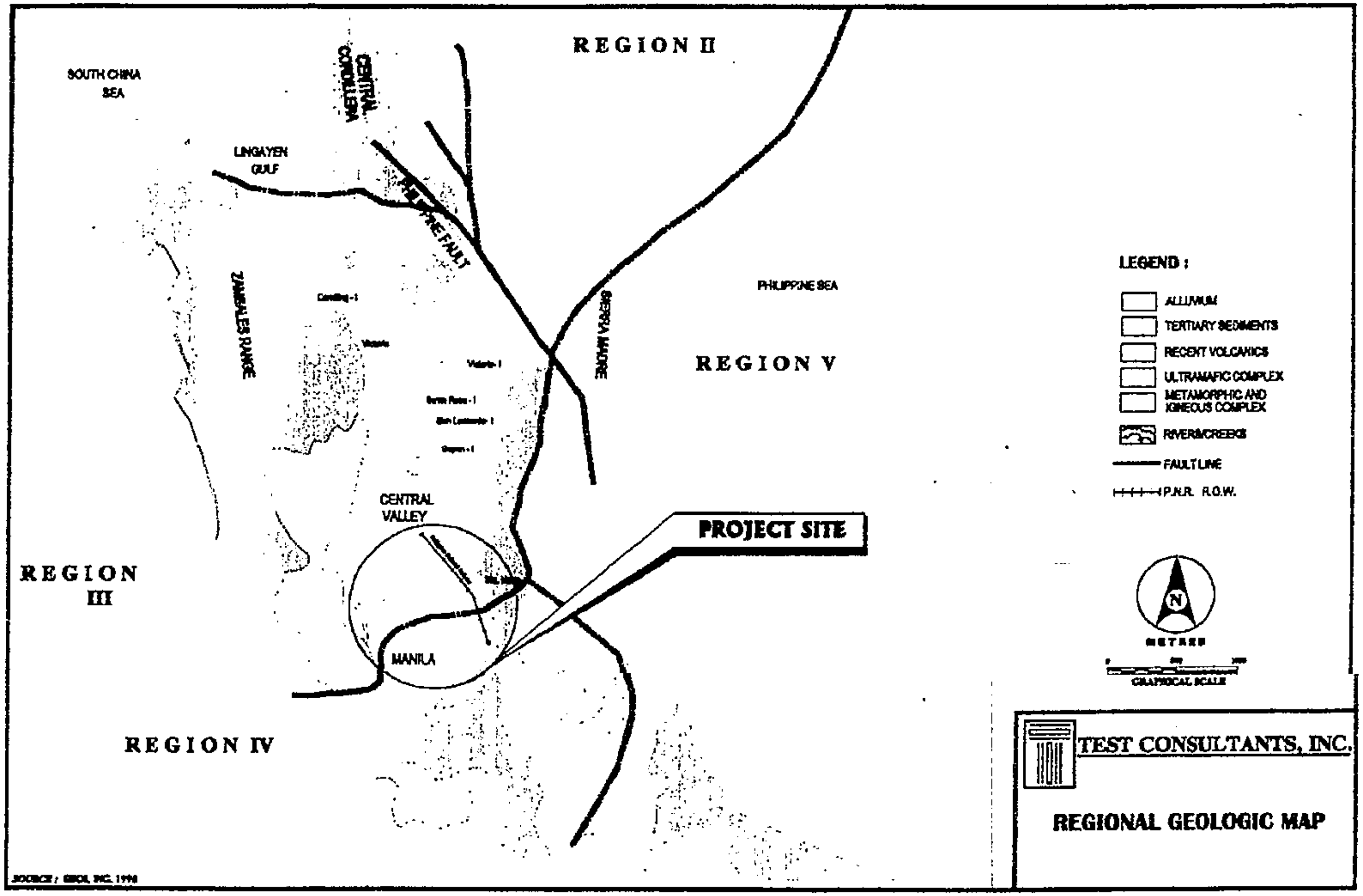


FIGURE 4.1: REGIONAL GEOLOGIC MAP
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

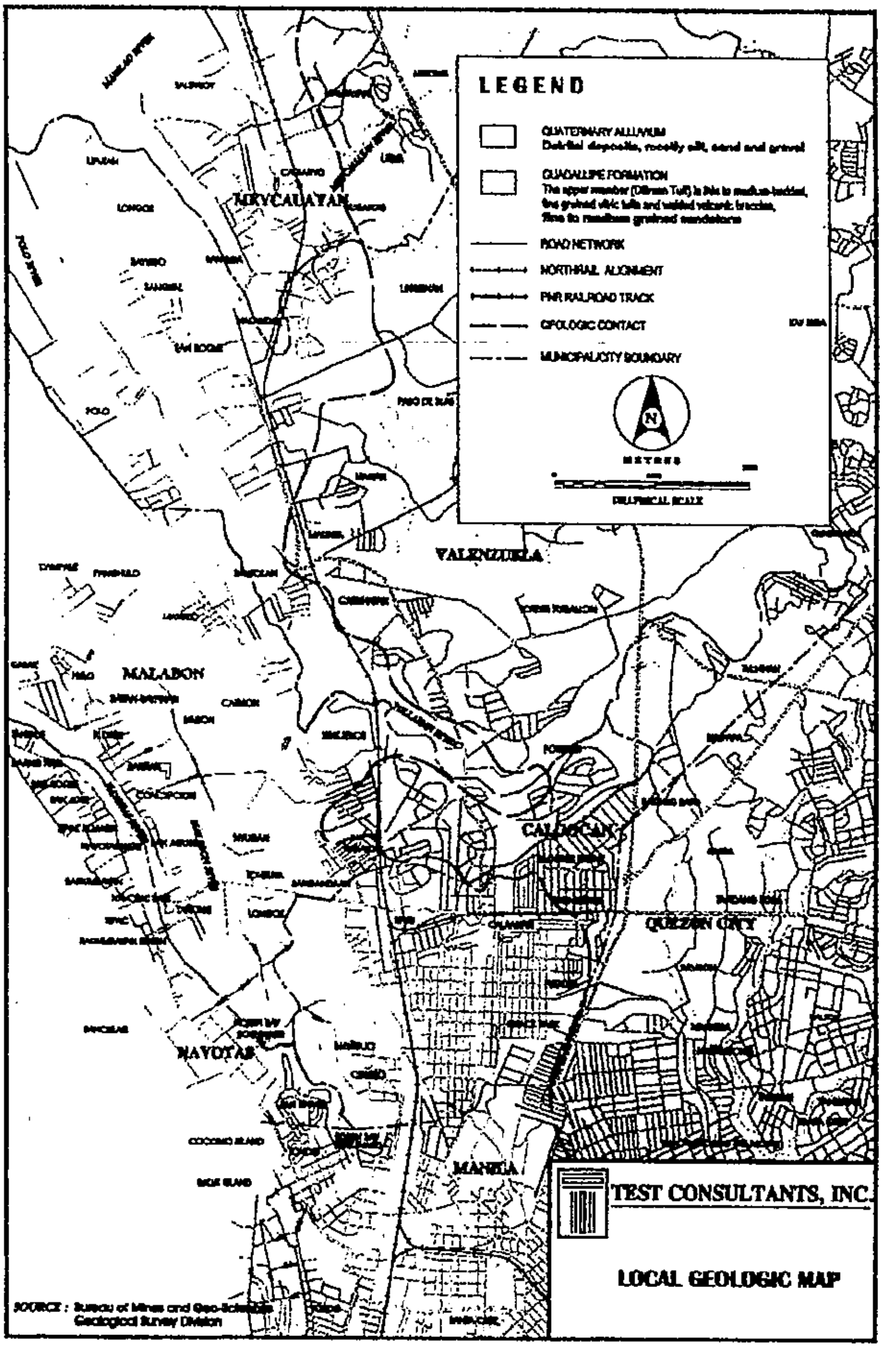


FIGURE 4.2: LOCAL GEOLOGIC MAP
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

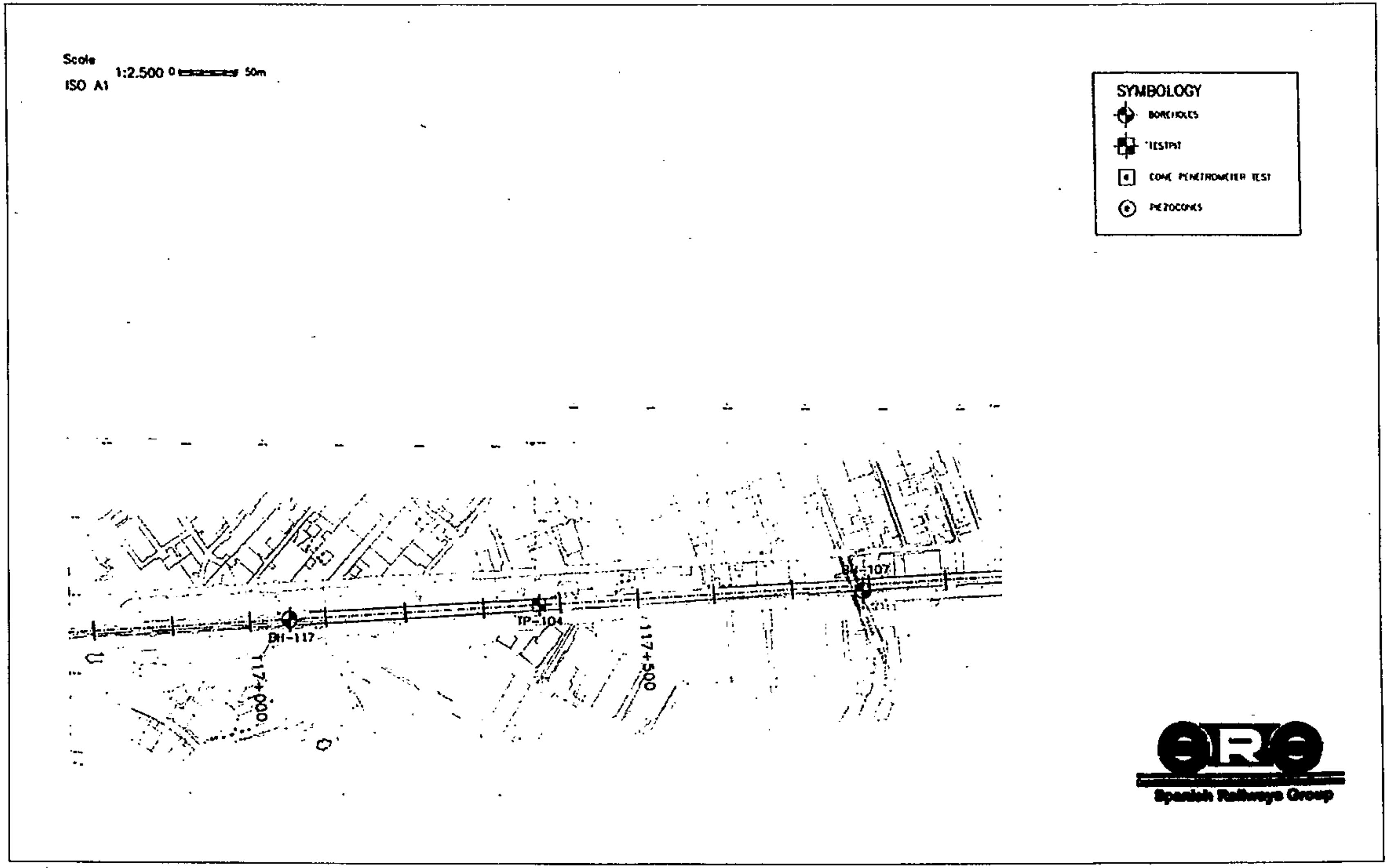


FIGURE 4.4: LOCATIONS OF SITE INVESTIGATIONS (2 OF 7)
Source: CEW-A-03-03 Site Investigation MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

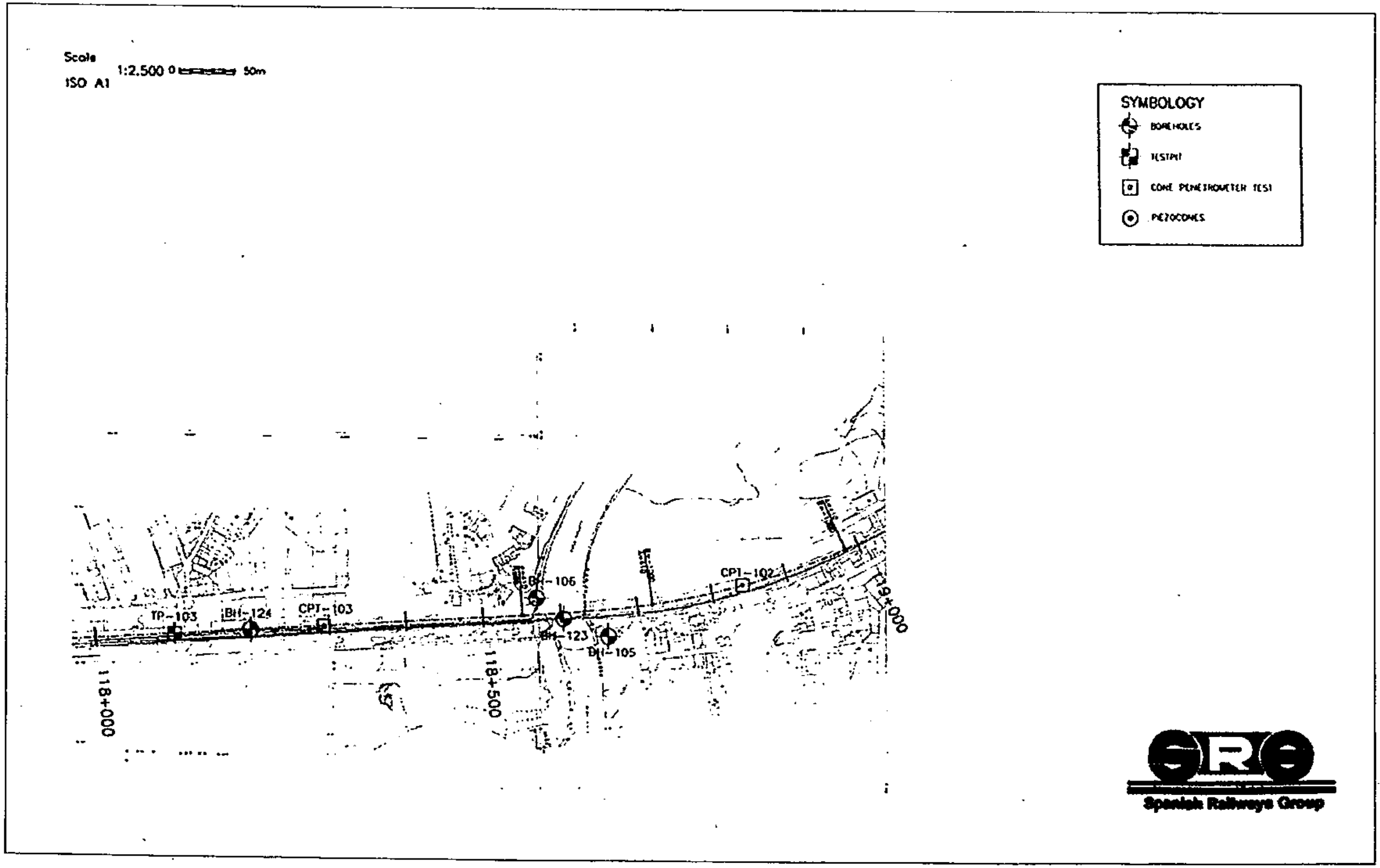


FIGURE 4.5: LOCATIONS OF SITE INVESTIGATIONS (3 OF 7)
Source: CEW-A-03-03 Site Investigation MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

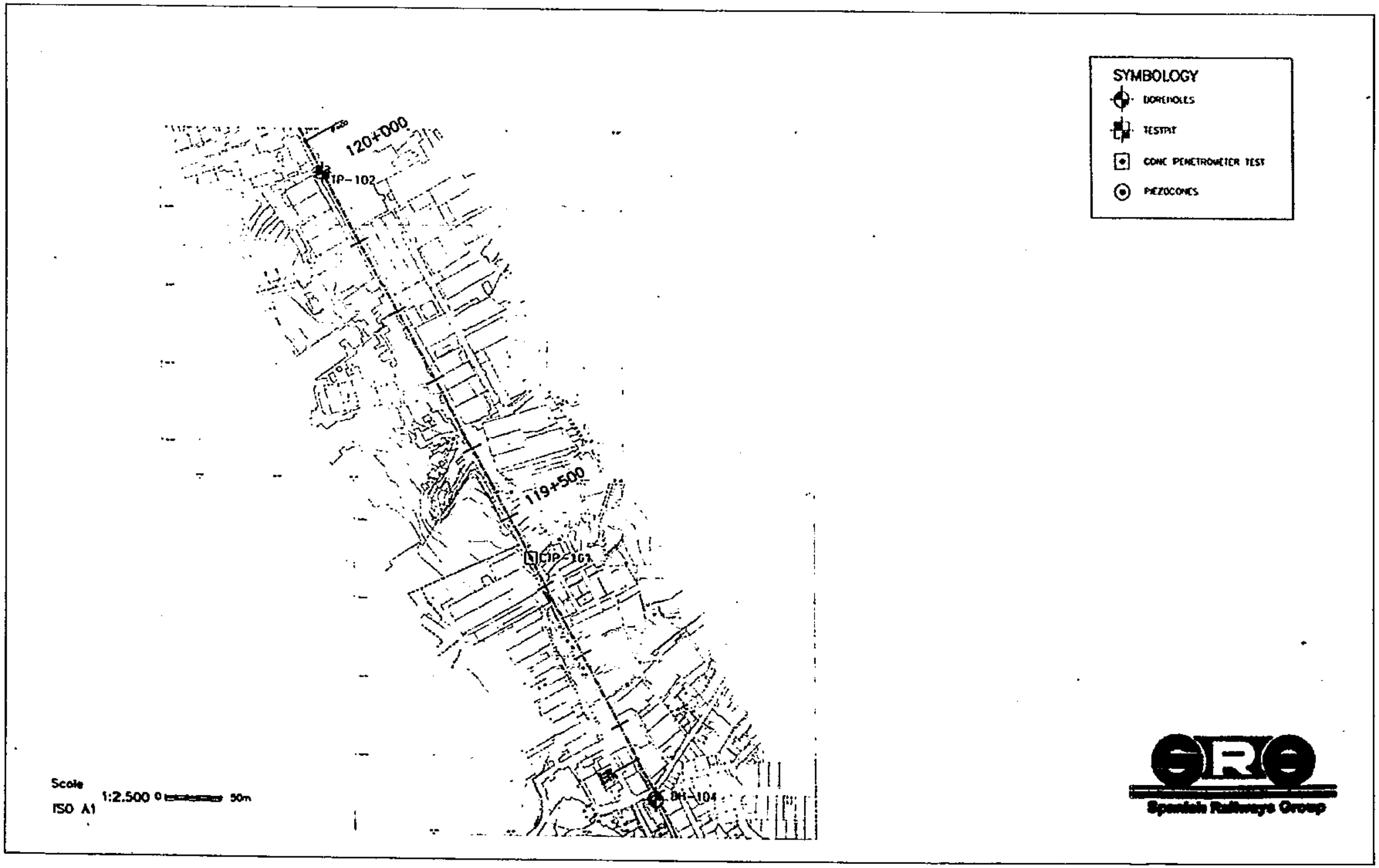


FIGURE 4.6: LOCATIONS OF SITE INVESTIGATIONS (4 OF 7)
Source: CEW-A-03-03 Site Investigation MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

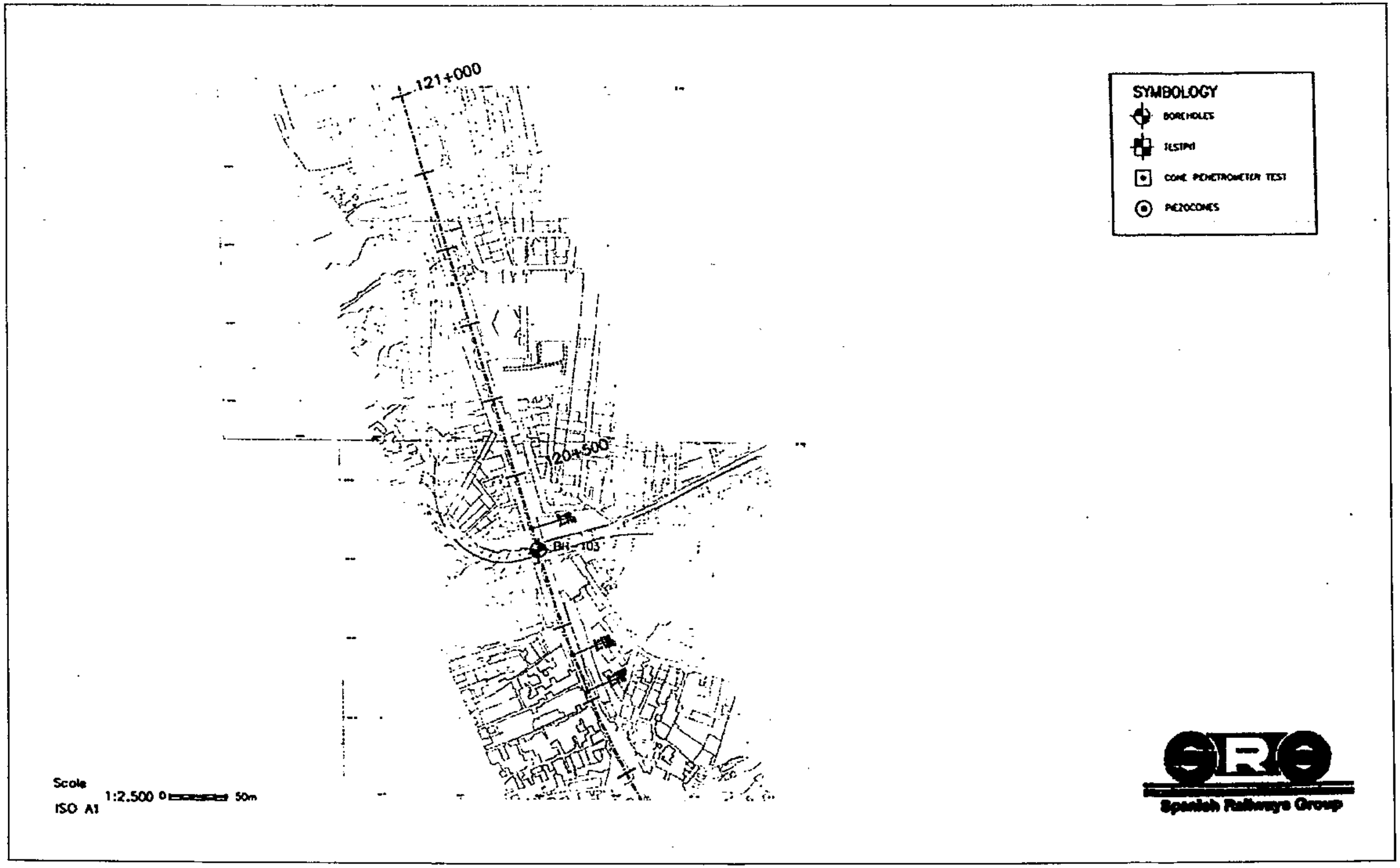


FIGURE 4.7: LOCATIONS OF SITE INVESTIGATIONS (5 OF 7)
Source: CEW-A-03-03 Site Investigation MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

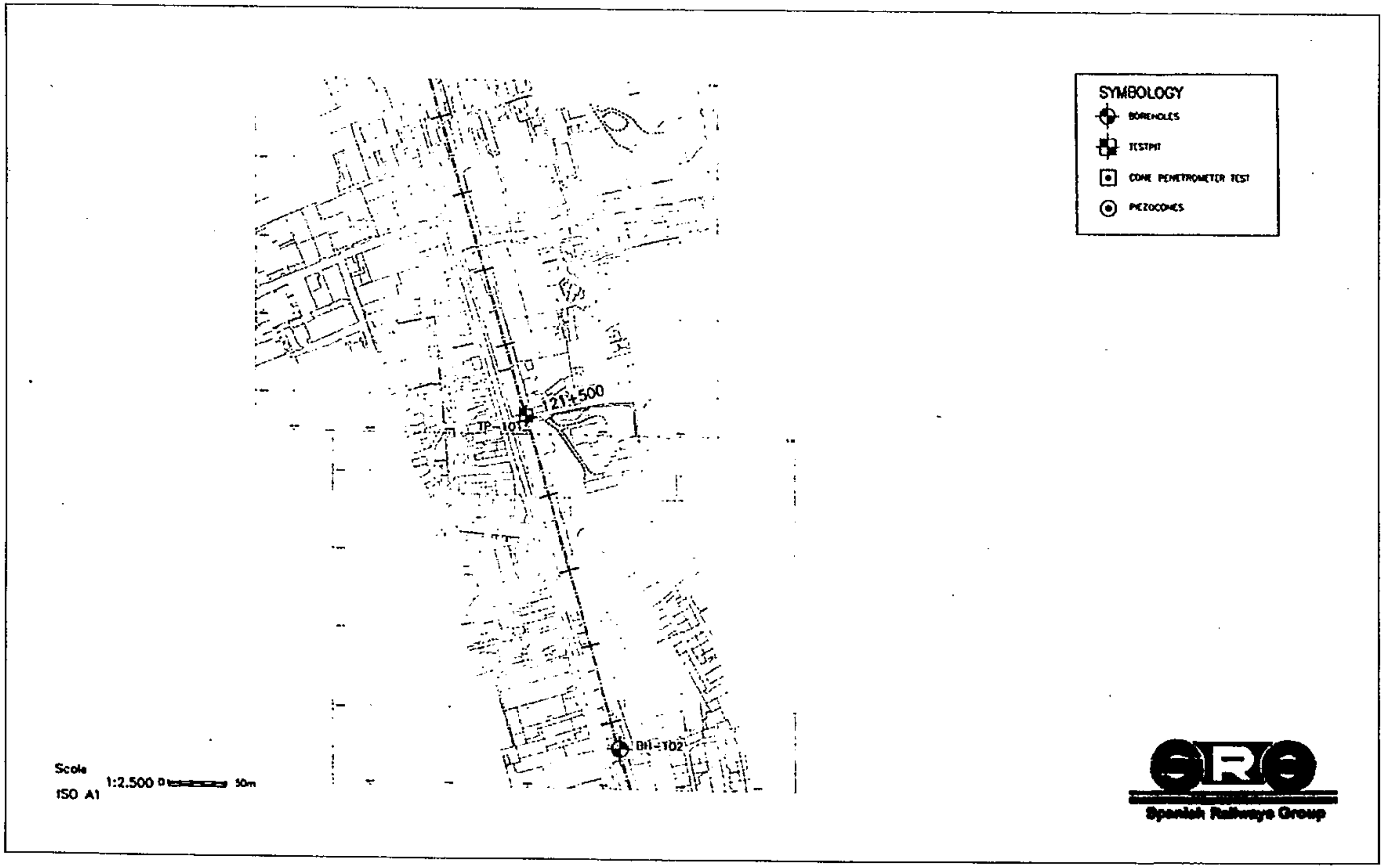


FIGURE 4.8: LOCATIONS OF SITE INVESTIGATIONS (6 OF 7)
Source: CEW-A-03-03 Site Investigation MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

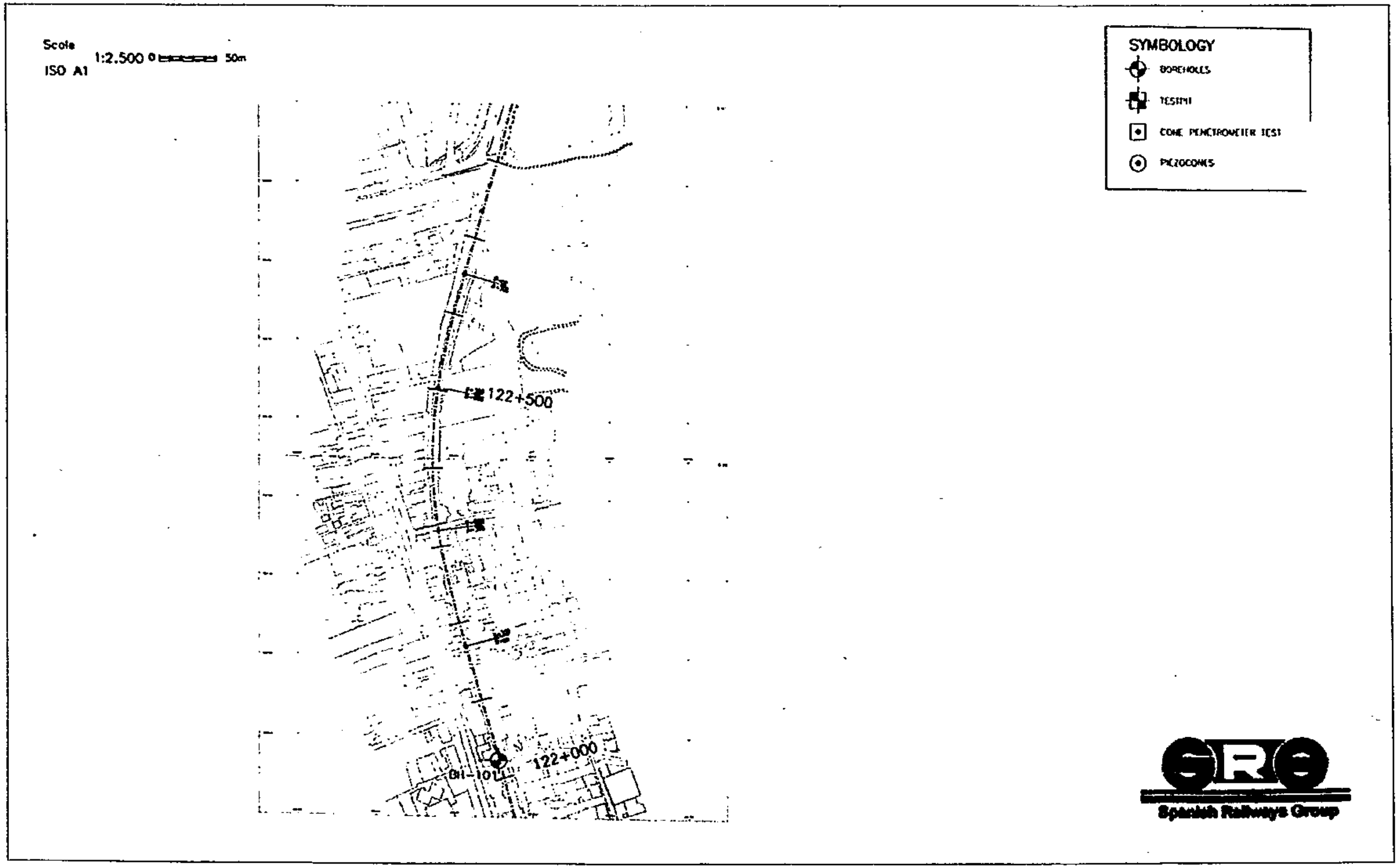


FIGURE 4.9: LOCATIONS OF SITE INVESTIGATIONS (7 OF 7)
Source: CEW-A-03-03 Site Investigation MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

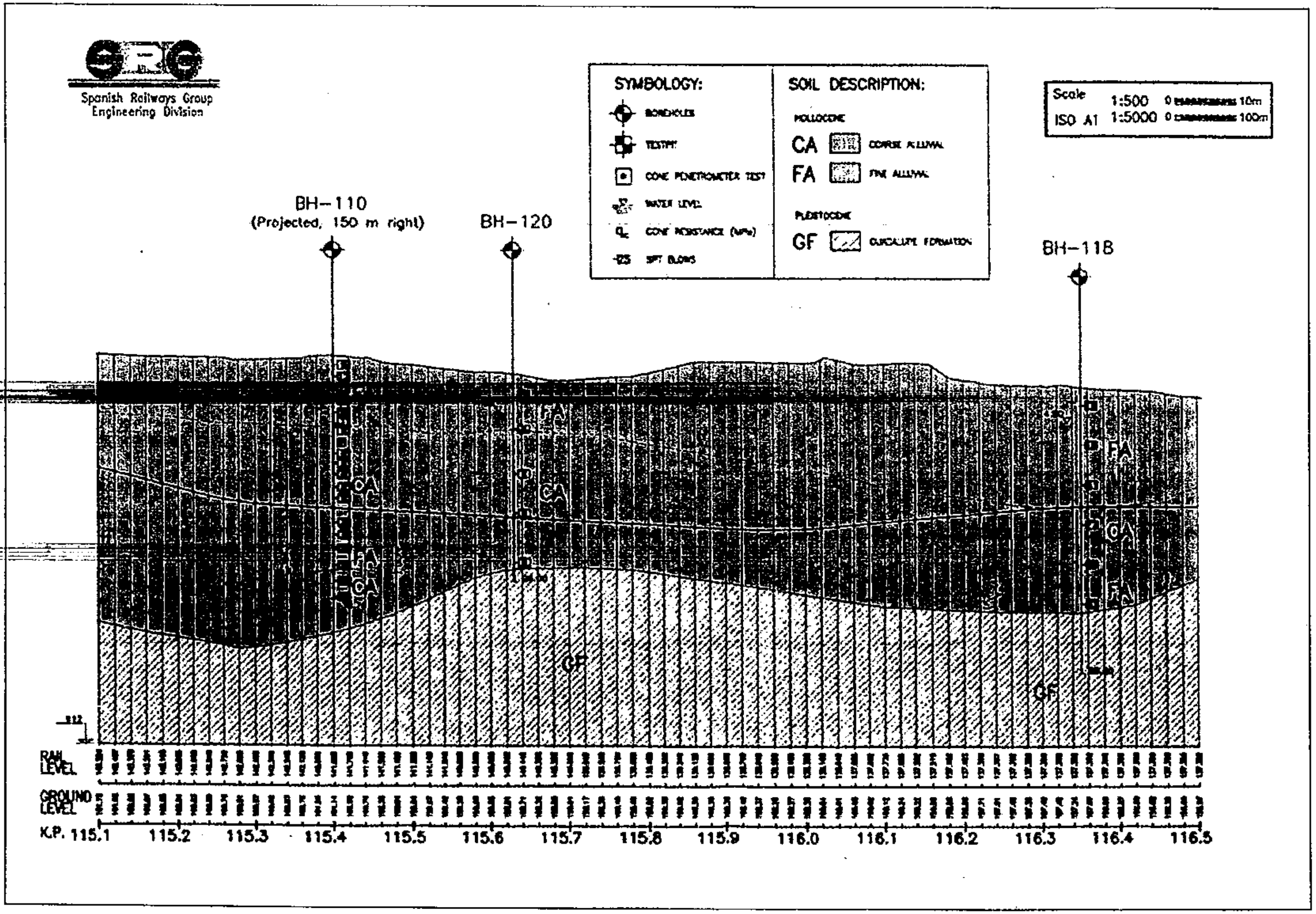


FIGURE 4.10: GEOTECHNICAL LONGITUDINAL PROFILE (1 OF 5)
Source: CEW-A-05-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

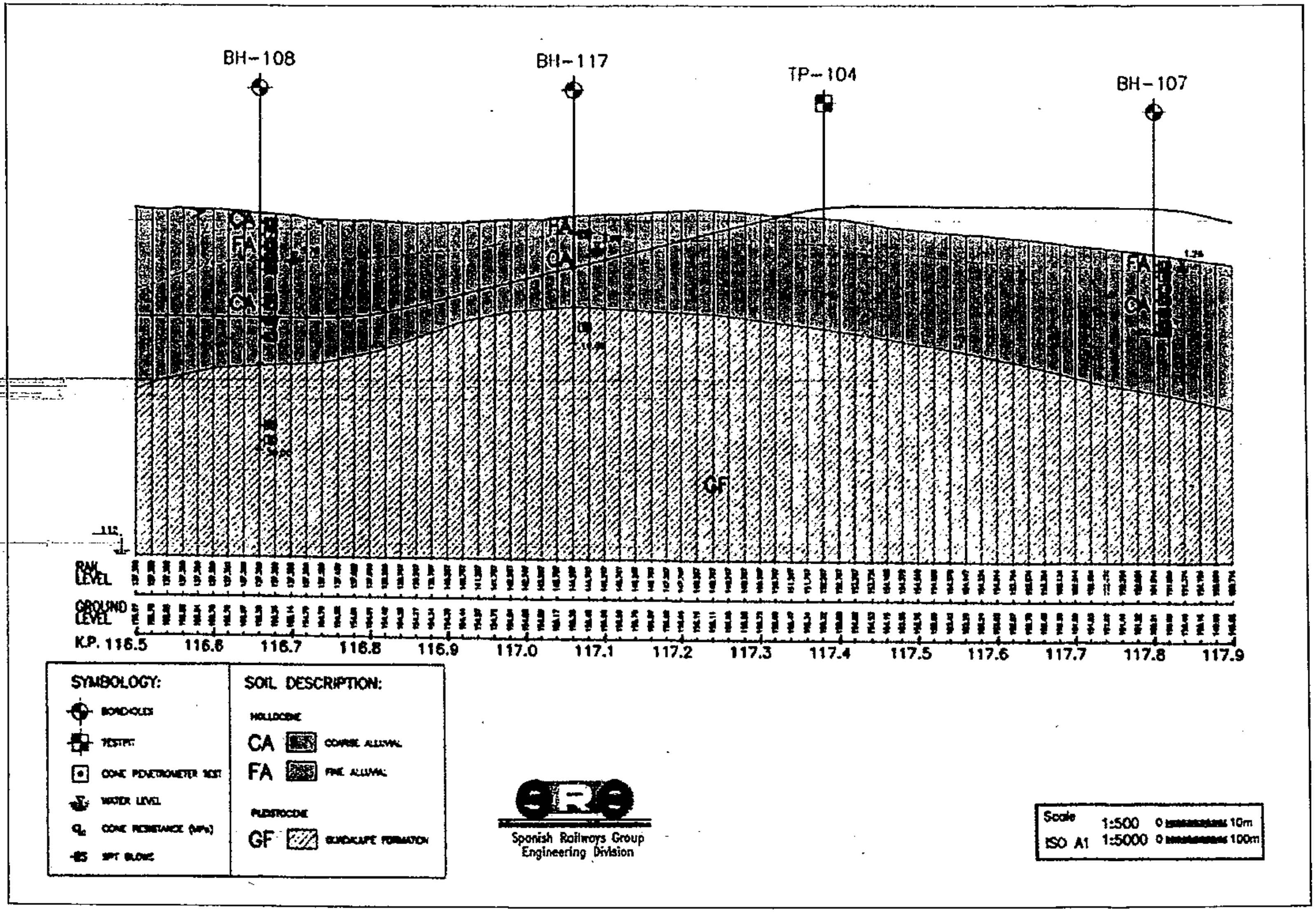


FIGURE 4.11: GEOTECHNICAL LONGITUDINAL PROFILE (2 OF 5)
Source: CEW-A-05-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

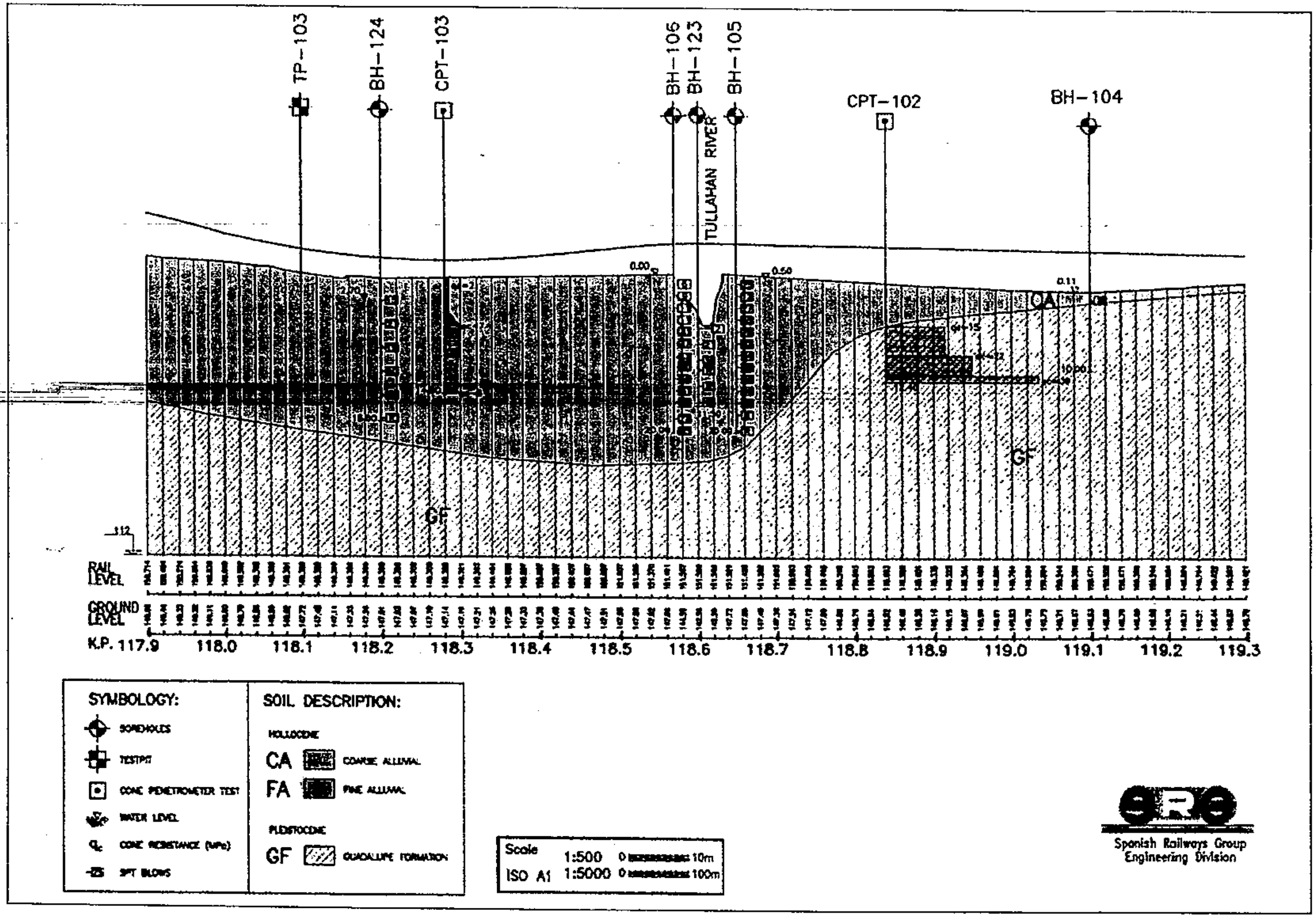


FIGURE 4.12: GEOTECHNICAL LONGITUDINAL PROFILE (3 OF 5)
Source: CEW-A-05-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

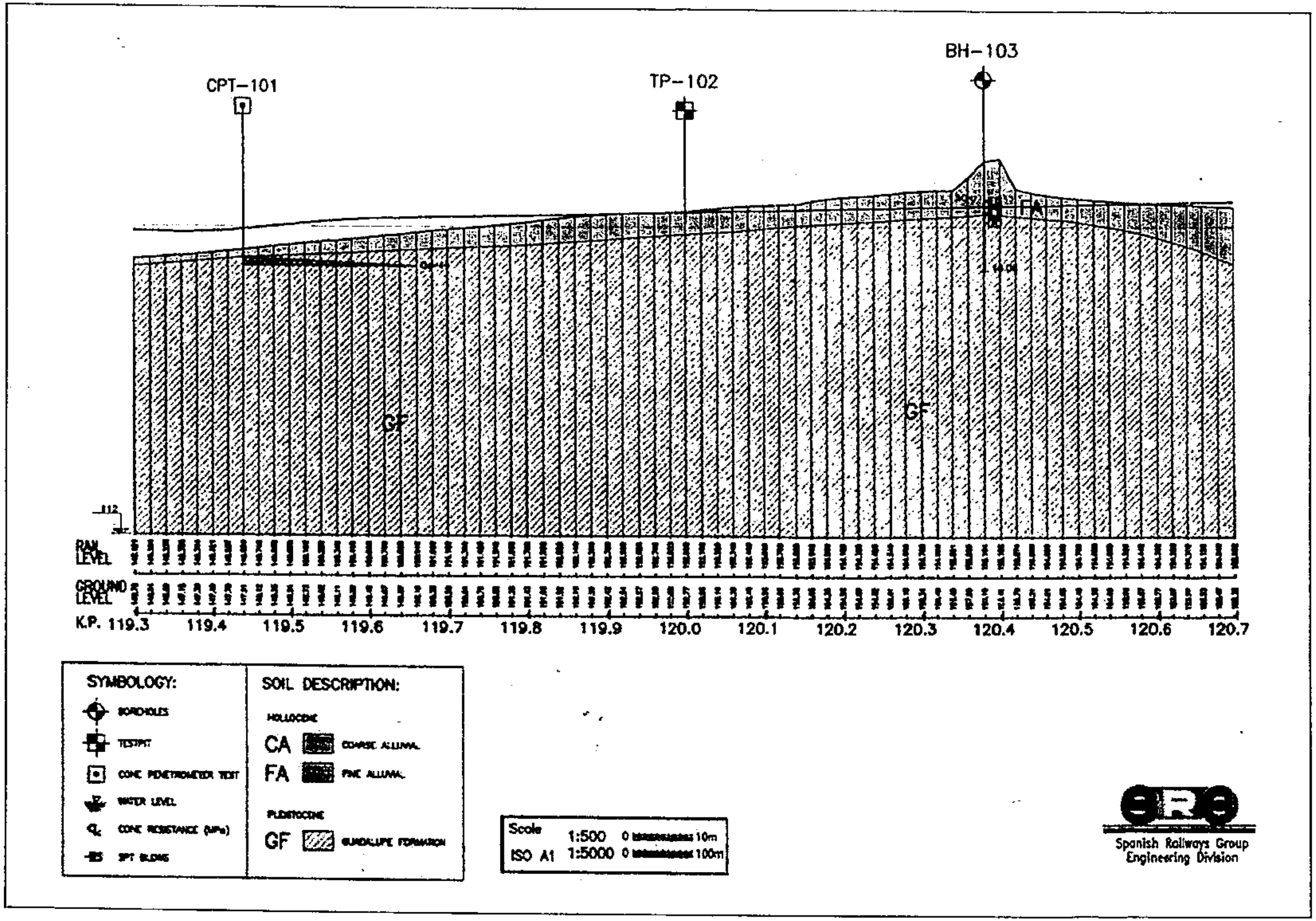


FIGURE 4.13: GEOTECHNICAL LONGITUDINAL PROFILE (4 OF 5)
Source: CEW-A-05-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

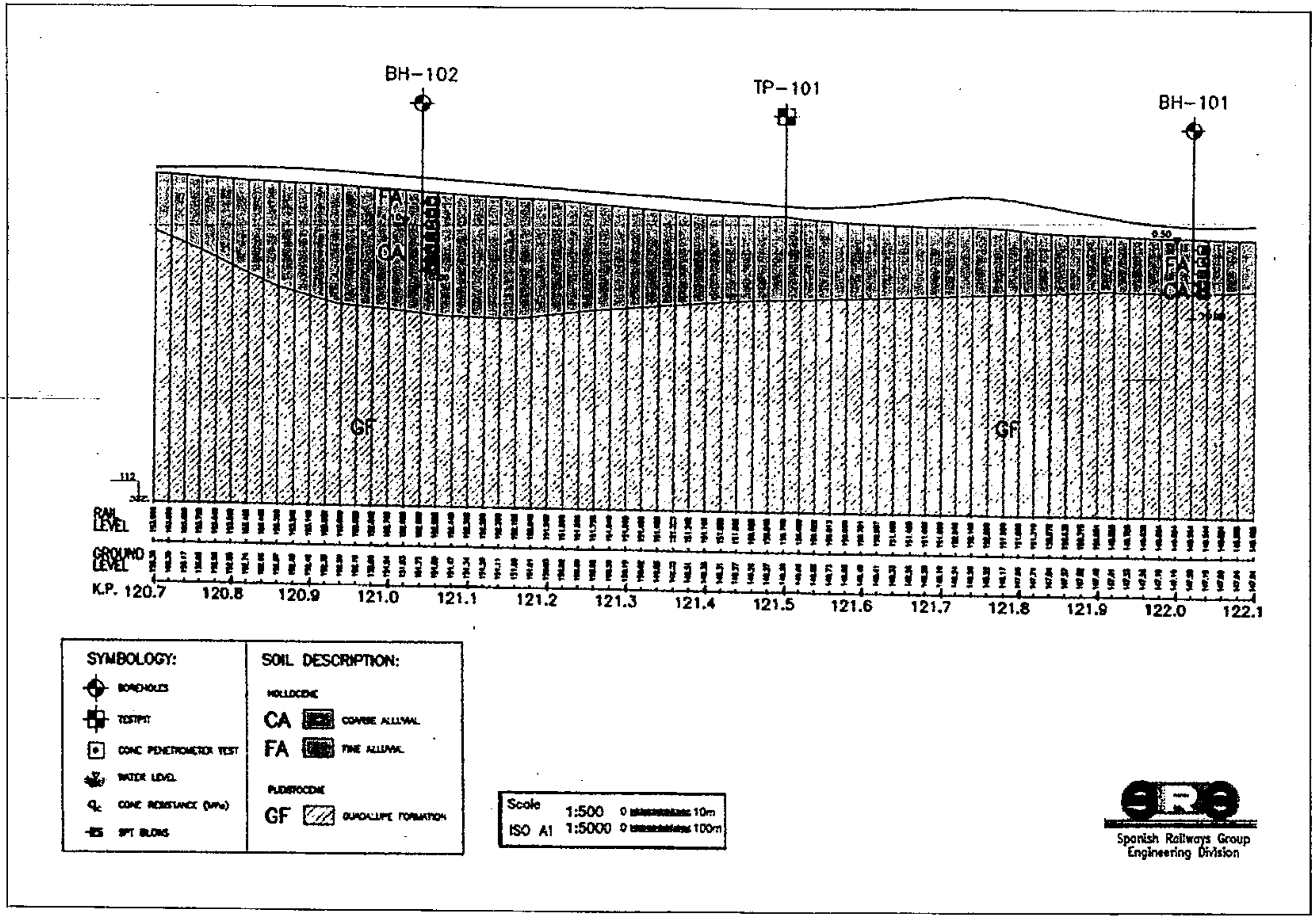


FIGURE 4.14: GEOTECHNICAL LONGITUDINAL PROFILE (5 OF 5)
Source: CEW-A-05-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

(c) Sequence of Stratigraphic Column of Rock Samples

Table 4.2 below describes the local geology and stratigraphy.

Table 4.2: Local Geology and Stratigraphy

Geological Age	Formation	Lithology
Recent	Alluvium	Boulders, gravel, sand and silt in river beds and flood plains
Pleistocene	Guadalupe Formation	Tuff, tuffaceous sandstone, claystone and conglomerate
Pilocene	Tartaro Formation	Mudstones and clayey sandstone
Upper Miocene	Makapilapil Formation	Tuffaceous sandstone and siltstone sequence with lenses of conglomerate limestone
	Lambak Shale	
Middle Miocene	Madlum Formation	Limestone, volcanic-andesite flows, agglomerate; tuff, tuffaceous, sandstone and shale; clastic facies of sandstone, shale and clonglomerates
Early Miocene	Angat Formation	Limestone layers interlayed by clastic shale units
Early Miocene	Angat Formation	Limestone layers interlayed by clastic shale units
Oligocene	Unconformity	
Late Cretaceous Basement	Complex	Ophiolitic volcanics, gabbros and meta-sedimentary rocks

Source: Annex A-3 MCRRS Phase 1A-2 EIS, Test Consultants, Inc. (Geos, Inc. 1995)

(d) Geomorphological Map

The Central Luzon Basin is geomorphologically bounded by three prominent mountain ranges – the Central Cordillera and Carballo Mountains in the north, the Zambales Range in the west, and the Southern Sierra Madre in the east. To the south are Taal Volcano and other dormant volcanoes such as Mt. Batulao and Mt. Banahaw. In the middle of Central Luzon is Mt. Arayat. These geomorphic features are the result of the collision of the Oceanic Philippine Sea Plate from the east and the Continental Asia Sea Plate from the west (please refer to Figure 4.15). Figure 4.16 is an interpretative crustal section across Central Luzon illustrating the geometric relationship of oceanic crustal blocks to several tectonic terrains. The plate boundaries are defined by deep oceanic trenches and troughs, interpreted to lie on the east along the Philippine Trench and along the East Luzon Trough; and on the west along the Manila Trench and Luzon Trough, and on the south along Negros Trench and Cotabato Trench. Preserved on the Luzon Island arc complex are remanant magmatic and volcanic arcs, ophiolite slabs and associated melanges, sedimentary Central Luzon Basin and other basins, folds, thrust belts, and faults which record a complex history deformation.

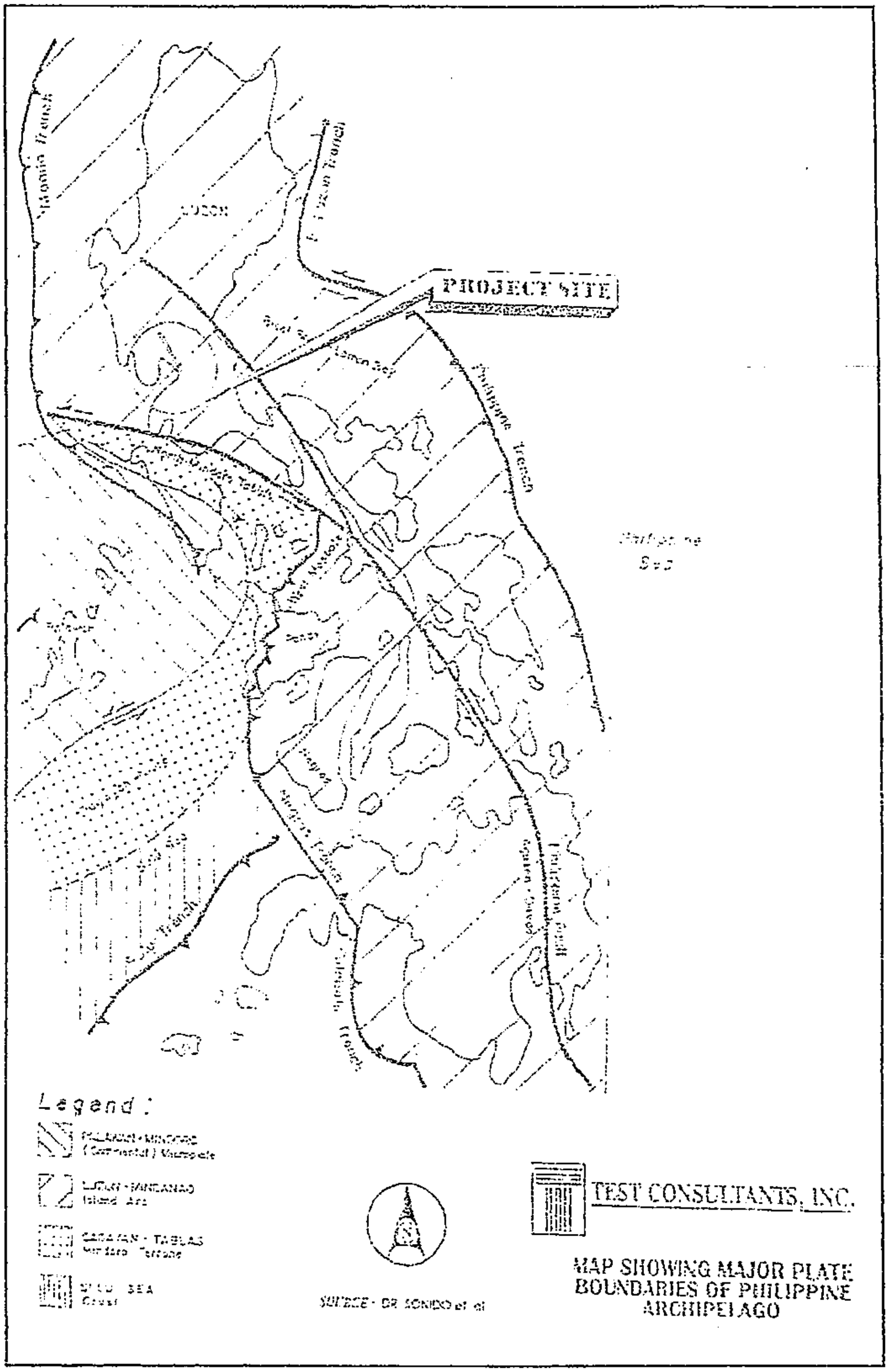


FIGURE 4.15: MAP SHOWING MAJOR PLATE BOUNDARIES OF PHILIPPINE ARCHIPELAGO
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

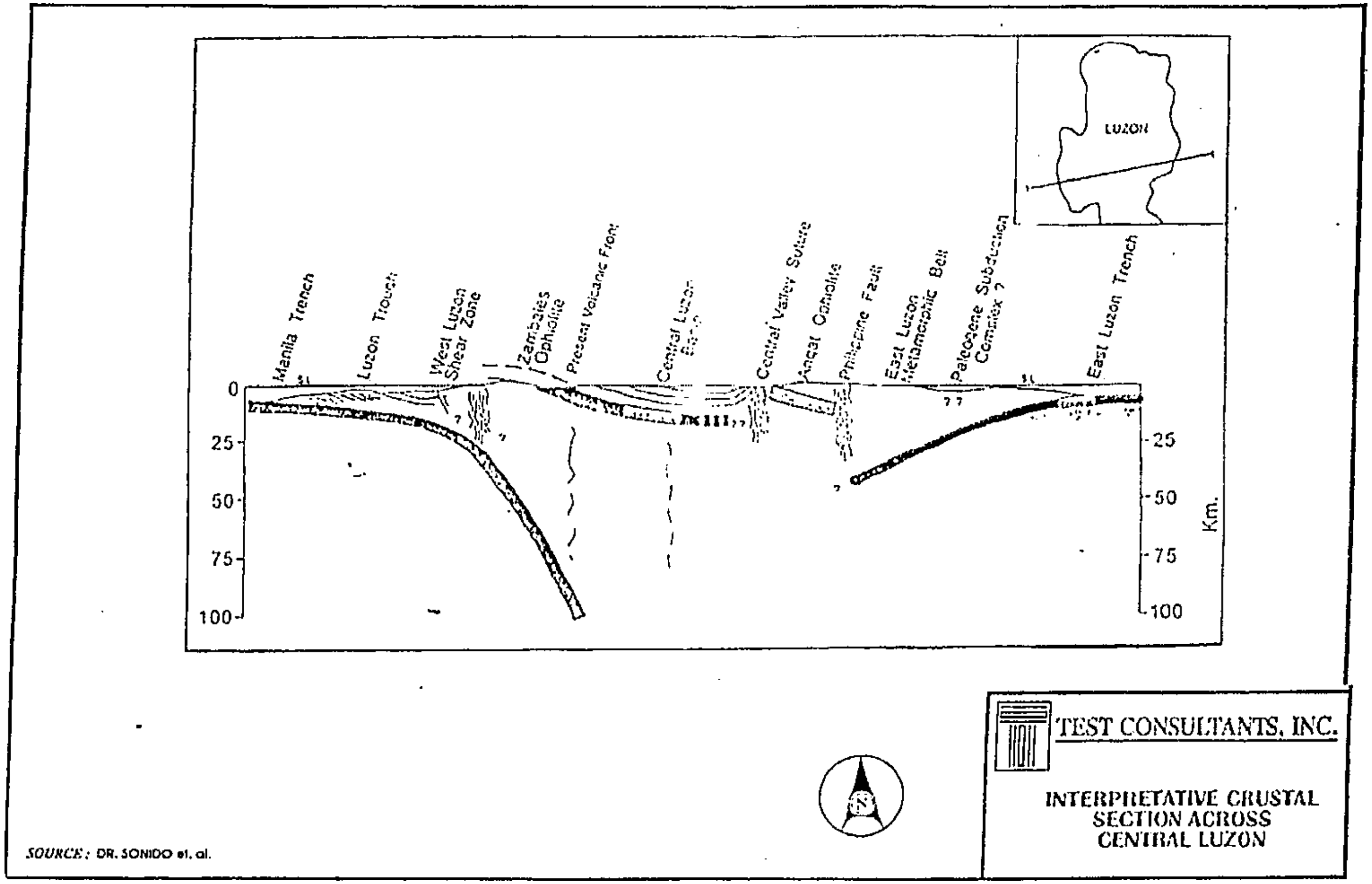


FIGURE 4.16: MAP INTERPRETATIVE CRUSTAL SECTION ACROSS CENTRAL LUZON

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc

The NorthRail corridor from Caloocan City to Meycauayan is mainly underlain by GF and some portions by QAL. East of the PNR ROW are some 5% slope rating or gently sloping, undulating terrain due to GF; and west of the PNR ROW, the slope ratio of less than 1% or level to nearly level terrain can be observed which is attributed to the QAL (please refer to Figures 4.17– 4.21).

(e) g factor Contour Map for Rocks
The G – Factor Contour Map of the Acceleration at 10% Probability of being exceeded in 50 years at Magnitude (M) = 7 for:

- Rock = 0.22 g
- Soft Soil = 0.61 g
- Medium soil = 0.40 g

The Association of Structural Engineers in the Philippines recommends that the Peak Ground Acceleration (PGA) of not less than 0.4 g should be applied, except in Palawan.

Please refer to Figure 4.20 for the acceleration in rocks with 90% probability of not being exceeded in 50 years.

(f) g factor Contour Maps for Medium Soils
Please refer to Figure 4.21 – 4.23 for the acceleration in soils (soft soils, medium soils and hard soils) with 90% probability of not being exceeded in 50 years.

(g) Seismicity Map
Seismotectonic Map (Figure 4.25) shows the distribution of epicenters of earthquakes with magnitude greater or equal to 6, which have caused great destruction to the region for many years.

Tectonic Map (Figure 4.24) shows the subduction zones and faults that are associated with the strong earthquakes. From the project site to a radial distance of 200 km away Table 4.3 shows the earthquake generators, with R as the shortest distance from fault to project site.

TABLE 4-3: RADIUS AND MAGNITUDE OF EARTHQUAKE GENERATORS OF PROJECT SITE

Earthquake Generators	Radius (R)	Magnitude (M)
Active Faults:	Philippine Fault (100 km)	7.8
	Casiguran Fault (100 km)	7.31
	Lubang Fault (100 km)	7.6
	West Marikina Valley Fault (15 km)	6.5
Oceanic Trenches:	Manila Trench (175 km)	7.6
	Philippine Trench (250 km)	7.4

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

The intensity of an earthquake in an environmentally affected area is dependent on the recorded Richter - Scale, M. When no recorded observations are available, an empirically computed magnitude is adopted considering the minimum distance of the earthquake source from the project site or R, and the geological nature of the rock or soil at the project site. The PGA is the horizontal acceleration to which the structures will be subjected to. The PGA for the West Marikina Valley Fault is equal to 0.4g.

The West Marikina Valley Fault (WMVF) is the western component of the fault system which is a north – northeast trending 80 km long fault structure that can be traced as far as Angat, Bulacan and extends southward to Taal Lake, Batangas Province, where it is displaced by an east-west trending fault. The WMVF traverses the area west of Laguna de Bay and dips steeply to the east as a normal slip fault. On the opposite side is the East Marikina Valley Fault (EMVF) which ends at about a few kilometers north of Laguna de Bay. It is a normal slip fault dipping to the west. Thus, Marikina Valley is a graben structure.

(h) Results of Geochemical Analyses of Rock Samples

The results of the soil analyses conducted by SRG are summarized in Figures 4.26 – 4.40.

4.2.2 *Pedology*

(a) Land use Map

A large portion of the alignment passes through urban-urbanizing areas (please refer to Figures 4.41 – 4.43). The areas within the PNR ROW have been occupied by informal settlers. However, some business establishments are legitimately occupying the PNR ROW having been awarded a leasehold permit from the PNR Management.

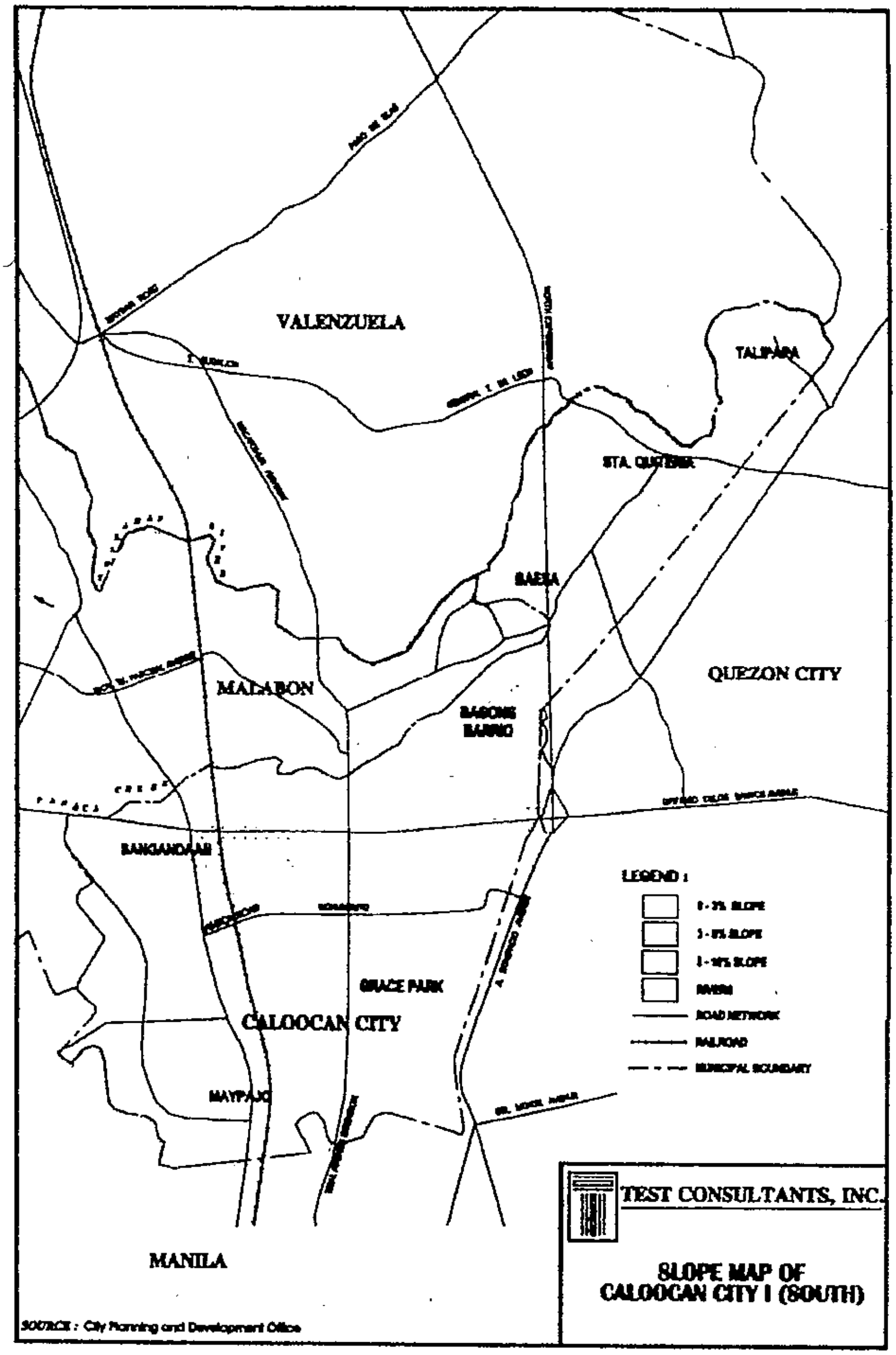


FIGURE 4.17: SLOPE MAP OF CALOOCAN CITY 1 (SOUTH)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

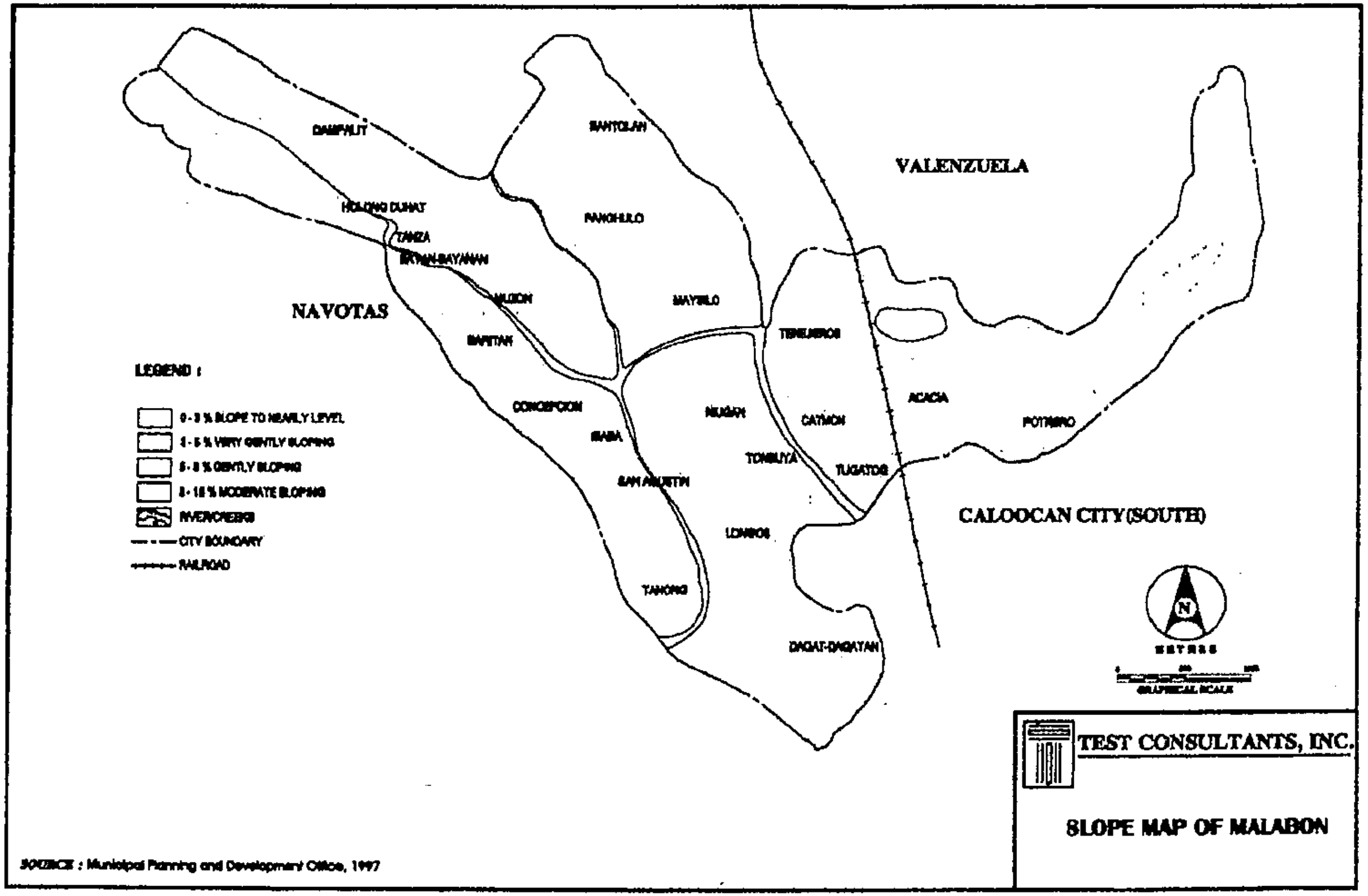


FIGURE 4.18: SLOPE MAP OF MALABON CITY
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

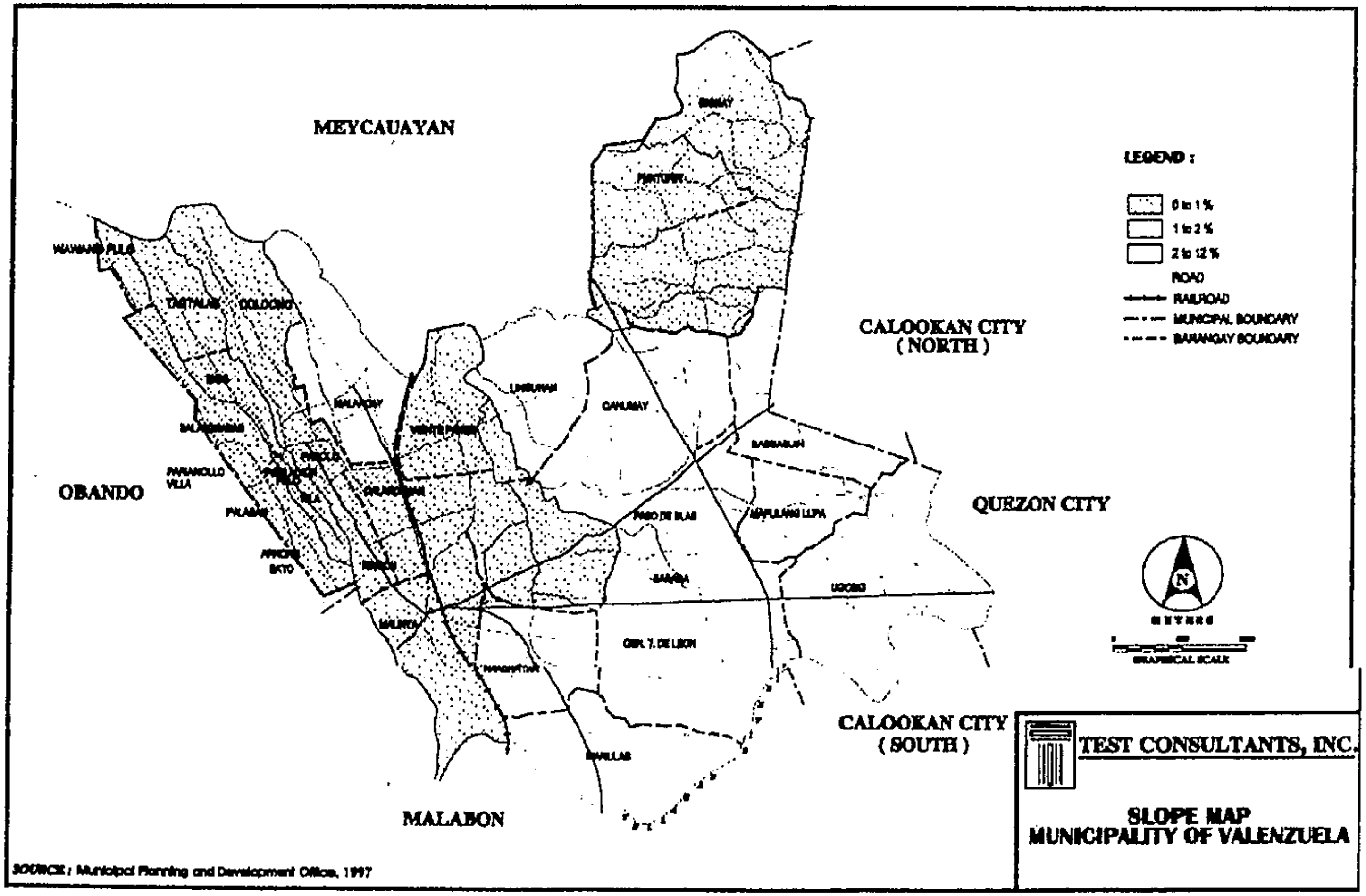


FIGURE 4.19: SLOPE MAP OF VALENZUELA CITY
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

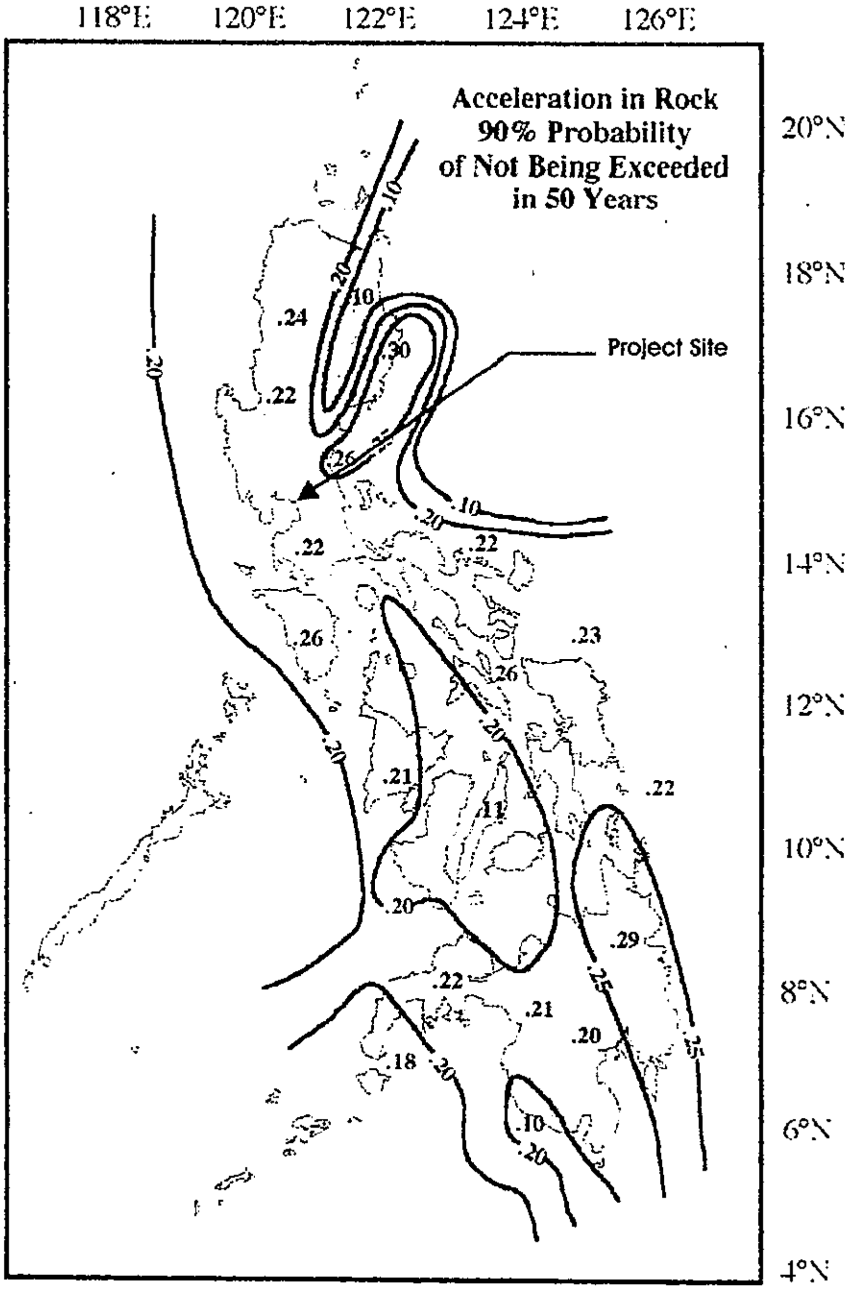


FIGURE 4.20: ACCELERATION IN ROCK
(Not to scale)
Source: PHIVOLCS

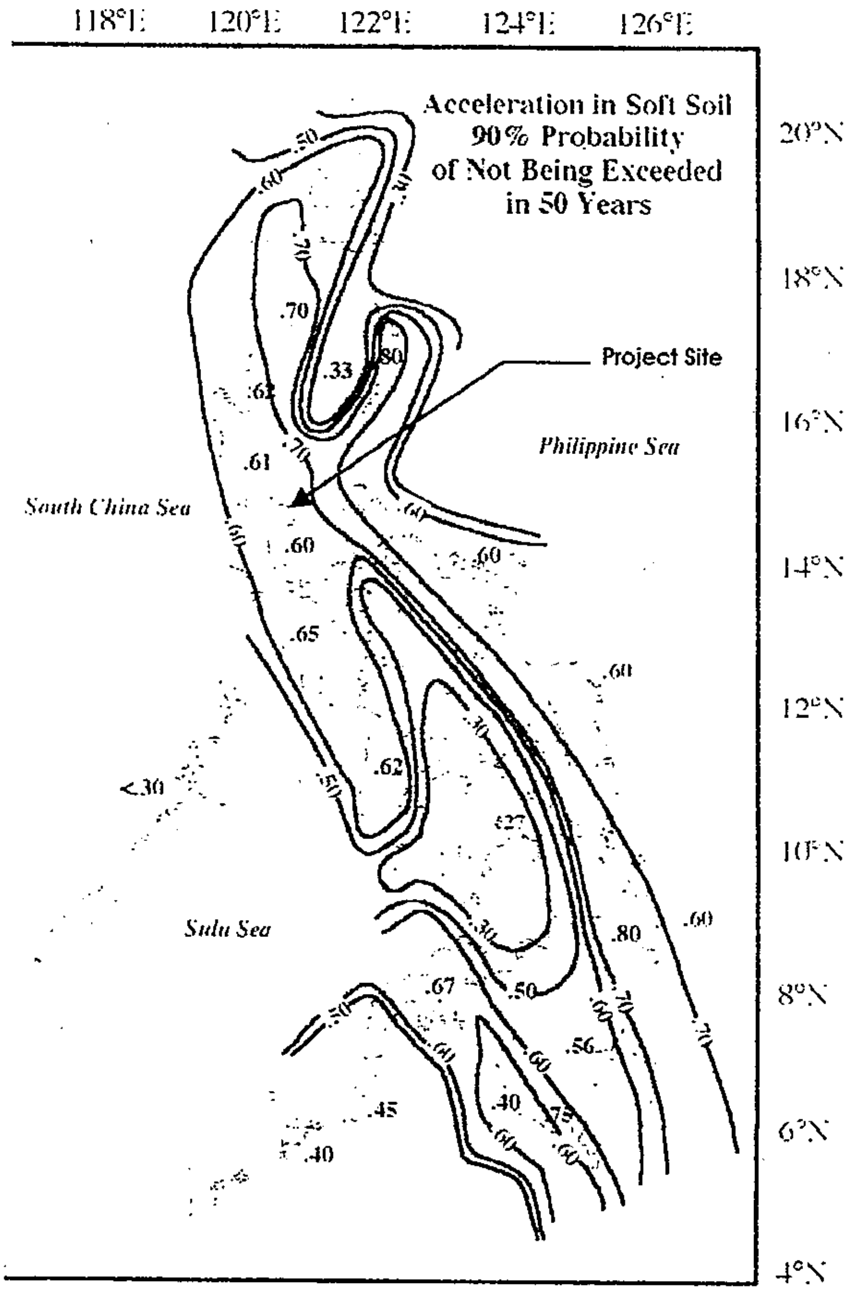


FIGURE 4.21: ACCELERATION IN SOFT SOIL
(Not to scale)
Source: PHIVOLCS

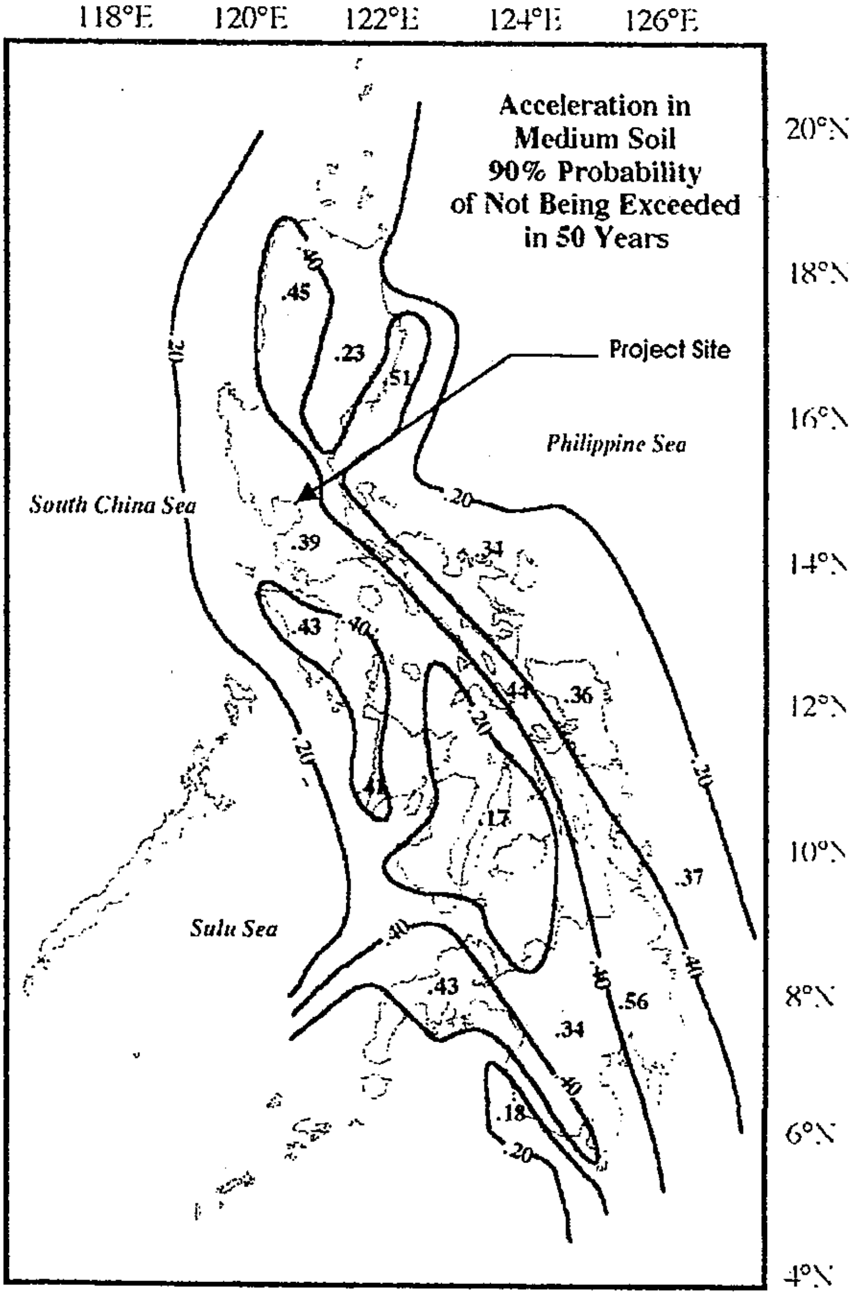


FIGURE 4.22: ACCELERATION IN MEDIUM SOIL
(Not to scale)
Source: PHILVOCS

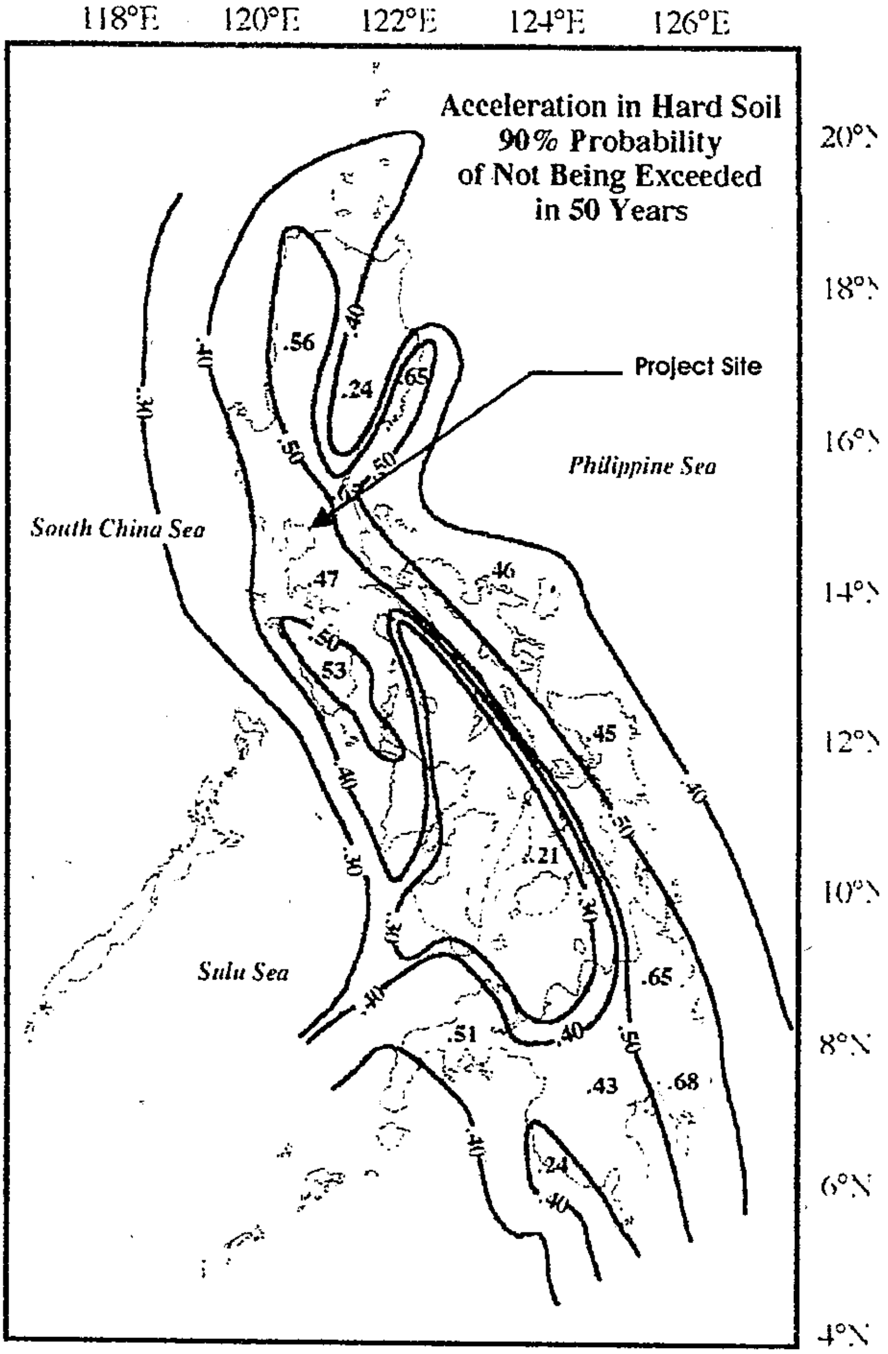


FIGURE 4.23: ACCELERATION IN HARD SOIL
(Not to scale)
Source: PHILVOCS

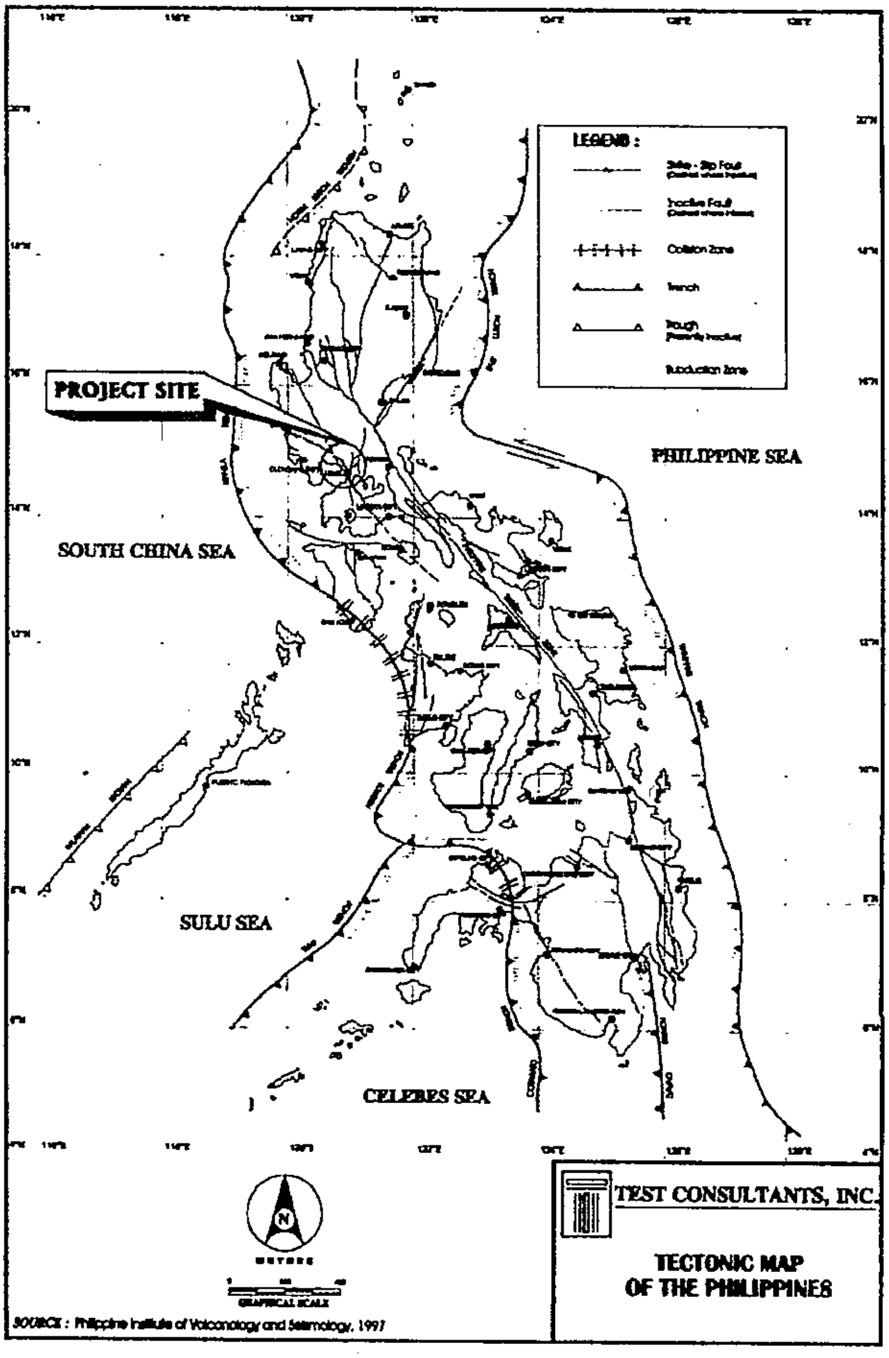


FIGURE 4.24: TECTONIC MAP OF THE PHILIPPINES
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

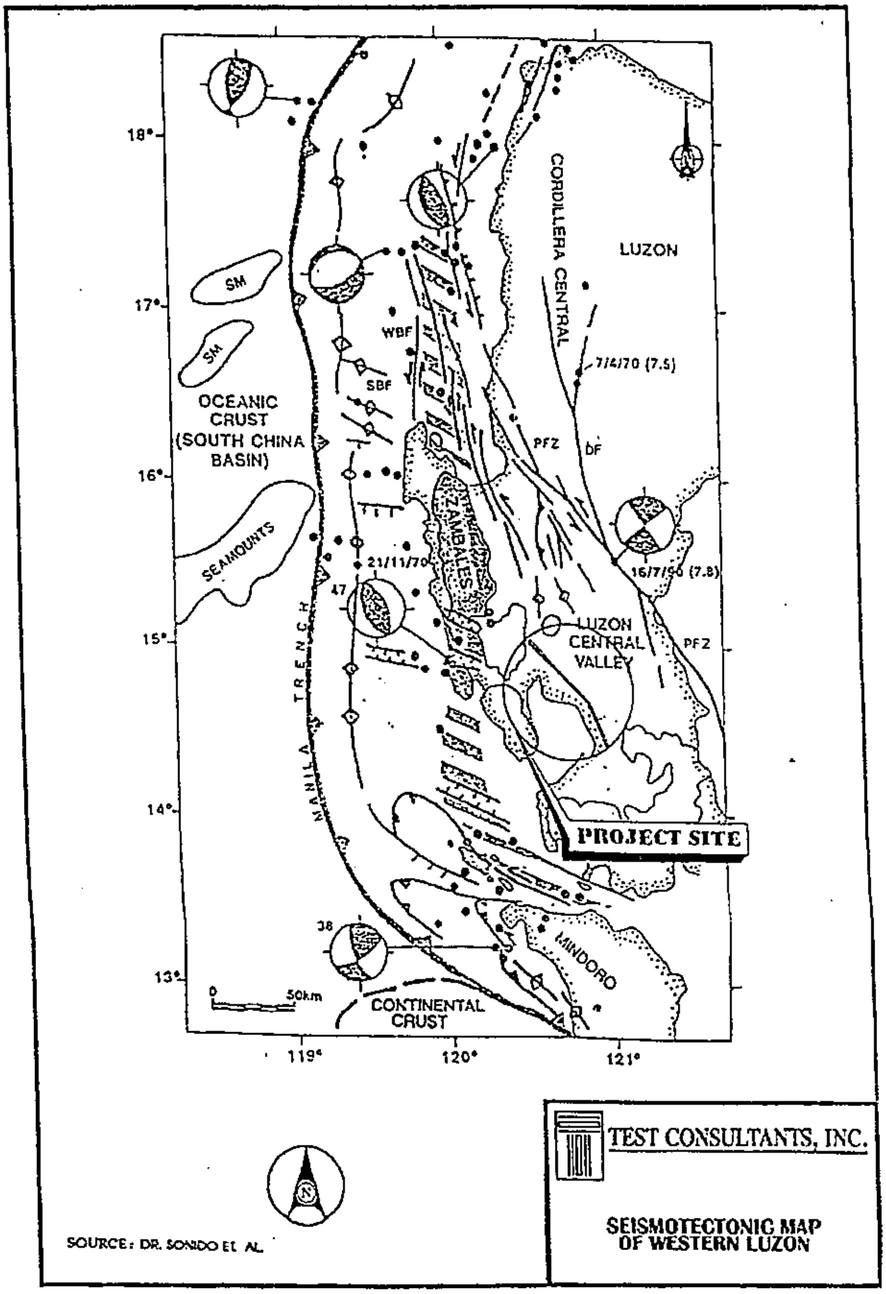


FIGURE 4.25: SEISMOTECTONIC MAP OF WESTERN LUZON
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

PROJECT MANILA - CLARK RAPID RAILWAY SYSTEM

BOREHOLE No. BH-101 DATE DRILLED June 23 to June 24, 1996 GROUND ELEV. ______ WATER LEVEL 0.90 m DATE GAUGED June 24, 1996

Sample Number	% Recovery	Unified Classification	Description	N-Blows (SPT) 15 cm	15 cm	15 cm	15 cm	Moisture Content (%)	Atterberg Limits LL (%)	PI (%)	Sieve Analysis % Passing Sieve 4	10	40	100	200	Percolation Test k (cm/sec)	Wet Density g/cc	Dry Density g/cc	Unconfined Compression Test C (kpa)	Strain (%)	Triaxial Compression Test C (kpa)	Φ (degrees)	Consolidation Test Cc	eo	Sand Equiv. (%)	Sulfate Content (ppm)	Organic Content (%)
SS-1	100	SC	Clayey SAND, brown, traces of gravel fragments, considerable moderately plastic fines, loose to very loose	1	3	5	7	19	35	14	98	94	76	42	33												3.8
SS-2	100			5	2	2	2	26	34	13	97	87	64	39	32*										65	38.4	
SS-3	100		do, gray; dense	14	17	12	14	23	46	21	97	94	76	48	41												
SS-4	100	CH	CLAY, light yellowish gray; appreciable amount of very fine sand, high plasticity; stiff to very stiff	7	7	8	9	53	68	39	100	90	90	90	85												
SS-5	100			4	8	9	38	24	NP		100	93	83	72	63		1.427	1.093	1,092	0.60	γ_d = 1.093 gm/cc						
CB-1	69	TST	Tuffaceous SILTSTONE, gray, with pockets of cemented sand; severely weathered; moderately cemented; weak.	CORING				31																			
CS-2	64			CORING				33									1.767	1.320	1,792	0.64	γ_d = 1.320 gm/cc					628.4	
			End of Borehole at 10.00 m.																								

FIGURE 4.26: BOREHOLE DATA 1

Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

PROJECT MANILA - CLARK RAPID RAILWAY SYSTEM
BOREHOLE No. BH-102 DATE DRILLED June 24 to June 24, 1996 GROUND ELEV. WATER LEVEL 4.10 m DATE GAUGED June 24, 1996

Depth (m)	Sample Number	% Recovery	Sample Type	Log Symbol	Unified Classification	DESCRIPTION	N-Blows (SPT) 15 cm	15 cm	15 cm	15 cm	Moisture Content (%)	Atterberg Limits LL (%)	PI (%)	Sieve Analysis % Passing Sieve 4	10	40	100	200	Percolation Test K (cm/sec)	Vane Shear Strength (kpa) U	R	Unconfined Compression Test C (kpa)	Strain (%)	Triaxial Compression Test C (kpa)	φ (degrees)	Consolidation Test Cc	eo	Sand Equiv. (%)	Sulfate Content (ppm)	Organic Content (%)
	SS-1	83			CL	Silty CLAY, brown, traces siltstone fragments, moderate plasticity, stiff	3	7	5	4	20	43	18	100	98	90	72	63												
	SS-2	92			SC	Clayey SAND, yellowish brown to brownish brown, with siltstone fragments; considerable moderate plastic fines; medium dense to very dense.	5	8	8	12	21	38	12	92	77	54	43	39										48		3.2
	SS-3	83					11	14	17	18	21	33	8	87	69	44	35	33										63	92.7	
	SS-4	52			SM	Silty SAND, yellowish brown; with gravel fragments; considerable to appreciable slight to non-plastic fines; medium dense to dense	8	9	11	14																				
	SS-5	65					9	10	12	16	14		NP	76	54	26	20	18											71.4	
	SS-6	41			GP	Sandy GRAVEL, yellowish brown; considerable medium to coarse sand; negligible non-plastic fines; very dense.	10	16	29	33																				
	SS-7	47					12	18	26	37	26		NP	44	23	8	3	1												
						End of Borehole at 10.00m.																								

FIGURE 4.27: BOREHOLE DATA 2
Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

PROJECT MANILA - CLARK RAPID RAILWAY SYSTEM

BOREHOLE No. BH-103 DATE DRILLED June 23 to June 24, 1996 GROUND ELEV. ____ WATER LEVEL 1.50 m DATE GAUGED June 24, 1996

Depth (m)	Sample Number	% Recovery	Unified Classification	Description	N-Blows (SPT) 15 cm	15 cm	15 cm	15 cm	Moisture Content (%)	Atterberg Limits LL (%)	PI (%)	Sieve Analysis % Passing Sieve 4	10	40	100	200	Percolation Test k (cm/sec)	Wet Density g/cc	Dry Density g/cc	Unconfined Compression Test C (kpa)	Strain (%)	Triaxial Compression Test C (kpa)	φ (degrees)	Consolidation Test Cc	Ce	Sand Equiv (%)	Sulfate Content (ppm)	Organic Content (%)
1	SS-1	100	CL	Silty CLAY, brown, considerable sand and little gravel fragments, moderate plasticity, stiff	7	5	5	7	17	39	15	85	76	62	54	54												
2–3	SS-2	100	ML	Sandy SILT, light brown, traces of fine gravel, considerable amount of fine to medium sand, low plasticity; very stiff	7	8	9	25	58	35	8	97	90	75	61	54										44		4.7
4	SS-3	100	TSi	Tuffaceous SILTSTONE, grayish brown to brownish gray, severely weathered, moderately cemented, very weak to weak	[illegible]																							
4	CS-4	73			CORING				24									1.702	1.334	3,393	1.36	γ_d=1.334 gm./cc						
5	CS-5	98							19									1.798	1.507	7,871	2.12	γ_d=1.507 gm./cc					937.4	
6	CS-6	67							31									1.764	1.326	6,263	1.87	γ_d=1.325 gm./cc						
7	CS-7	100			CORING				24									1.828	1.468	8,267	1.94	γ_d=1.460 gm./cc					248.3	
9	CS-8	100	SaT	Tuffaceous SANDSTONE, yellowish brown, severely weathered, moderately cemented, weak	CORING				23									1.738	1.644	5,205	1.13	γ_d=1.41 gm./cc					376.2	
10				End of Borehole at 10.00 m.																								

FIGURE 4.28: BOREHOLE DATA 3

Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

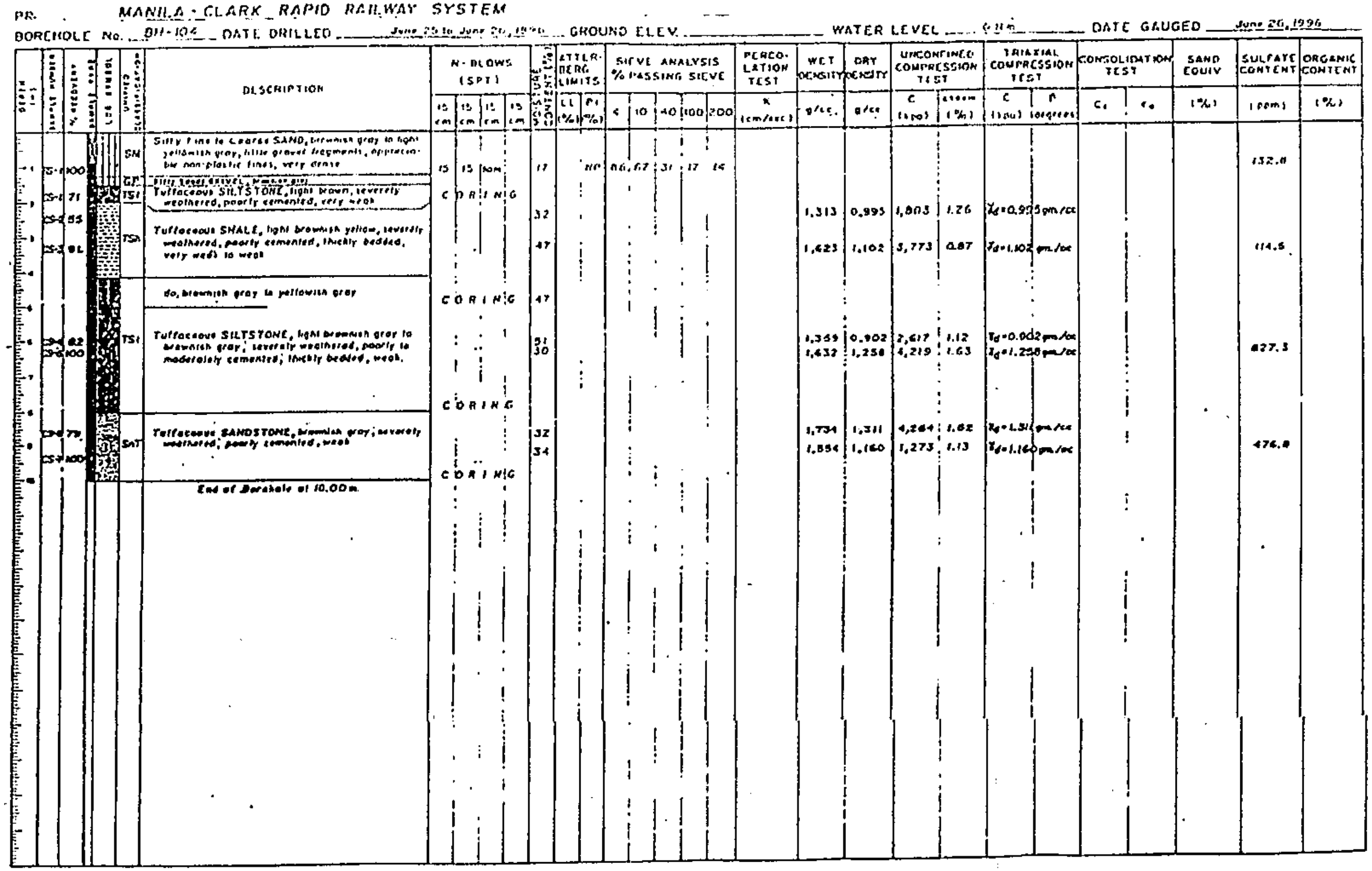


FIGURE 4.29: BOREHOLE DATA 4
Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

PROJECT: MANILA-CLARK RAPID RAILWAY SYSTEM
BOREHOLE No. BH-105 DATE DRILLED: — GROUND ELEV. — WATER LEVEL 0.50 m. DATE GAUGED —

Depth (m)	Sample Number	% Recovery	Sample Type	Log Symbol	Unified Classification	Description	N-Blows (SPT) 15 cm	15 cm	15 cm	15 cm	Moisture Content (%)	Atterberg Limits LL (%)	PI (%)	Sieve Analysis % Passing Sieve 4	10	40	100	200	Percolation Test K (cm/sec)	Vane Shear Strength (Kpa) u	R	Unconfined Compression Test C (kpa)	Strain (%)	Triaxial Compression Test C (kpa)	φ degrees	Consolidation Test Cc	eo	Sand Equiv. (%)	Sulfate Content (ppm)	Organic Content (%)
	SS1	300				Clayey Gravel - brown, fine to coarse, medium plastic, with some coarse and fine sand, highly organic, relatively dense	7	10	15		23		NP	79	72	57	43	35												
	SS2	400			SC	Clayey Sand - dark brown to gray fine to coarse, loose, with some gravel, medium plastic highly organic	4	5	7		57	56	27	97	94	90	80	76											3,774	
	SS3	350			CH	Highly Plastic Clay - dark, fine with trace of coarse gravel.	8	12	15		7	51	23	100	99	95	89	66											34,900	
	SS4	300				Silty Gravel - dark gray, fine to coarse, almost non plastic, extremely dense, with sand, gravel.	20	25	30		7		NP	38	29	20	16	15											14,266	
	SS5					Lost Sample	29	33	39				NP																	
	SS6	400			GP	Sandy Gravel - gray coarse, extremely dense, non plastic, gravelly	30	40	42		4		NP	68	44	16	9	7	1.32×10^{-3}										26,976	
	SS7					Lost Sample																								
	SS8					-do-					3		NP	57	48	13	9	8											8,376	
	SS9	29			GP	Sample same as SS-6																								
	SS10	500			GP	Sample same as SS-6					4		NP	63	45	24	8	7												
	SS11					Lost Sample																								
	SS12					Lost Sample																								
	SS13	300				Sample same as SS6, SS-9, SS-10					3		NP	46	34	21	16	14											5,606	
						Water table @ 0.50 m Note: No retrieved sample on SS-5, SS-7, SS-8, SS-11, SS-12, due to gravel formation.																								

End of Borehole at 20.00 m

FIGURE 4.30: BOREHOLE DATA 5

Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

PROJECT: MANILA-CLARK RAPID RAILWAY SYSTEM
BOREHOLE No. BH-106 DATE DRILLED: GROUND ELEV. WATER LEVEL 0.00 m. DATE GAUGED

Sample Number	Unified Classification	Description	N-Blows (SPT) 15 cm	15 cm	15 cm	15 cm	Moisture Content (%)	Atterberg Limits L.L. (%)	P.I. (%)	Sieve Analysis % Passing Sieve 4	10	40	100	200	Percolation Test K (cm/sec)	Vane Shear Strength (kpa) U	R	Unconfined Compression Test c (kpa)	Strain (%)	Triaxial Compression Test c (kpa)	φ (degrees)	Consolidation Test Cc	eo	Sand Equiv. (%)	Sulfate Content (ppm)	Organic Content (%)
SS1	CH	Clay- grayish brown, highly plastic, medium stiff, moist with slight organic matter.	2	2	4		40	49	26	97	92	82	71	65	1.25×10^{-3}										1,461	
SS2	CH	-do-	3	4	5		42	46	23	100	100	96	86	59											724	
SS3	CH	-do-	4	5	6		22	46	20	97	96	90	74	65											532	
SS4	SC	Clayey Sand- brown medium plastic, medium dense	5	4	7		46	61	30	100	97	86	74	65											203	
SS5	SM	Silty Sand- brown slightly plastic dense with trace of fine.	12	15	16		50		NP	81	77	33	20	17											3,070	
SS6	SM	Poorly Graded Sand- dark gray to black, non plastic, with little or no fine, dense to extremely dense fine to medium grain coarse	16	18	19		80		NP	100	99	27	2	1											2,948	
SS7	SM	-do-	20	21	23		55		NP	100	99	18	2	3												
SS8	SM	-do-	22	24	26		11		NP	100	90	24	2	1											23.9	
SS9	SM	-do-	25	27	28		11		NP	100	99	40	4	2	6.14×10^{-3}										3,061	
SS10	SM	-do-	28	30	31		15		NP	100	100	27	2	2											3,054	
SS11	SM	-do-	30	33	35		12		NP	100	90	34	6	2											1,900	
SS12	SM	-do-	36	38	40		3		NP	82	67	16	3	2											2,010	
	SM	-do-	39	41	44				NP	46	28	16	10	1											10,014	

End of Borehole at 20.00
Water Table: 0.00 m level on ground

FIGURE 4.31: BOREHOLE DATA 6
Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

PROJECT MANILA - CLARK RAPID RAILWAY SYSTEM

BOREHOLE No. BH-107 DATE DRILLED June 29, 1996 GROUND ELEV. ______ WATER LEVEL 1.26m DATE GAUGED June 22, 1996

Depth (m)	Sample Number	% Recovery	Sample Type	Log Symbol	Unified Classification	Description	N-Blows (SPT) 15 cm	15 cm	15 cm	15 cm	Moisture Content (%)	Atterberg Limits LL (%)	PI (%)	Sieve Analysis % Passing Sieve 4	10	40	100	200	Percolation Test K (cm/sec)	Vane Shear Strength (kpa) u	R	Unconfined Compression Test c (kpa)	Strain (%)	Triaxial Compression Test c (kpa)	φ (degrees)	Consolidation Test Cc	Ce	Sand Equiv. (%)	Sulfate Content (ppm)	Organic Content (%)
	SS-1	100			SC	Clayey Medium to Coarse SAND, brown to light brown, some gravel fragments, appreciable moderate plastic fines, medium dense	9	11	7	2	14	32	10	79	61	33	21	20												
	SS-2	100			CH	CLAY, brown; negligible amount of very fine sand; high plasticity, stiff.	3	4	5	6	47	50	32					100										2	547.6	4.9
	SS-3	100					4	6	8	10	30	50	29			100	99	99												
	SS-4	100				very stiff.	6	8	10	11	52	74	45				100	99												
	SS-5	100			CL	Silty CLAY, brown, with fine to coarse sand and traces of gravel fragments; moderate plasticity, very stiff.	7	8	12	14	37	48	23	93	89	76	61	56												
	SS-6	100				Silty CLAY, brown; negligible amount of very fine sand, moderate plasticity, very stiff.	6	8	11	12	39	47	22			100	99	99												
	SS-7	100					5	8	12	13	39	46	23		100	99	99	89												
10						End of Borehole at 10.00m.																								

* HYDROMETER

FIGURE 4.32: BOREHOLE DATA 7

Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

PROJECT MANILA - CLARK RAPID RAILWAY SYSTEM

BOREHOLE No. BH-108 DATE DRILLED June 23 to June 28, 1996 GROUND ELEV. ____ WATER LEVEL 5.70 m DATE GAUGED June 28, 1996

Sample Number	% Recovery	Unified Classification	Description	N-Blows (SPT) 15 cm	15 cm	15 cm	15 cm	Moisture Content (%)	Atterberg Limits LL (%)	PI (%)	Sieve Analysis % Passing Sieve 4	10	40	100	200	Percolation Test K (cm/sec)	Vane Shear Strength (kpa) U	R	Unconfined Compression Test C (kpa)	Strain (%)	Triaxial Compression Test C (kpa)	Φ (degrees)	Consolidation Test Cc	Ce	Sand Equiv (%)	Sulfate Content (ppm)	Organic Content (%)
SS-1	65	SM	Silty SAND, reddish brown, with fine sub-angular gravel fragments, appreciable non plastic fines; medium dense	7	10	6	9	16		NP	85	76	64	40	22												
SS-2	75			3	3	4	3	20	40	17	100	99	86	74	62											1562	
SS-3	83	CL	Silty CLAY, light brown; considerable fine to medium sand, moderate plasticity, firm to stiff.	3	7	8	10	30																	24		
SS-4	92			4	7	8	8	38	40	22		100	94	76	68												
SS-5	67	GC	Clayey Sandy GRAVEL, light grayish brown; angular to sub-angular fragments, appreciable moderate plastic fines; dense to very dense	21	15	17	19	27																			
CS-1	37			C O R I N G																							
CS-2	3		Silty Fine SAND, light grayish brown, occasional gravel; considerable slight to non-plastic fines, dense.	C O R I N G																							
SS-6	75			12	15	15	10	20		NP	100	99	85	52	32											286.5	
SS-7	67			17	15	12	14	21																			
SS-8	64	SM	Silty Fine to Coarse SAND, light brown; with sub-angular gravel fragments, appreciable to considerable non-plastic fines; dense to very dense.	10	16	18	21	22		NP	89	75	58	34	25												
SS-9	65			26	31	32	40	18																			
CS-3	33			C O R I N G																							
CS-4	37			C O R I N G																							
CS-5	38	TSt	Tuffaceous SILTSTONE, brown, severely weathered, thickly bedded, weak.	C O R I N G																							
CS-6	64			C O R I N G																							
CS-7	81			C O R I N G																							
CS-8	50			C O R I N G																							
CS-9	0	ML	Very Fine to Fine Sandy SILT, brown to brownish gray; tuffaceous, non-plastic; hard.	C O R I N G																							
SS-10	92			14	17	28	27	24		NP	100	89	82	65	51												
SS-11	93	SAT	Tuffaceous SANDSTONE, brownish gray; severely weathered; poorly cemented; very weak to weak.	18	30			18		NP	97	94	75	40	28												
CS-10	51			C O R I N G																							
			End of Borehole at 30.00m																								

Note: Core samples are insufficient for all test required

FIGURE 4.33: BOREHOLE DATA 8

Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

PROJECT MANILA - CLARK RAPID RAILWAY SYSTEM

BOREHOLE No. BH-117 DATE DRILLED October 22 to October 25, 1996 GROUND ELEV. ______ WATER LEVEL 3.96 m DATE GAUGED October 26, 1996

Sample Number	% Recovery	Unified Classification	Description (Ground Surface - Center of Tracks)	N-Blows (SPT) 15 cm	15 cm	15 cm	15 cm	Moisture Content (%)	Atterberg Limits LL (%)	PI (%)	Sieve Analysis % Passing Sieve 4	10	40	100	200	Percolation Test K (cm/sec)	Vane Shear Strength (kpa) U	R	Unconfined Compression Test C (kpa)	Strain (%)	Triaxial Compression Test C (kpa)	Ø degrees	Consolidation Test Cc	eo	Sand Equiv. (%)	Sulfate Content (ppm)	Organic Content (%)
SS-1	100	CH	CLAY, light brown, high plasticity, stiff	4	5	9	18	35	57	32	100	90	96	85	78												
CS-1	12	GC	Clayey Sandy GRAVEL, brownish gray; assorted hard subrounded to subangular gravels with clay coatings.	C	O R	I N	G																				
CS-2	12			C	O R	I N	G																				
CS-3	16		Clayey Sandy GRAVEL and COBBLES, brownish gray, assortment of hard, durable fragments up to cobble-size, interspaced by plastic fines; very dense.	C	O R	I N	G									4.44x10[illegible]											
CS-4	20			C	O R	I N	G																				
CS-5	30	TST	Tuffaceous SILTSTONE, grayish brown to light brown; highly to moderately weathered; moderately cemented; weak to moderately strong	C	O R	I N	G												5,611.8	2.12	γ_d=1.429 g/cc						
CS-6	35			C	O R	I N	G																				
SS-2	77			30/8				18	38	11	94	88	48	28	22	3.65x10[illegible]			2,038.2	0.48	γ_d=1.276 g/cc						
CS-7	92			C	O R	I N	G																				
			End of Borehole at 13.00 m																								

FIGURE 4.34: BOREHOLE DATA 9

Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

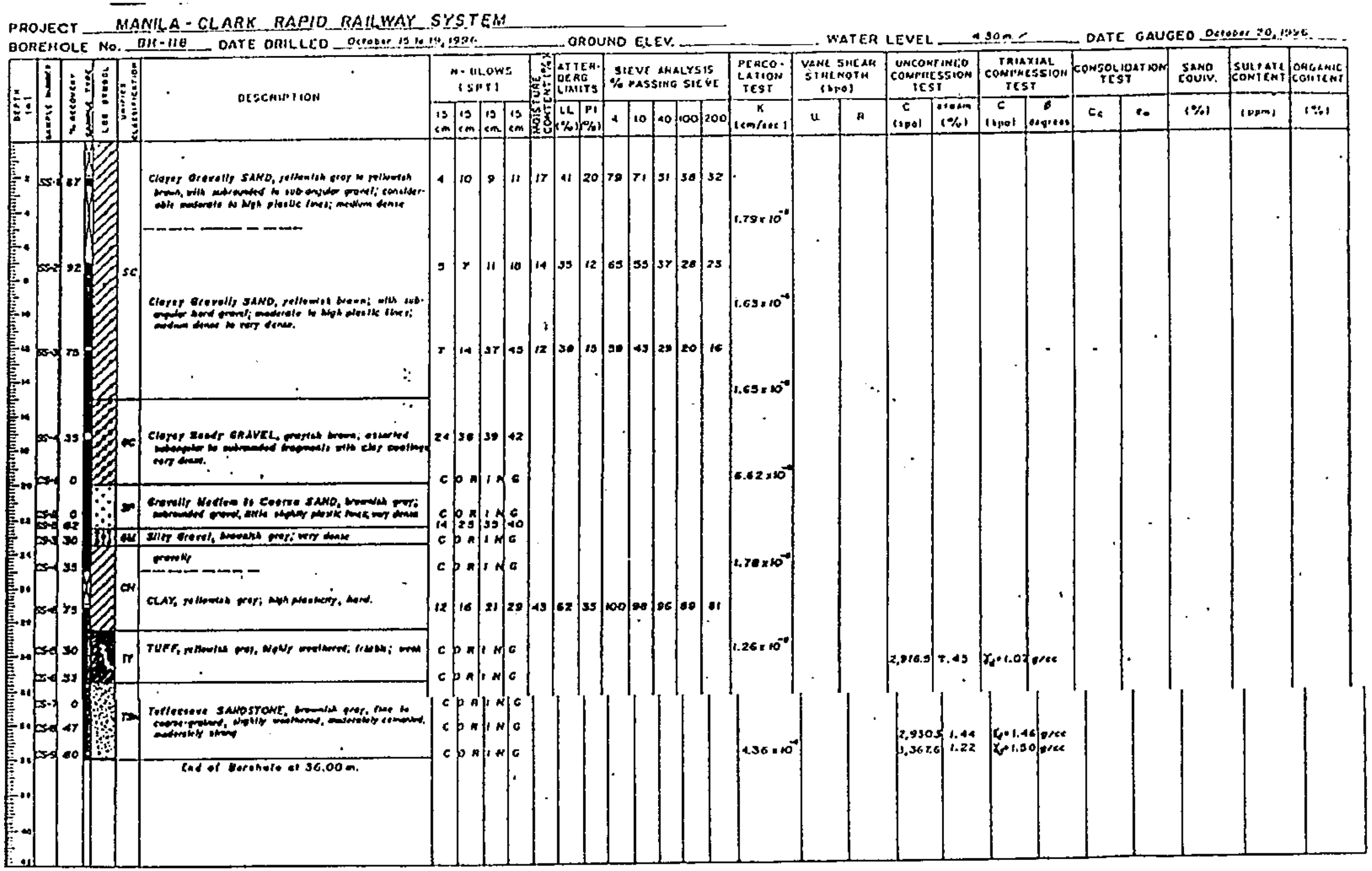


FIGURE 4.35: BOREHOLE DATA 10

Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

PROJECT: MANILA - CLARK RAPID RAILWAY SYSTEM

BOREHOLE No.: BH-124 DATE DRILLED: October 26 to October 27, 1996 GROUND ELEV.: WATER LEVEL: 2.70 m DATE GAUGED: October 27, 1996

Sample Number	% Recovery	Unified Classification	Description	N-Blows (SPT) 15 cm	15 cm	15 cm	15 cm	W.C. (%)	Atterberg Limits LL (%)	PI (%)	Sieve Analysis % Passing Sieve 4	10	40	100	200	Percolation Test K (cm/sec)	Vane Shear Strength (kpa) U	R	Unconfined Compression Test C (kpa)	Strain (%)	Triaxial Compression Test C (kpa)	Ø degrees	Consolidation Test Cc	eo	Sand Equiv (%)	Sulfate Content (ppm)	Organic Content (%)
			Ground Surface Within Existing Tracks																								
SS-1	83	SC	Clayey Fine to Coarse SAND, light brown, with pieces of rounded stones, considerable plastic fines, medium dense	7	7	8	12	15	45	20	90	73	53	45	41												
SS-2	75	CL	Sandy CLAY, yellowish brown with rust brown lenses, considerable fine sand, moderate plasticity, very stiff	7	9	12	12	45	48	24	100	99	89	68	61												
SS-3	83	SM	Silty Fine to Medium SAND, dark grayish brown; appreciable non plastic fines, trace of gravel, medium dense.	9	9	10	11	24		NP	99	96	58	27	19												
SS-4	75	SC	Clayey Fine to Medium SAND, grayish black; trace of subrounded gravel, moderate plasticity, very dense. CORING	15	20	30	44	20	41	16	96	93	56	42	36												
SS-5	73	SM	Silty Gravelly SAND, grayish brown, fine to coarse-grained with fine subrounded gravel, appreciable none to slightly plastic fines, very dense. CORING	17	26	40	50/5	15		NP	71	50	30	21	16												
SS-6	68	SM	CORING	22	28	50/10		16		NP	84	58	35	24	19												
			End of Borehole at 12.80 m.																								

Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

FIGURE 4.36: BOREHOLE DATA 11

IDENTIFICATION				NATURAL CONDITIONS		ATTERBERG LIMITS			SIEVE ANALYSIS						MECHANICAL CHARACT.				CHEMICAL CHARACT.		
BOREHOLE	SAMPLE	DEPTH (m)	S.P.T. BLOWS	NATURAL MOISTURE (%)	DRY DENSITY (KN/m3)	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	#4	#10	#40	#100	#200	U.S.C.S.	U.C.S. (KPa)	M. OF ELASTICITY (Ton/m²)	SAND EQUIVALENT (%)	PERMEABILITY k (cm/s)	SULFATE CONTENT (ppm)	ORGANIC CONTENT (%)	TYPE OF SOIL
BH-101	SS-1	0,90-1,50	6	19		35	21	14	98	94	76	42	33	SC						3,8	CA
	SS-2	2,40-3,00	4	26		34	21	13	97	87	64	39	32	SC			65,0		58,4		CA
	SS-3	3,90-4,50	29	23		46	21	25	97	94	76	48	41	SC							CA
		5,00																1,86E-06			FA
	SS-4	5,40-6,00	15	53		68	29	39	100	98	98	98	85	CH							FA
	SS-5	6,40-7,00	17																		FA
	CS-1	7,48-7,55		31	10,93	0	0	0	100	95	83	72	53		1.114	21.250					GF
	CS-2	9,27-9,42		33	13,28										1.827	32.625					GF
BH-102	SS-1	0,90-1,50	12	20		43	15	28	100	98	90	72	63	CL							FA
	SS-2	2,40-3,00	16	21		38	26	12	92	77	54	43	39	SC			48,2			3,2	CA
	SS-3	3,90-4,50	31	21		35	27	8	87	69	44	35	33	SC			63,0		92,7		CA
	SS-4	5,40-6,00	20																		CA
	SS-5	6,90-7,50	22	14		0	0	0	76	54	26	20	18	SM					71,4		CA
	SS-6	8,40-9,00	45																		CA
	SS-7	9,40-10,00	44	26		0	0	0	44	23	8	3	1	GP							CA
BH-103	SS-1	0,90-1,50	10	17		39	24	15	85	76	62	54	54	CL							FA
	SS-2	2,40-3,00	17	56		35	29	6	97	90	73	61	54	ML			44,0			4,7	FA
	SS-3	3,90-4,03	R																		GF
		4,53																2,18E-06			GF
	CS-1	4,53-4,65		28	13,34										3.460	35.802					GF
	CS-2	5,43-5,60		19	15,07										8.026	45.161					GF
	CS-3	6,00-6,17		31	13,25										6.387	40.476					GF
	CS-4	7,60-7,76		25	14,68										8.430	51.429					GF
	CS-5	9,10-9,28		23	14,11										5.308	55.060					GF
BH-104	SS-1	0,90-1,24	R	17		0	0	0	86	67	31	17	14	SM					132,8		CA
	CS-2	2,40-2,50		32	9,95										1.832	18.625					GF

Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

FIGURE 4.37: SOIL AND IN SITU TEST RESULTS 1

IDENTIFICATION				NATURAL CONDITIONS		ATTERBERG LIMITS			SIEVE ANALYSIS						MECHANICAL CHARACT.				CHEMICAL CHARACT.		
BOREHOLE	SAMPLE	DEPTH (m)	S.P.T. BLOWS	NATURAL MOISTURE (%)	DRY DENSITY (KN/m3)	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	# 4	# 10	# 40	# 100	# 200	U.S.C.S	U.C.S (KPa)	M. OF ELASTICITY (Ton/m²)	SAND EQUIVALENT (%)	PERMEABILITY k (cm/s)	SULFATE CONTENT (ppm)	ORGANIC CONTENT (%)	TYPE OF SOIL
	CS-3	3,64-3,83		47	11,02										3.947	55.385					GF
	CS-4	6,20-6,40		51	9,02										2.668	24.000					GF
	CS-5	6,68-6,88		30	12,58										4.302	28.889		3,17E-06			GF
		6,75																			GF
	CS-6	8,80-8,95		32	13,11										4.348	30.000					GF
	CS-7	9,38-9,57		34	11,6										1.299	20.192					GF
BH-105	SS-1	1,05-1,50	25	23															3.774,0		CA
	SS-2	2,55-3,00	12	57															34.900,0		CA
	SS-3	4,05-4,50	27																14.266,0		CA
	SS-4	5,55-6,00	55	7																	CA
	SS-5	7,05-7,50	78																28.976,0		CA
	SS-6	8,55-9,00	82	4														1,32E-05			CA
		9,00																			CA
	SS-7	10,05-10,50	84																8.376,0		CA
	SS-8	11,55-12,00	88	3																	CA
	SS-9	13,05-13,50	96																		CA
	SS-10	14,55-15,00	96	4																	CA
	SS-11	16,05-16,50	98																		CA
	SS-12	17,55-18,00	100																3.686,0		CA
	SS-13	19,55-20,00	103	5															1.461,0		CA
BH-106	SS-1	1,05-1,50	6	48															724,0		FA
	SS-2	2,55-3,00	9	42															532,0		FA
	SS-3	4,05-4,50	11	22														1,29E-05			CA
		4,50																	203,0		CA
	SS-4	5,55-6,00	11	46															5 070,0		CA
	SS-5	7,05-7,50	31	50																	CA

Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

FIGURE 4.38: SOIL AND IN SITU TEST RESULTS 2

IDENTIFICATION				NATURAL CONDITIONS		ATTERBERG LIMITS			SIEVE ANALYSIS						MECHANICAL CHARACT.				CHEMICAL CHARACT.		
BOREHOLE	SAMPLE	DEPTH (m)	S.P.T. BLOWS	NATURAL MOISTURE (%)	DRY DENSITY (KN/m3)	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	#4	#10	#40	#100	#200	U.S.C.S.	U.C.S (KPa)	M. OF ELASTICITY (Ton/m²)	SAND EQUIVALENT (%)	PERMEABILITY K (cm/s)	SULFATE CONTENT (ppm)	ORGANIC CONTENT (%)	TYPE OF SOIL
	SS-6	8,55-9,00	37	50															2.948,0		CA
	SS-7	10,05-10,50	44	55																	CA
	SS-8	11,55-12,00	50	11															2.997,0		CA
	SS-9	13,05-13,50	55	11															3.061,0		CA
		13,50																6,14E-05			CA
	SS-10	14,55-15,00	61	15															3.054,0		CA
	SS-11	16,00-16,50	68	12															2.905,0		CA
	SS-12	17,55-18,50	78	3															2.610,0		CA
	SS-13	19,55-20,00	65	3															10.074,0		CA
BH-107	SS-1	0,90-1,50	18	14		32	22	10	79	61	33	21	20	SC							CA
	SS-2	2,40-3,00	9	47		58	26	32	100	100	100	100	100	CH			2,0		547,6	4,9	FA
	SS-3	3,90-4,50	14	38		56	27	29	100	100	100	100	99	CH							FA
	SS-4	5,40-6,00	18	52		74	29	45	100	100	100	100	99	CH							FA
	SS-5	6,90-7,50	20	37		48	25	23	93	89	76	61	58	CL							FA
	SS-6	8,40-9,00	19	39		47	25	22	100	100	100	99	99	CL							FA
	SS-7	9,40-10,00	20	39		46	23	23	100	100	99	99	99	CL							FA
BH-108	SS-1	0,90-1,50	16	16		0	0	0	85	76	64	48	22	SM							CA
	SS-2	2,40-3,00	7	28		40	23	17	100	99	86	74	62	CL					1.562,0		FA
	SS-3	3,90-4,50	15	30													24,0				FA
	SS-4	5,40-6,00	15	38		46	24	22	100	100	94	76	68	CL							FA
	SS-5	6,90-7,50	30	27																	CA
	SS-6	10,50-11,10	30	20		0	0	0	100	99	85	52	32	SM							CA
	SS-7	11,40-12,00	27	21															286,5		CA
	SS-8	13,40-14,00	34	22		0	0	0	89	75	58	34	25	SM							CA
	SS-9	15,40-16,00	63	18																	CA
	SS-10	26,50-27,10	45	24		0	0	0	100	99	92	65	51	ML							GF
	SS-11	28,50-28,93	R	18		0	0	0	97	94	73	40	28								GF

Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

FIGURE 4.39: SOIL AND IN SITU TEST RESULTS 3

IDENTIFICATION				NATURAL CONDITIONS		ATTERBERG LIMITS			SIEVE ANALYSIS						MECHANICAL CHARACT.				CHEMICAL CHARACT.		
BOREHOLE	SAMPLE	DEPTH (m)	S.P.T. BLOWS	NATURAL MOISTURE (%)	DRY DENSITY (KN/m3)	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	# 4	# 10	# 40	# 100	# 200	U.S.C.S.	U.C.S. (KPa)	M. OF ELASTICITY (Ton/m³)	SAND EQUIVALENT (%)	PERMEABILITY k (cm/s)	SULFATE CONTENT (ppm)	ORGANIC CONTENT (%)	TYPE OF SOIL
BH-117	SS-1	1,90-2,50	14																		FA
	SS-2	14,00-14,03	R																		GF
BH-118	SS-1	1,90-2,50	19																		FA
	SS-2	6,90-7,50	18																		FA
	SS-3	11,90-12,50	51																		FA
	SS-4	16,90-17,50	77																		CA
	SS-5	21,90-22,50	60																		CA
	SS-6	26,92-27,50	37																		FA
BH-123	SS-1	1,40-2,00	2																		FA
	SS-2	3,40-4,00	21																		FA
	SS-3	5,40-6,00	36																		FA
	SS-4	6,90-7,15	R																		FA
	SS-5	9,40-9,45	R																		FA
	SS-6	11,40-11,50	R																		CA
BH-124	SS-1	2,40-3,00	15																		FA
	SS-2	5,40-6,00	21																		FA
	SS-3	8,40-9,00	19																		CA
	SS-4	11,40-12,00	50																		FA
	SS-5	14,40-14,95	66																		CA
	SS-6	17,40-17,80	R																		CA

Source: CEW-A-04-05 Geotechnical Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

FIGURE 4.40: SOIL AND IN SITU TEST RESULTS 4

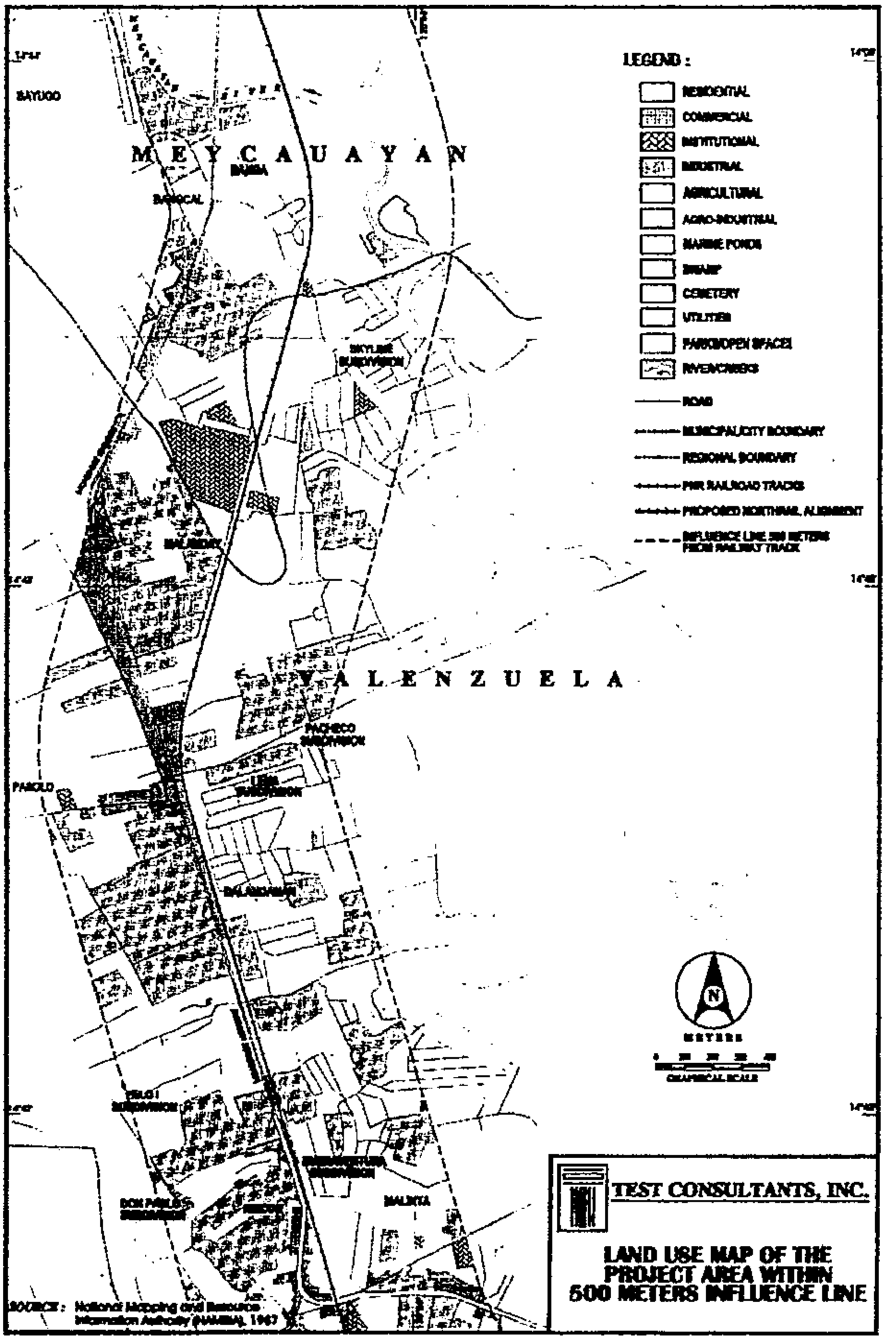


FIGURE 4.41: LAND USE MAP 1
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

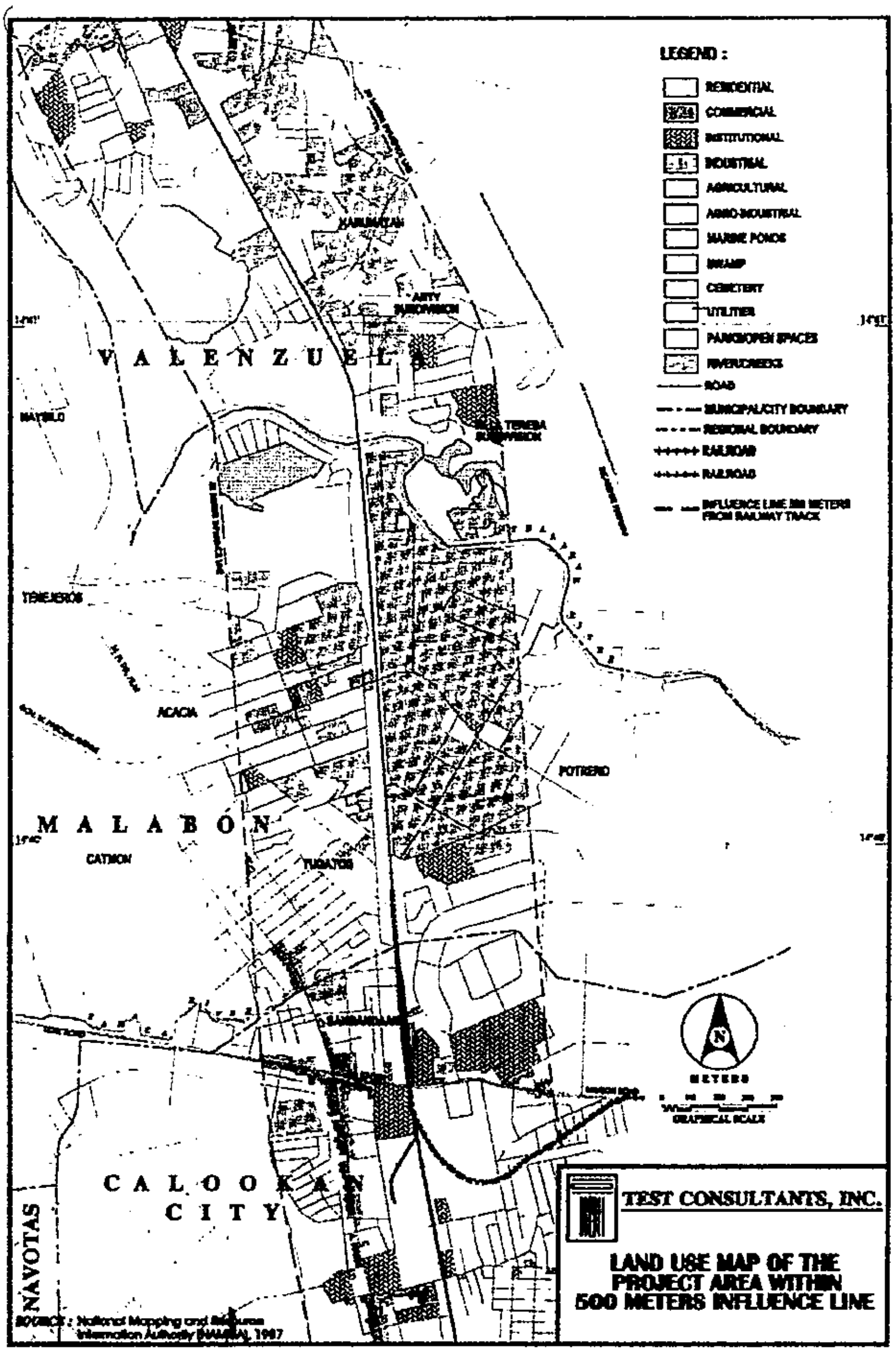


FIGURE 4.42: LAND USE MAP 2
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

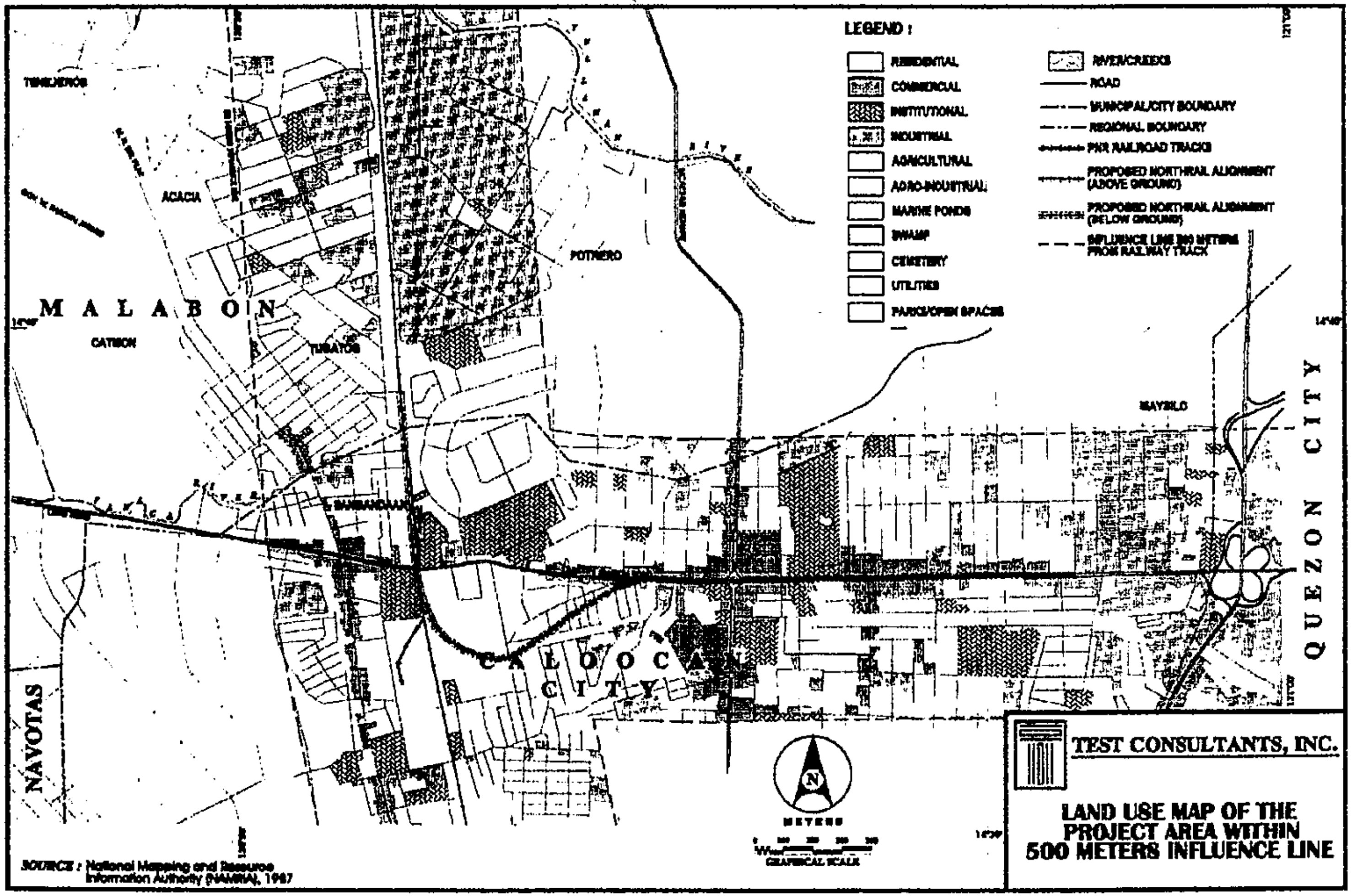


FIGURE 4.43: LAND USE MAP 3
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

(b) Topographic Map showing Drainage System
The existing local drainage system of Caloocan to Valenzuela section of the NorthRail Project is shown in Figures 4.44 and 4.46 below. It crosses the westward flow of the Meycauayan and Tullahan rivers. Both rivers drain towards the Manila Bay.

(c) Slope and Elevation Map
The proposed Caloocan to Valenzuela section of the NorthRail Project area is characterized by a flat and rolling terrain. The elevation descends gently and gradually southwards towards Manila Bay. Some sections of the PNR ROW in Caloocan City, Malabon and Valenzuela City (Figures 4.47-4.49) are flood prone.

Please refer to Section 4.21 (d).

(d) Soil Investigation Report
Based on soil maps, (Figures 4.50 and 4.51) the Caloocan – Valenzuela section of the PNR ROW is underlain by the following:

(i) Obando Fine Sandy Loam in the western part of the route
The Obando Fine Sandy Loam of the Obando series is classified as Island and Basin soil. As per the soil survey report of Bulacan Province, the Obando Fine Sandy Loam is characterized by a brown fine sandy loam surface soil with a depth ranging from 10 to 30 cm. Below the surface, at a depth of about 80 cm, is a subsoil of fine brown sand. Beneath the subsoil are gray sands mixed with marine shells.

(ii) Prensa Clay Loam in the eastern part of the route
The Prensa Series is classified as upland and mountain soils. The Prensa Clay Loam is the lower member of the Prensa Series. The surface soil is brown to light reddish brown clay loam, loose and granular with numerous spherical iron concretions. Its depth ranges from 20 to 25 cm.

The soil within the depth from 40 to 50 cm is loose and gravelly clay grading to sandy clay with many concretions. Substratum from a depth of 50 cm is gravelly clay and the presence of tuffaceous material. The presence of clay makes it more plastic than the sandy loam. Prensa Clay Loam is distributed in the gently sloping area along the PNR ROW in Malabon and extends eastward to the foothills of the Sierra Madre mountain ranges.

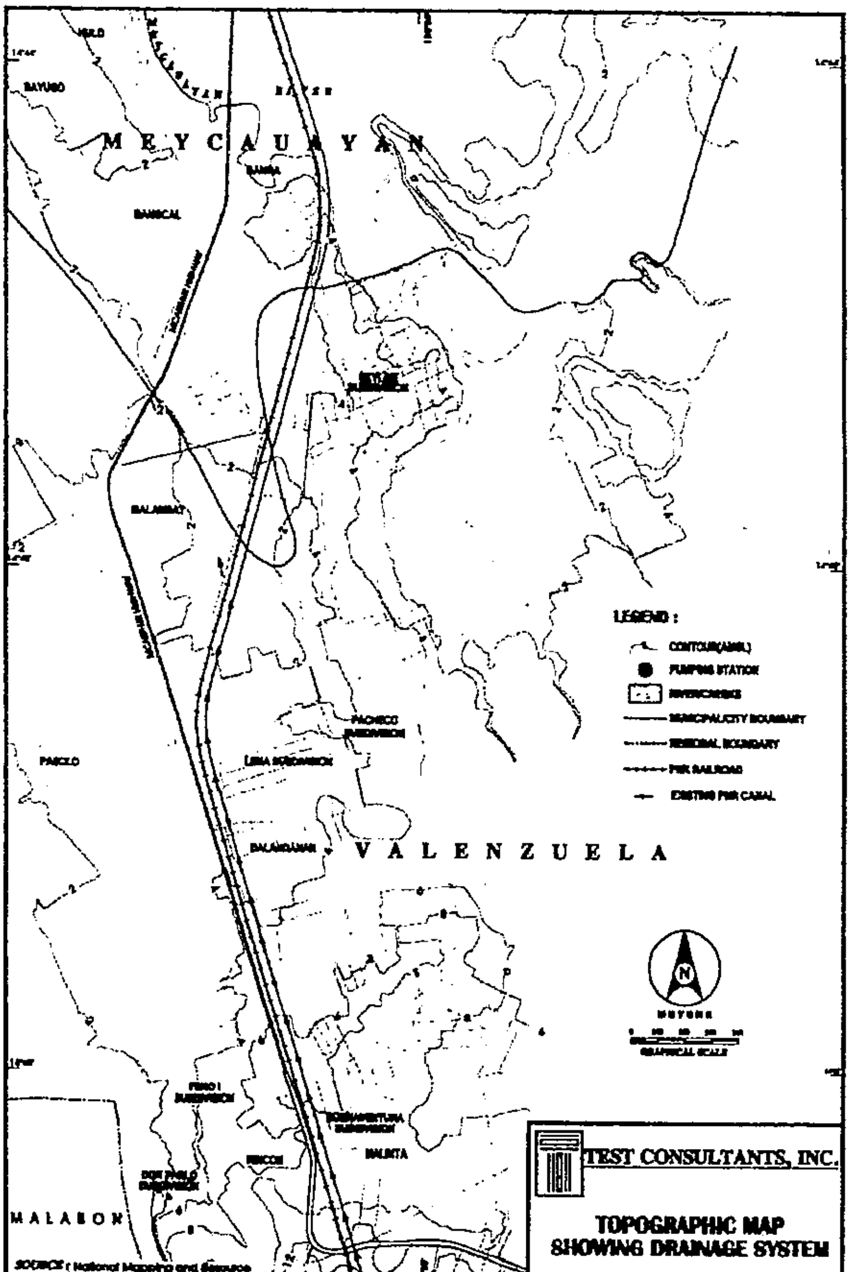


FIGURE 4.44: TOPOGRAPHIC MAP SHOWING DRAINAGE SYSTEM 1
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

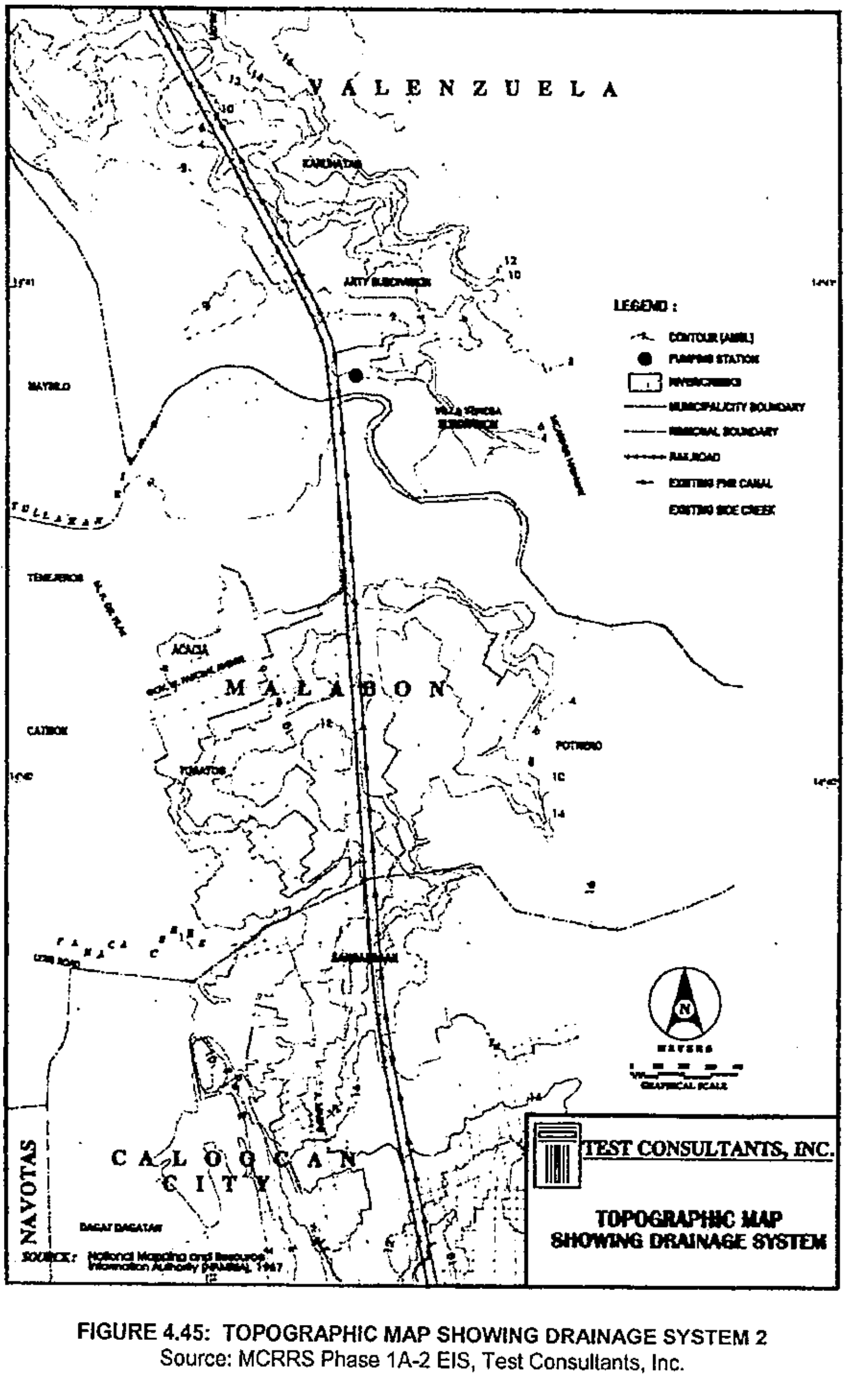


FIGURE 4.45: TOPOGRAPHIC MAP SHOWING DRAINAGE SYSTEM 2
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

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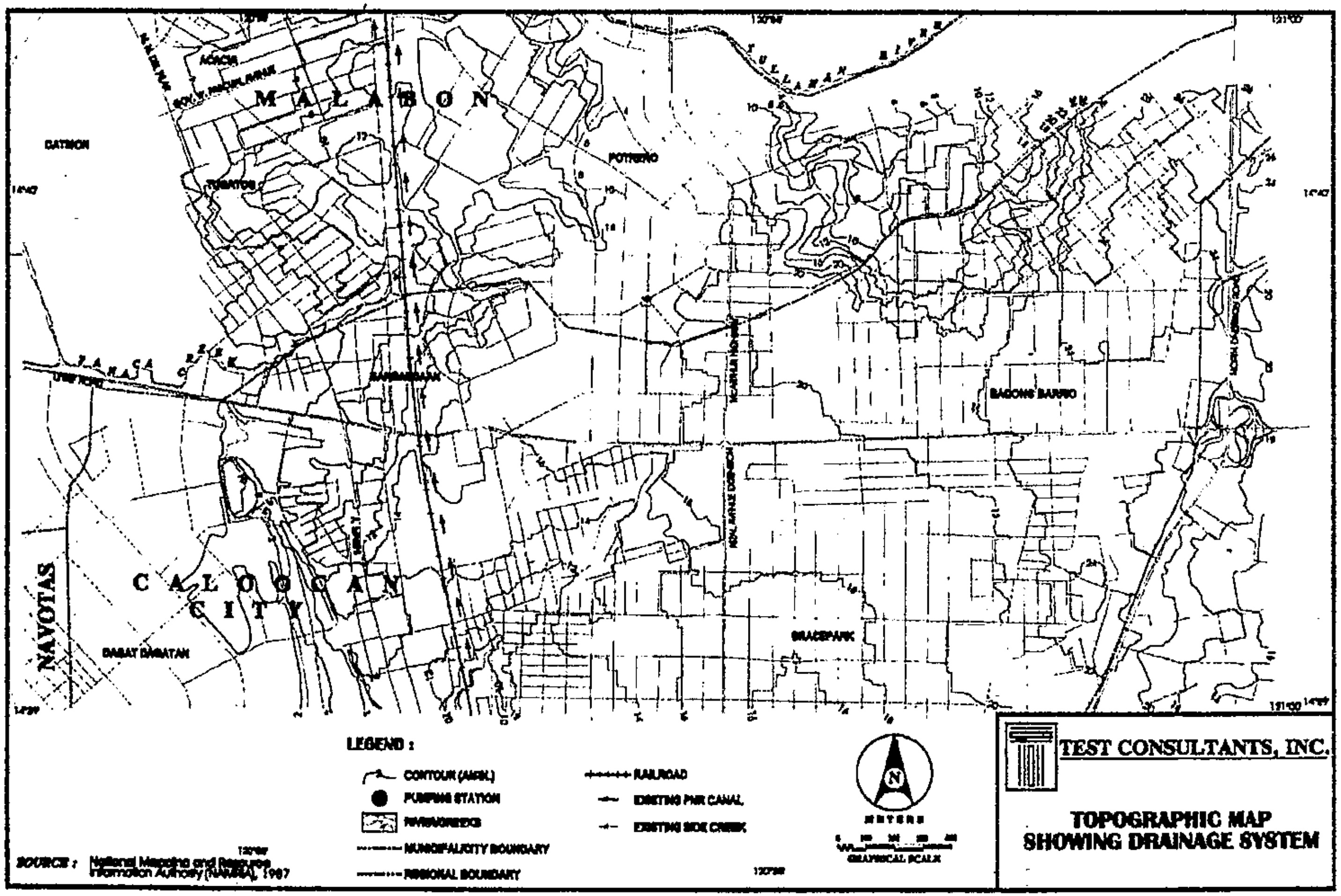

FIGURE 4.46: TOPOGRAPHIC MAP SHOWING DRAINAGE SYSTEM 3
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

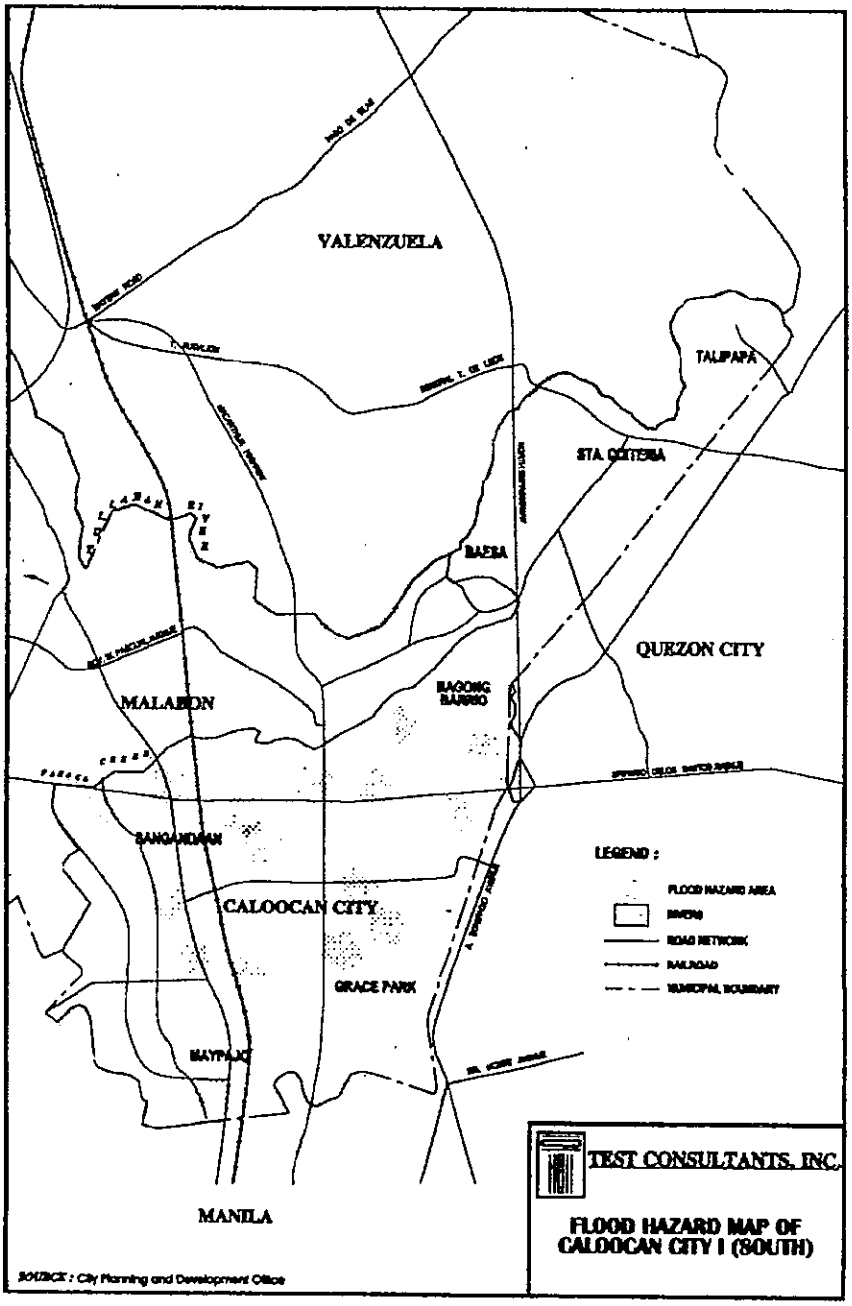

FIGURE 4.47: FLOOD HAZARD MAP OF CALOOCAN I (SOUTH)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

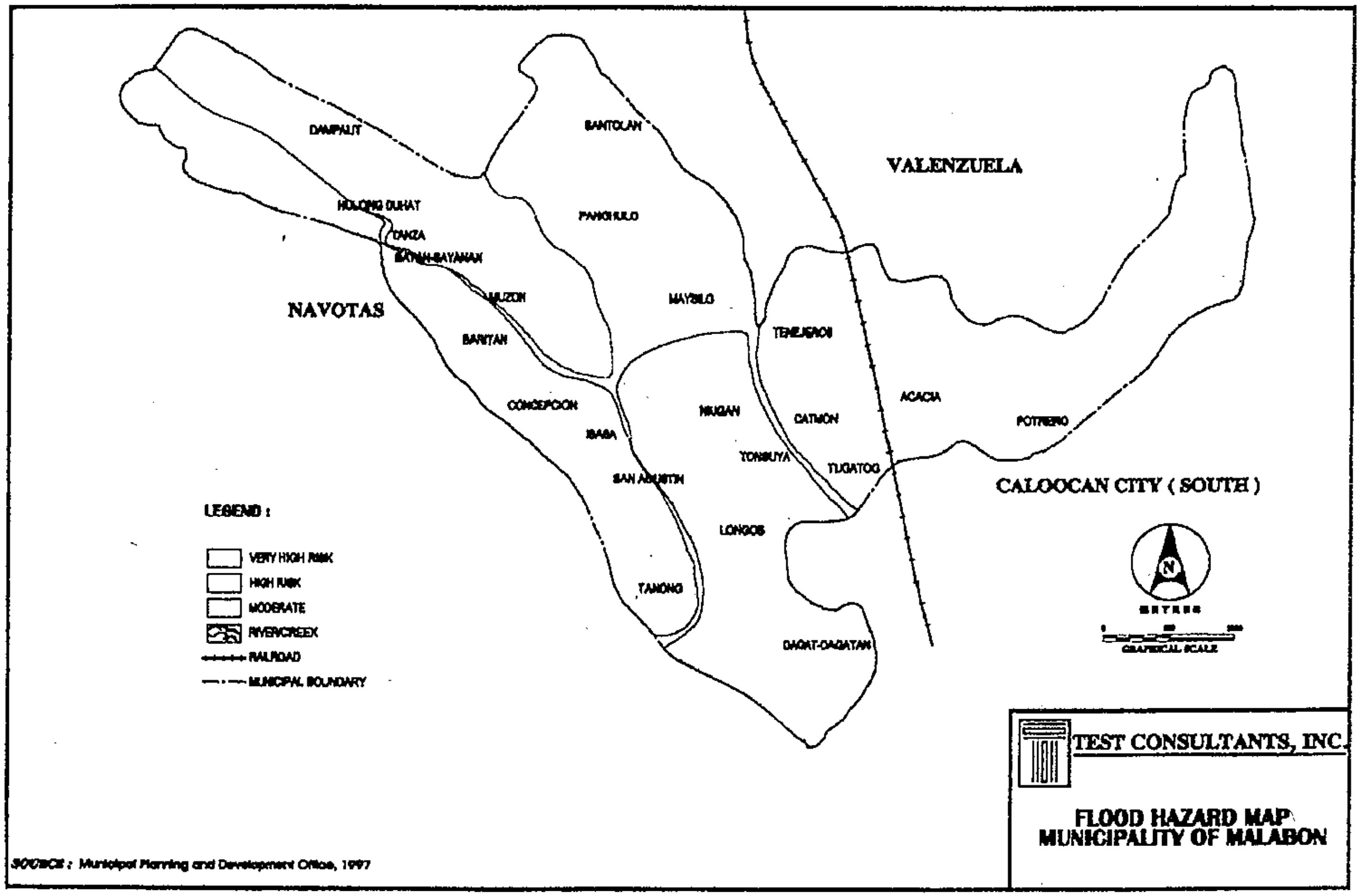

FIGURE 4.48: FLOOD HAZARD MAP OF MALABON
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

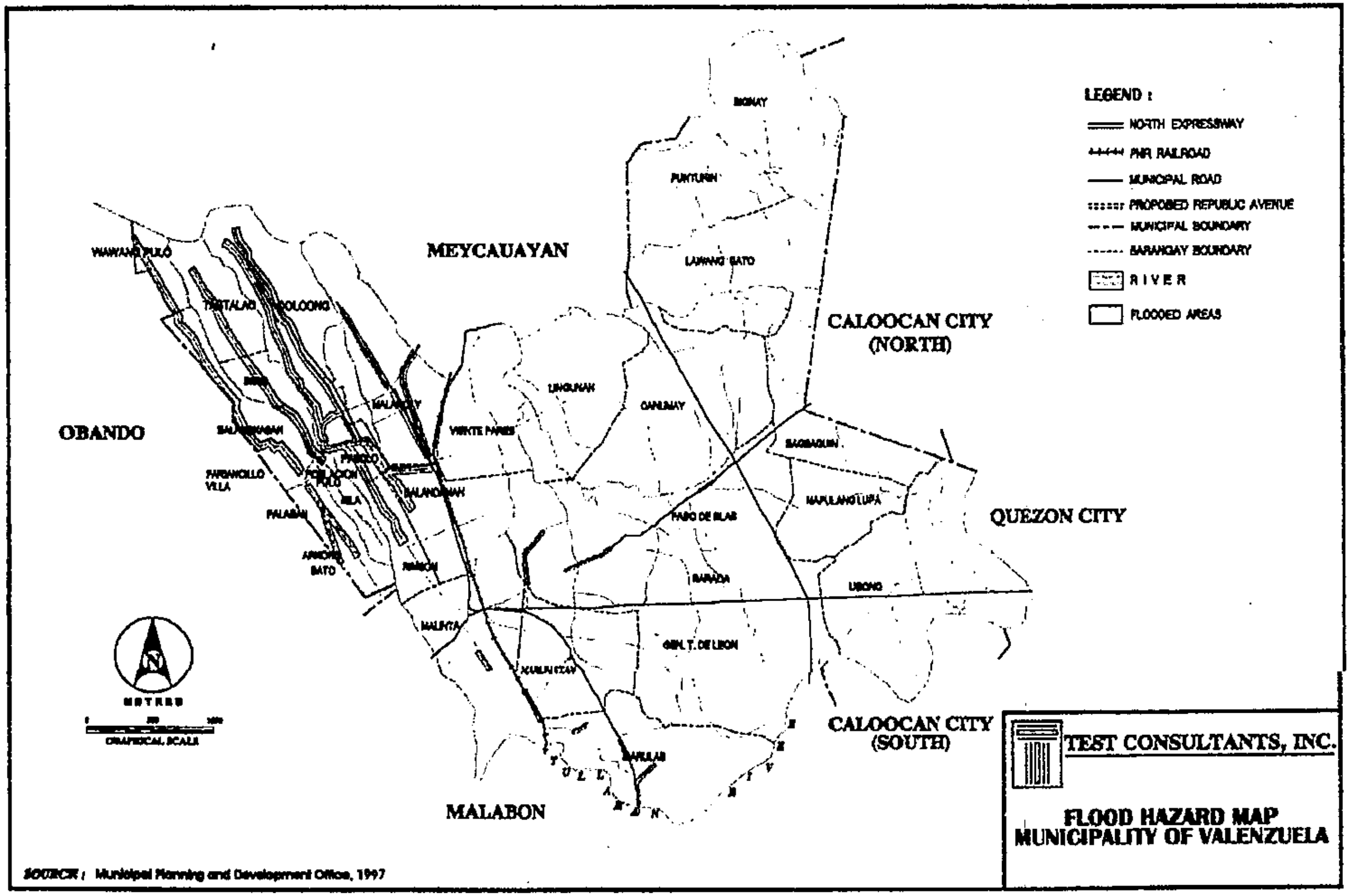

FIGURE 4.49: FLOOD HAZARD MAP OF VALENZUELA
Source: MCRRS Phase 1A-2 EIS, Test Consultants, In

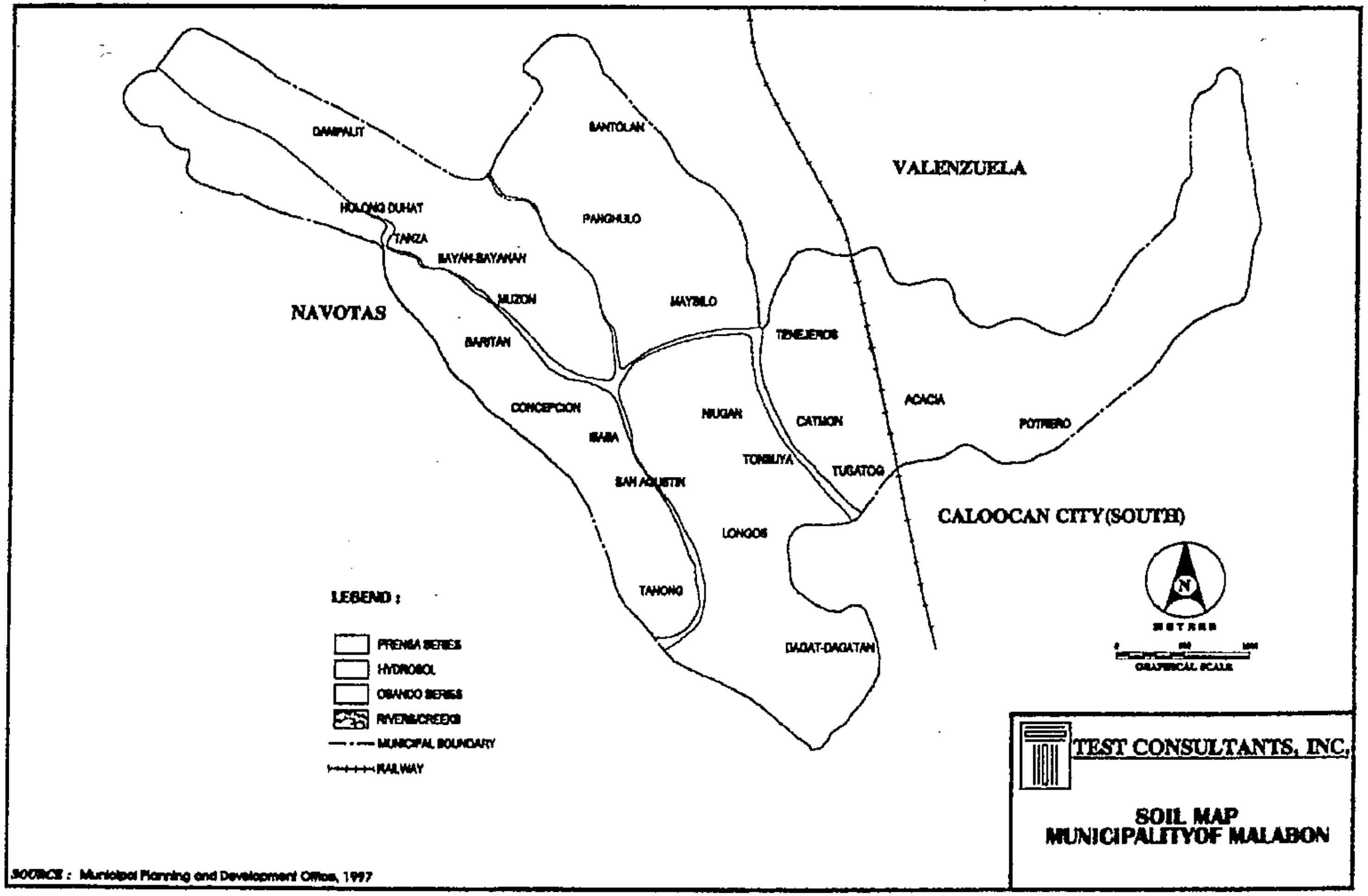

FIGURE 4.51: SOIL MAP OF MALABON
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

(iii) Soil erosion

The area is relatively flat, 0-3% slope ratio. Observation indicated there is no area within the ROW that is actively eroding.

(e) Laboratory Results of Soil Sample Analyses

Please refer to Section 4.2.1 (h).

4.2.3 *Hydrology*

(a) Regional Hydrogeologic Map

The Tullahan - Malabon River is the major river system which crosses the PNR ROW in Malabon. It has a drainage area of about 69,325 km^2 (Figure 4.52).

SRG conducted a hydrological study to determine the discharges which may occur in Tullahan River as it crosses the Caloocan – Valenzuela segment of the NorthRail Project. Using this discharge data, the works necessary to provide transversal and longitudinal drainage along the planned alignment will be determined.

The process began by delimiting the basins that crosses the alignment of the Project using a 1:50,000 scale map from the National Mapping and Resource Information Authority (NAMRIA) in order to determine the principal basin and sub-basins that may affect the Project. Using the said map and AutoCAD, the total area of the basins and the length of the principal channel were calculated. The reference elevations of the basins to determine average gradients were also taken from the same map.

The physical and hydrological parameters deduced from the above-mentioned process are presented in Tables 4-4 and 4-5 below:

TABLE 4-4: PHYSICAL AND HYDROLOGICAL CHARACTERISTICS OF TULLAHAN BASIN 1

Basin	Name	Sub-basin	Type	Area Coefficient	Length (km)	Elevation		Diff of Level
						Max	Min	
0	Tullahan	SB-0.1	Point Basin	1	23.95	200	80	120
		SB-0.2	Point Basin	1	5.925	90	28	62
		SB-0.3	Point Basin	1	9.125	95	38	57
		SB-0.4	Diffused Basin	1	8.525	70	30	40
		SB-0.5	Point Basin	1	6.725	50	30	20
		SB-0.6	Diffused Basin	1	6.800	30	3	27
		SB-0.7	Diffused Basin	1	8.275	30	3	27

Source: CEW-A-07-03 Hydrological Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

TABLE 4-5: PHYSICAL AND HYDROLOGICAL CHARACTERISTICS OF TULLAHAN BASIN 2

Basin	Name	Sub-basin	Type	Mean Slope	Time of Concentr ation	Lag Time (h)	Interval 0.29 TLAG (h)
0	Tullahan	SB-0.1	Point Basin	0.0104	4.57	2.74	0.8
		SB-0.2	Point Basin	0.0200	1.49	0.89	0.3
		SB-0.3	Point Basin	0.0143	1.93	1.16	0.3
		SB-0.4	Diffused Basin	0.0267	0.81	0.49	0.1
		SB-0.5	Point Basin	0.0067	1.79	1.07	0.3
		SB-0.6	Diffused Basin	0.0180	0.88	0.53	0.2
		SB-0.7	Diffused Basin	0.0180	0.88	0.53	0.2

Source: CEW-A-07-03 Hydrological Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

Figures 4.53 – 4.55 illustrate the basin maps for the Caloocan – Valenzuela section of the NorthRail Project.

(b) Streamflow Measurements / Mean Monthly Flow Data

The basic climatic variables for this hydrological study are summarized in Table 4-6.

(c) Flood Peaks, volumes, frequency rating curves and Stormwater flow estimates

Using the HEC – 2 model developed by the US Corps of Engineers, Hydrologic Engineering Center and the corresponding discharge values (m^3/s) for return periods 2, 10, 25, 50, 100, 500 yrs. are summarized and presented in Table 4-7. Isohyetal maps for return periods of 2, 10, 25, 50, 100 and 500 years are shown in Figures 4.56 – 4.61.

TABLE 4-6: BASIC CLIMATIC VARIABLES (MANILA, PORT AREA)

Climatic Elements	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Rainfall (mm)	13	4	6	54	112	240	335	428	323	192	128	55	1890
Number of Rainy Days	4	2	2	2	8	16	23	22	20	14	12	8	133
Mean Temperature (^0C)	25.4	26.2	27.4	29.0	29.5	28.5	27.7	27.3	27.5	27.3	26.7	25.8	27.3
Relative Humidity (%)	76	71	67	65	69	78	82	84	84	82	80	79	76
Cloudiness	6	5	4	4	6	8	8	8	9	7	7	6	7
Prevailing Winds	SE/3	SE/3	SE/4	SE/4	SE/3	SW/3	SW/3	SW/2	SW/2	SE/2	SE/2	SE/2	SE/3

Source: CEW-A-07-03 Hydrological Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

TABLE 4-7: TULLAHAN RIVER DISCHARGES DURING VARIOUS RETURN PERIODS

Basin	Description	Reference P.K.	Basin Area km^2	Return Period					
				2 Y m^3/s	10 Y m^3/s	25 Yr m^3/s	50 Yr m^3/s	100 Yr m^3/s	500 Yr m^3/s
B – 0	Tullahan River	116 + 600	69.325	164	356	457	530	606	775

Source: CEW-A-07-03 Hydrological Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

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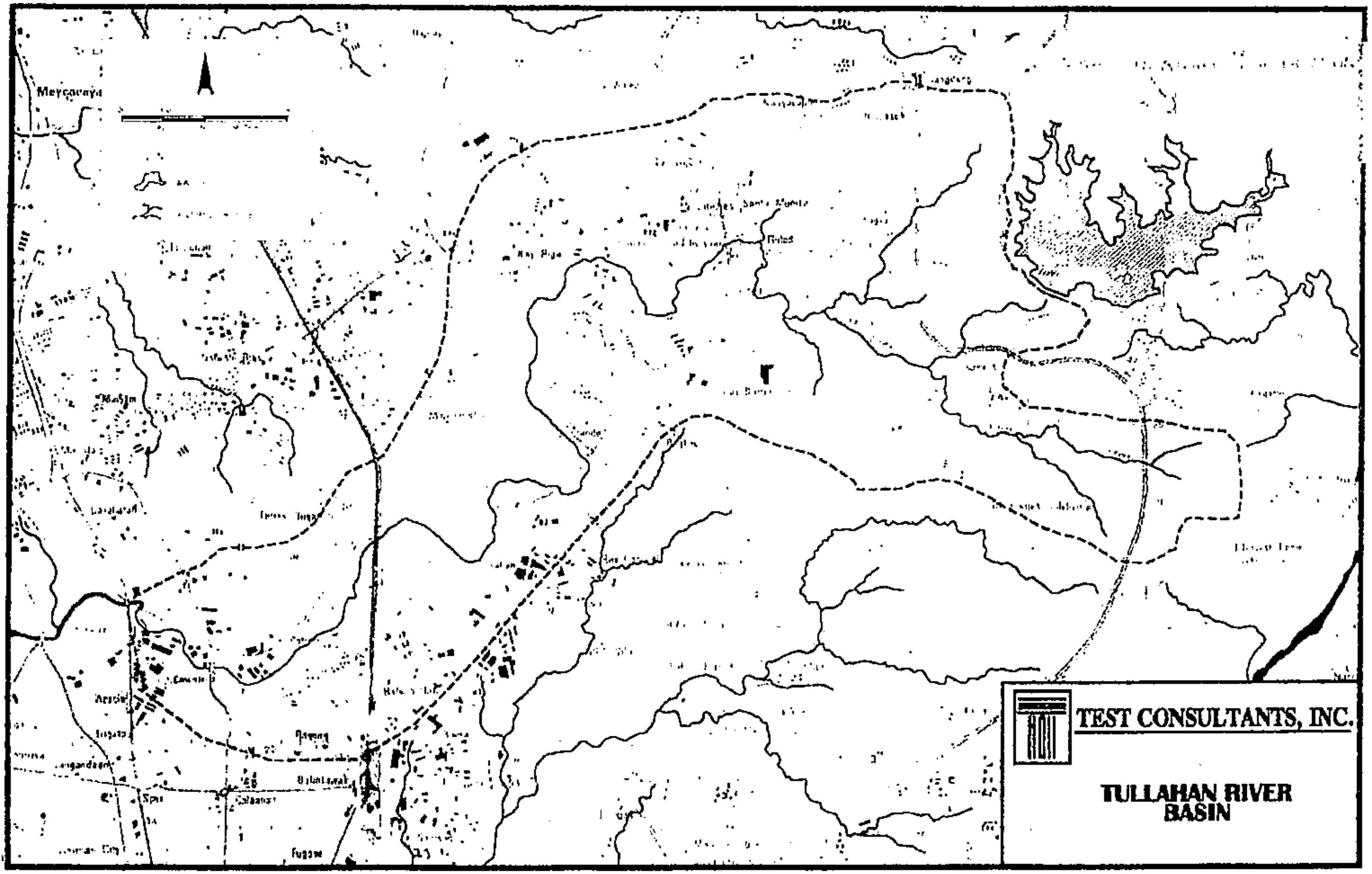

FIGURE 4.52: TULLAHAN RIVER BASIN
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc

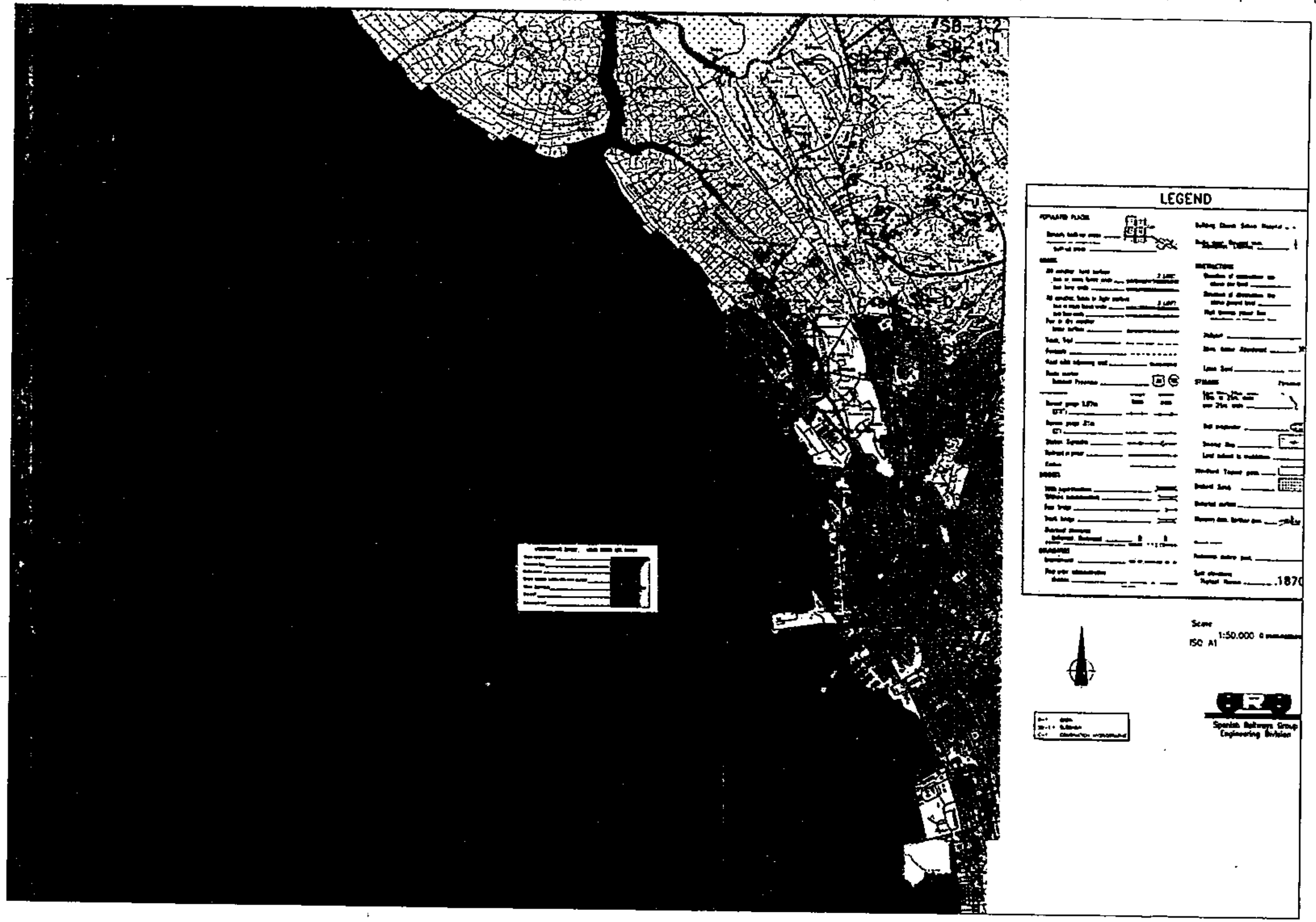

FIGURE 4.53: BASIN MAP (1 OF 3)
Source: CEW-A-07-03 Hydrological Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

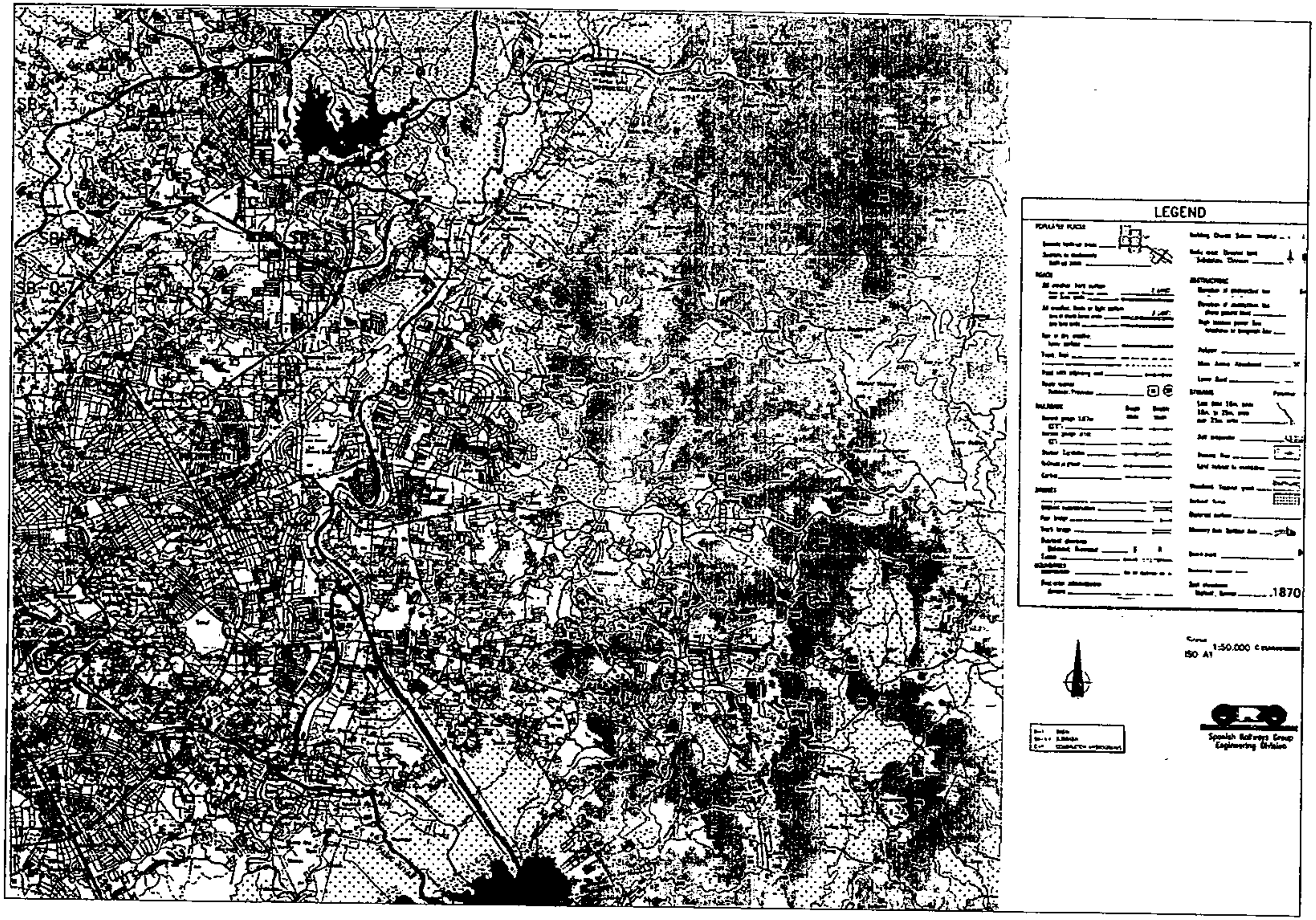

FIGURE 4.54: BASIN MAP (2 OF 3)
Source: CEW-A-07-03 Hydrological Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

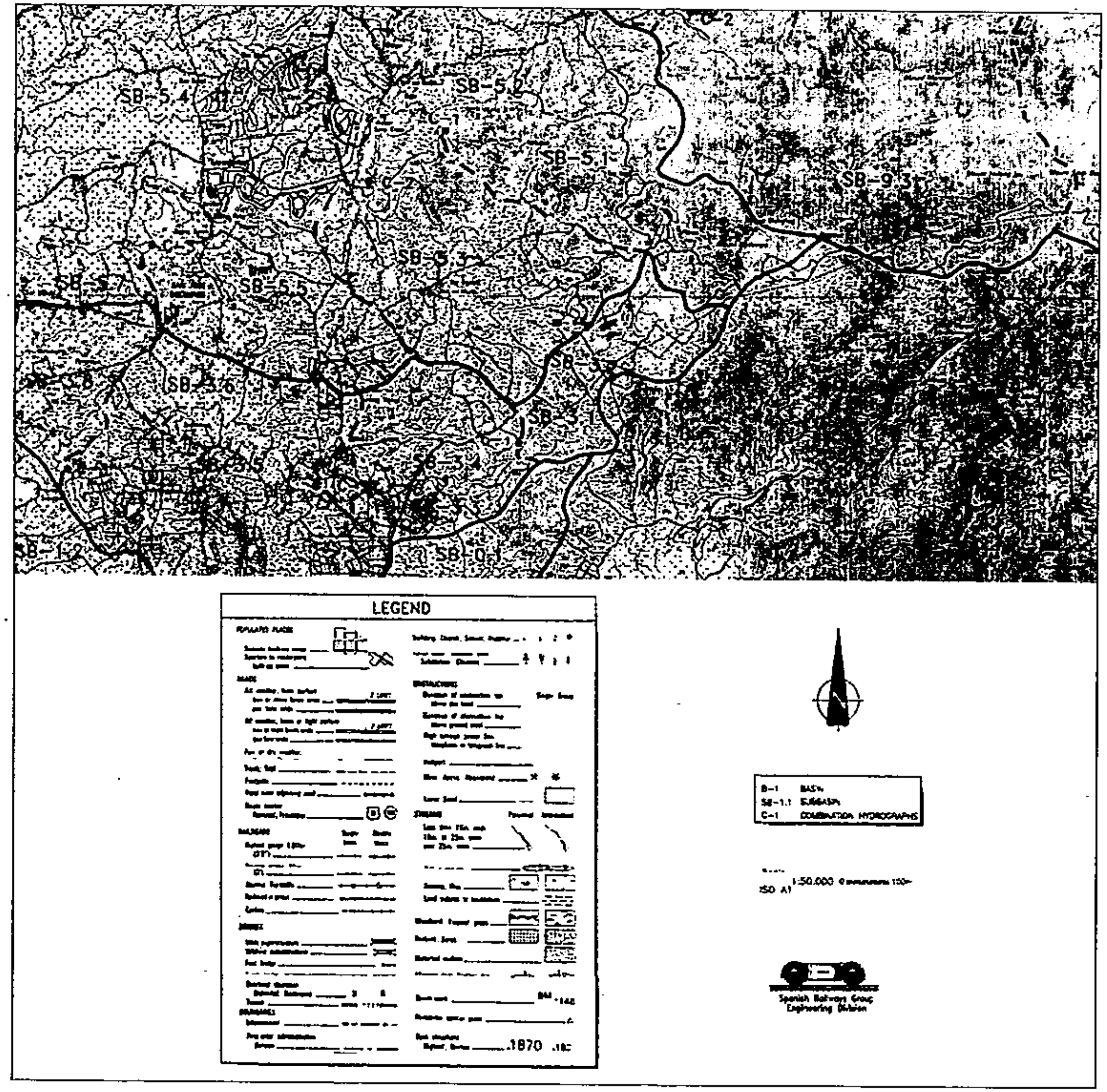

FIGURE 4.55: BASIN MAP (3 OF 3)
Source: CEW-A-07-03 Hydrological Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

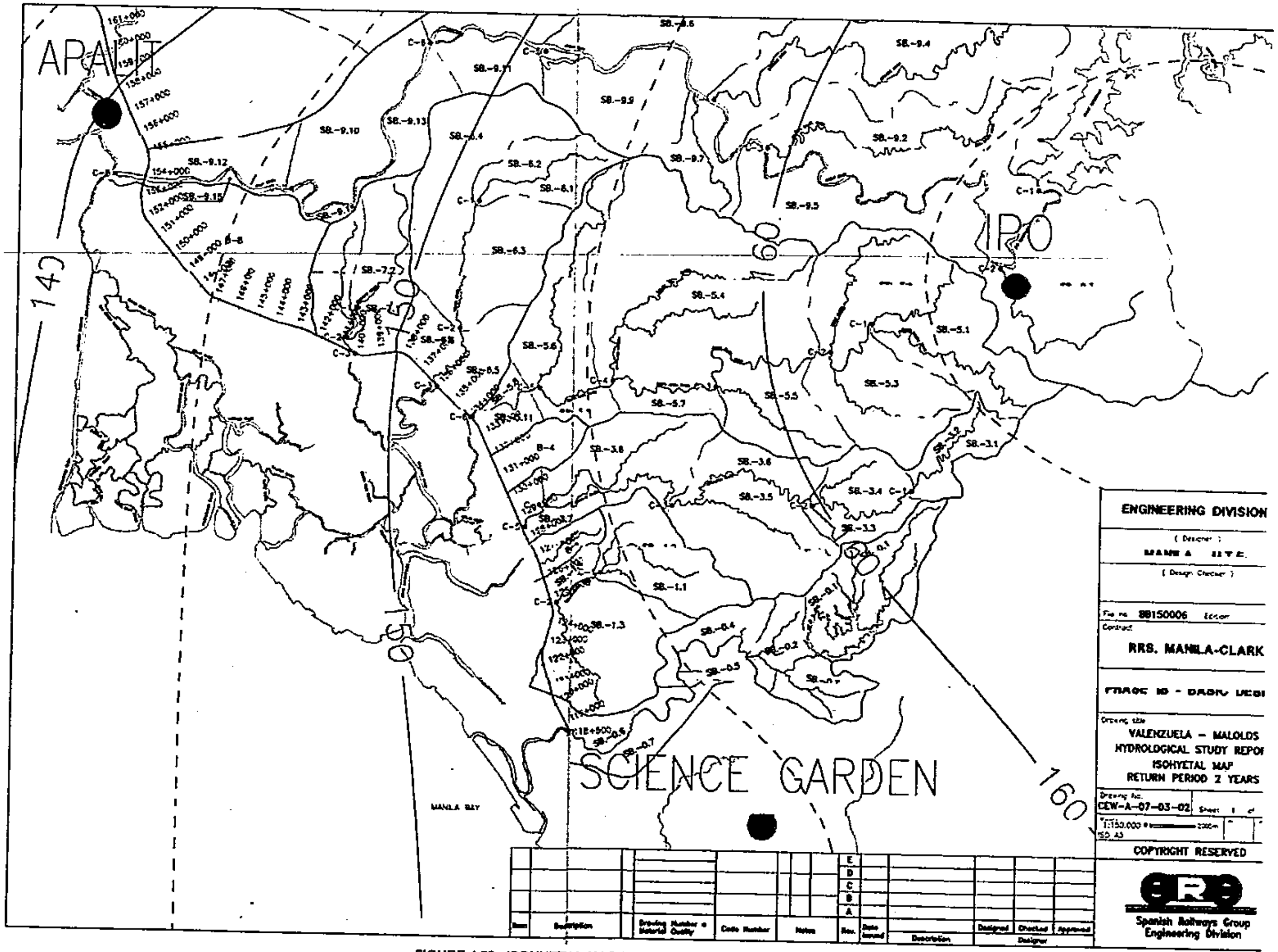

FIGURE 4.56: ISOHYETAL MAP (RETURN PERIOD 2 YEARS)
Source: CEW-A-07-03 Hydrological Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

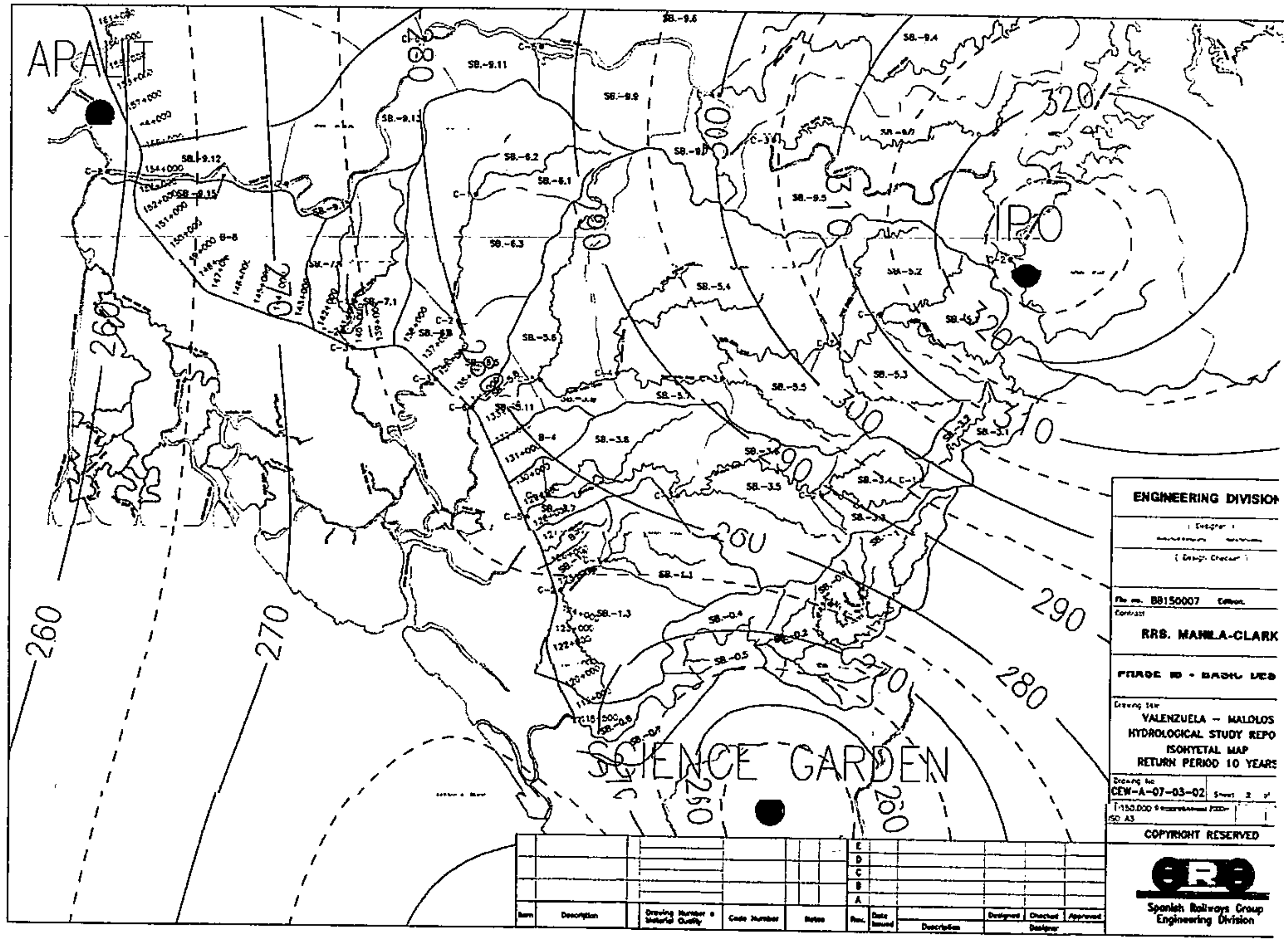

FIGURE 4.57: ISOHYETAL MAP RETURN PERIOD 10 YEARS
Source: CEW-A-07-03 Hydrological Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

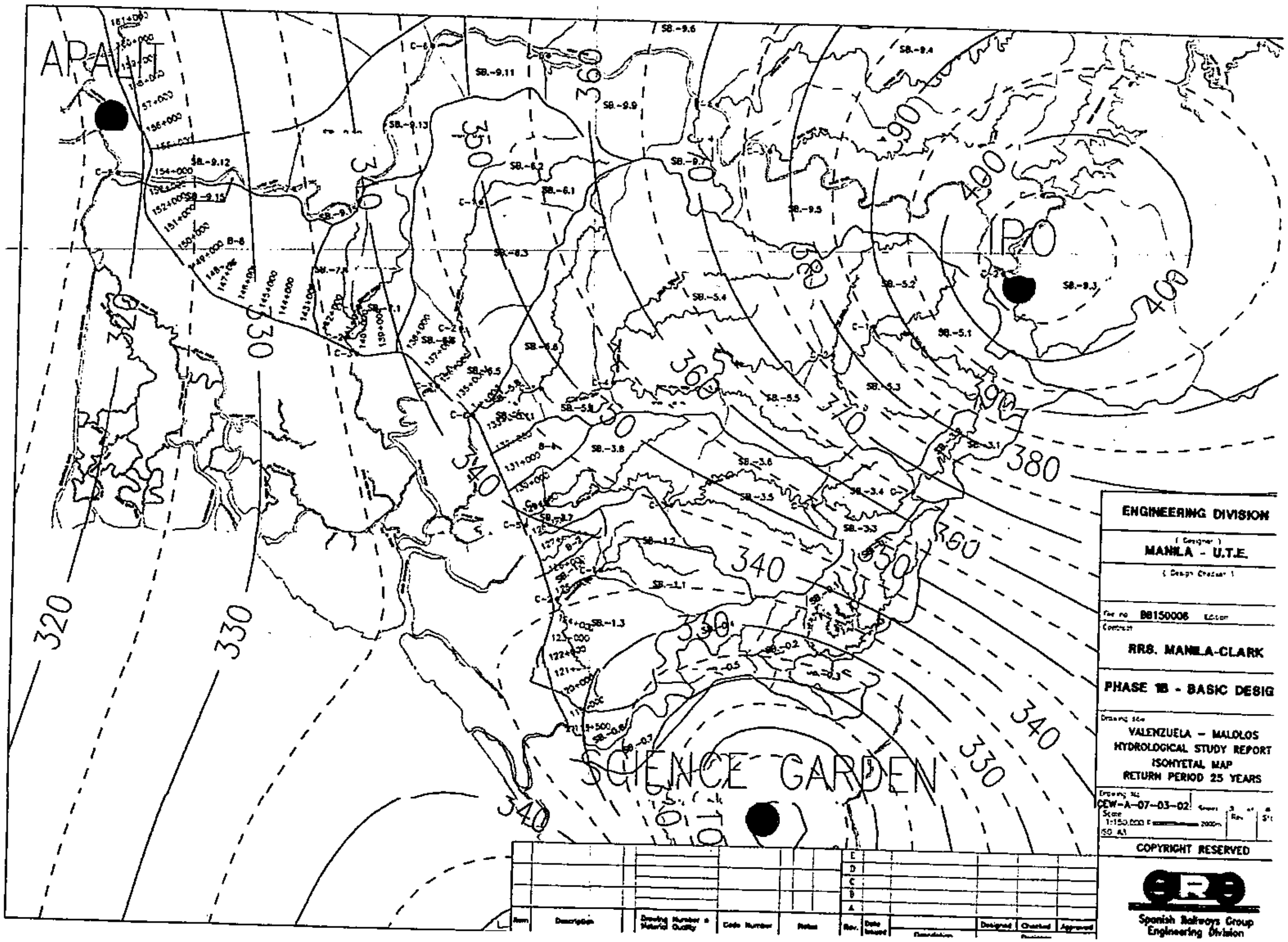

FIGURE 4.58: ISOHYETAL MAP RETURN PERIOD 25 YEARS
Source: CEW-A-07-03 Hydrological Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

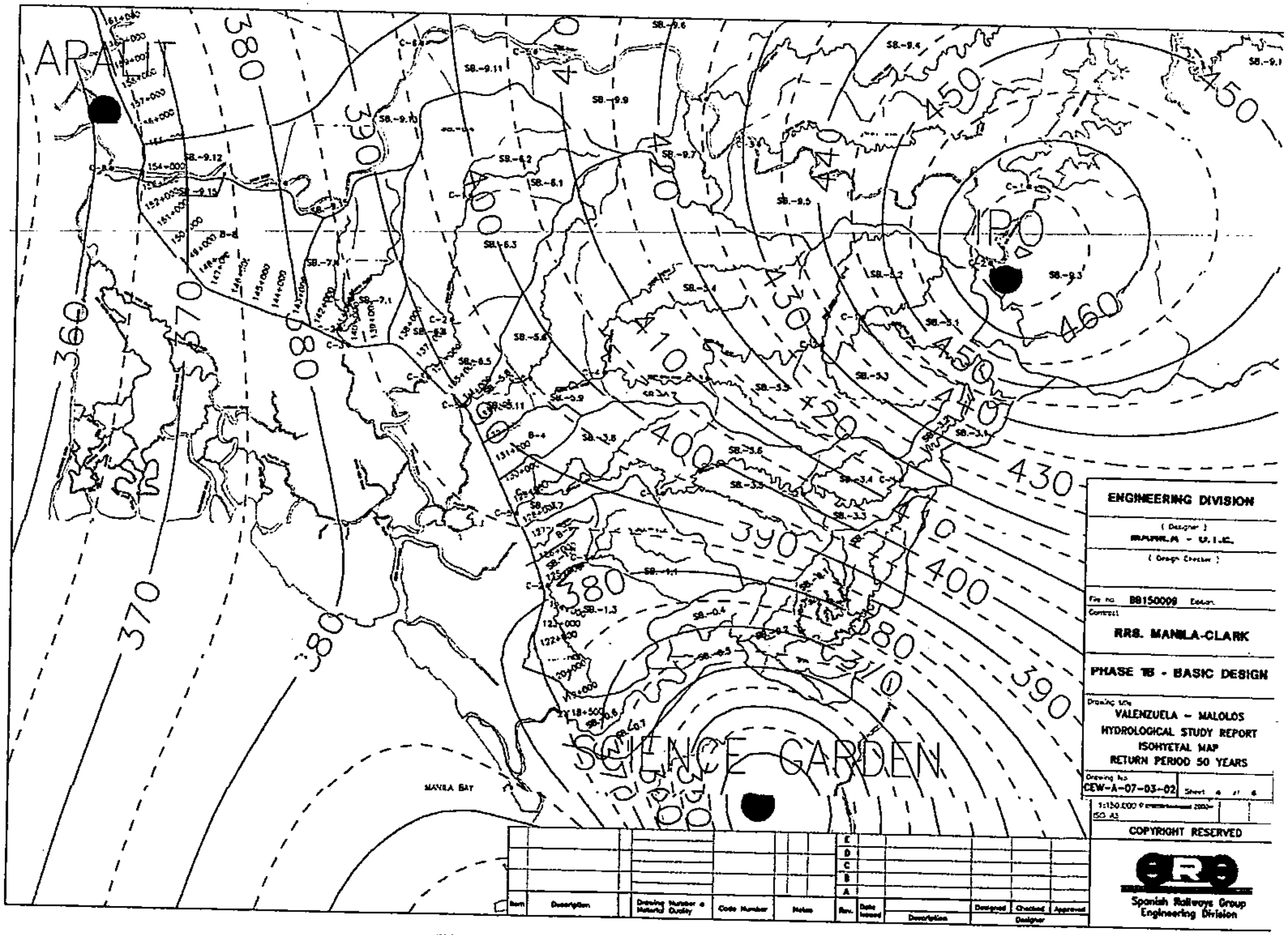

FIGURE 4.59: ISOHYETAL MAPRETURN PERIOD 50 YEARS
Source: CEW-A-07-03 Hydrological Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

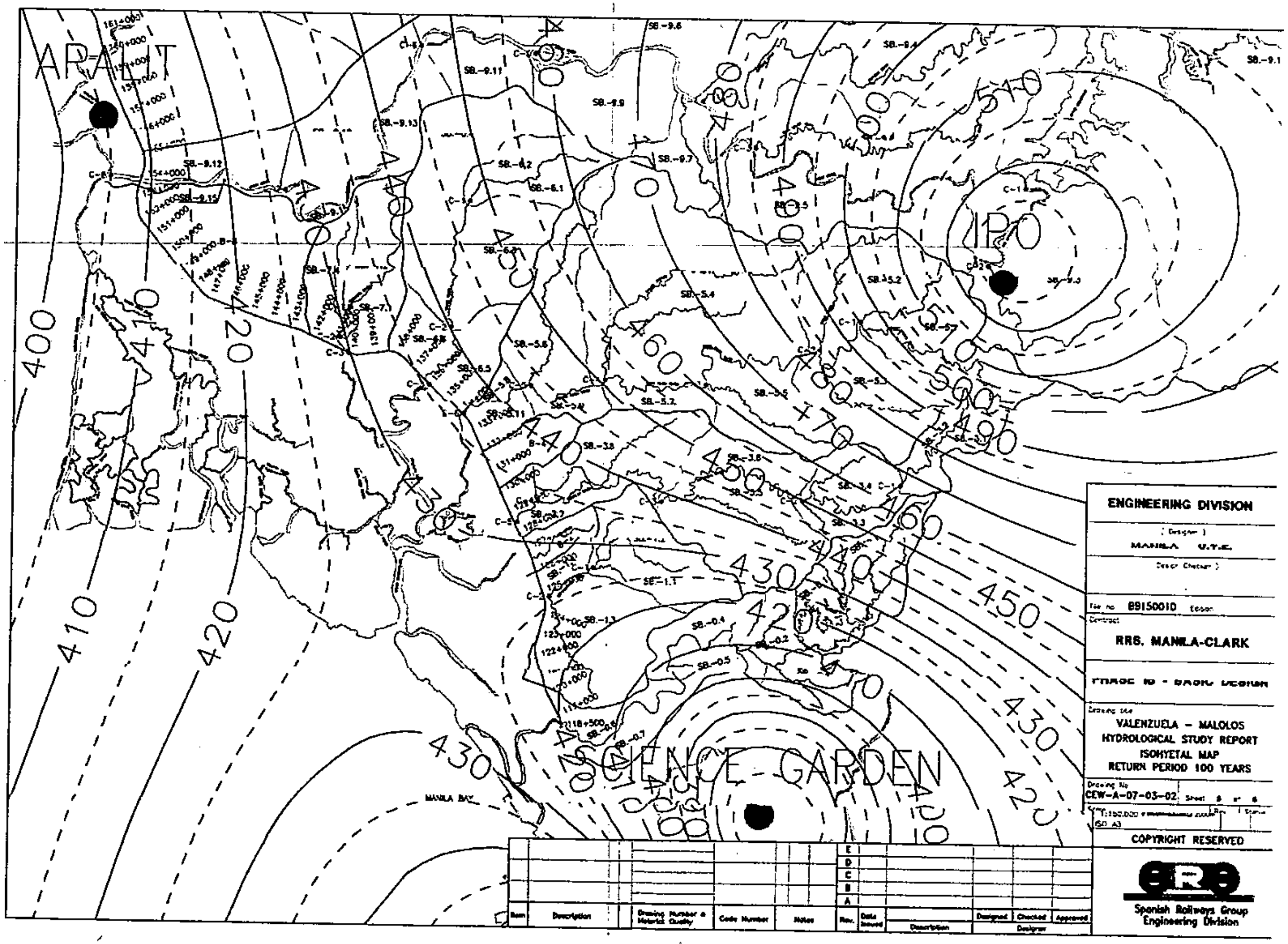

FIGURE 4.60: ISOHYETAL MAPRETURN PERIOD 100 YEARS
Source: CEW-A-07-03 Hydrological Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

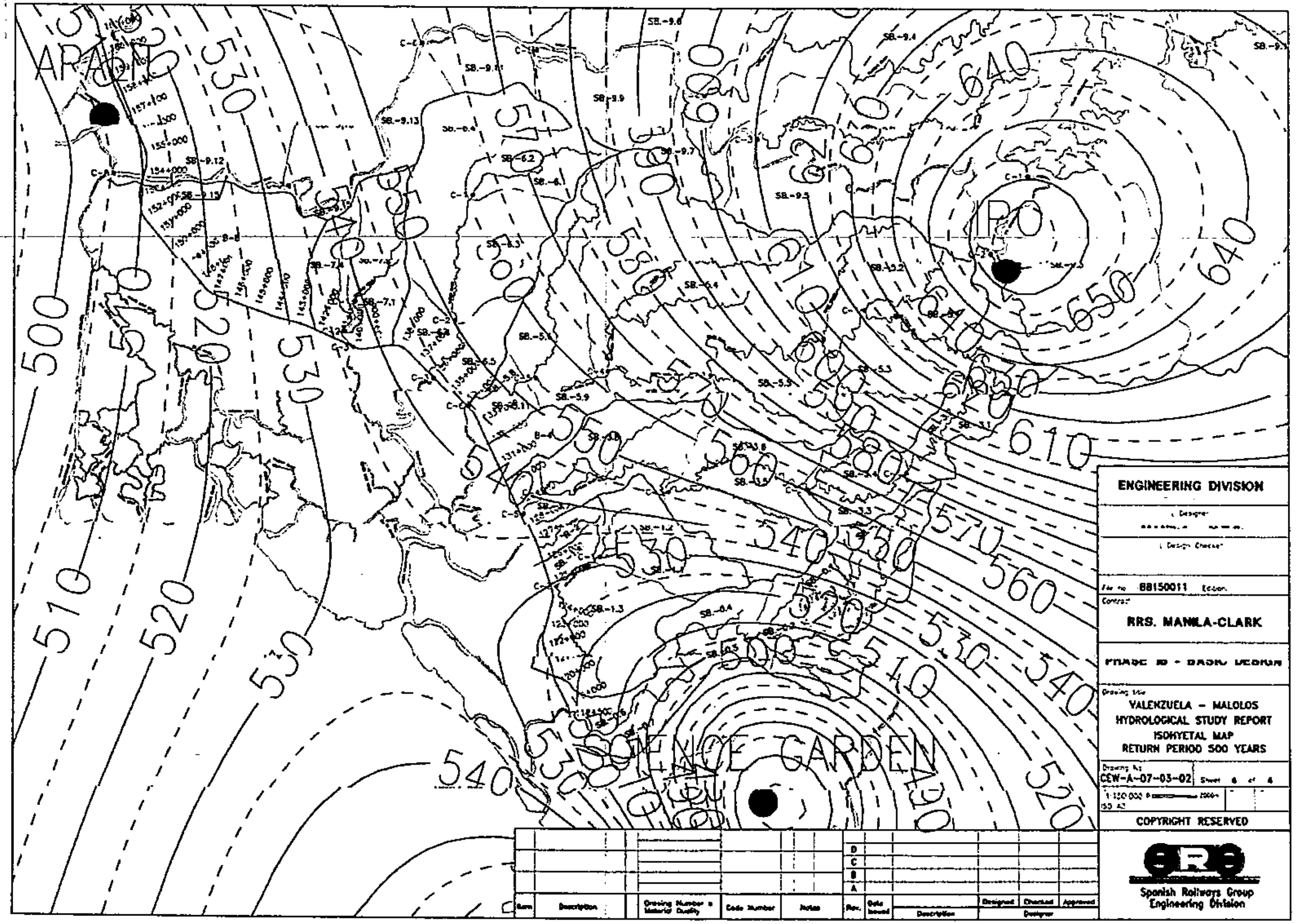

FIGURE 4.61: ISOHYETAL MAP RETURN PERIOD 500 YEARS
Source: CEW-A-07-03 Hydrological Study Report MCRRS Phase 1B (Balintawak – Valenzuela), SRG, October 1996

Information gathered from the Malabon Engineering Office states that the flood level of Tullahan River had been going up to about 1 foot in every 2 years. This observation will likely continue as long as siltation on the river bed is not stopped.

The Prime Contractor assumed that the flooding frequency of 1/100Y and 1/50Y will be taken into account for bridges and culverts, respectively.

(d) Spring and Well inventory
Actual foot survey along the PNR ROW in Caloocan City and Malabon City revealed the presence of several water wells. However, there is no available information on the exact number of water wells within the area. For Valenzuela City, no well is situated in the area.

4.2.4 *Water Quality*

(a) Physico-Chemical and Bacteriological Characteristics of Wells and Springs
In October 1998, it was observed that the average groundwater level is about 40 m below ground surface. An in-depth study on well characteristics was not undertaken because all existing wells within the project area will be closed and sealed. Waters in these areas will not be used for any purpose by the Project and no project activities could significantly impair the water quality.

(b) Physico-Chemical and Bacteriological Characteristics of Inland Surface Waters
On December 2000, TCI took water samples from Panaca Creek and Tullahan River and tested them for presence of heavy metals. These samples were brought to Ostrea Mineral Laboratories, Inc. for testing. Test results were released to NLRC on January 2001 (please refer to Annex L).

TABLE 4-8: WATER SAMPLING RESULTS (TEST FOR PRESENCE OF HEAVY METALS)

Parameters	TULLAHAN RIVER	PANACA CREEK	DENR Standards (DAO 90-34)
BOD (mg/L)	31	31	10(15)
TSS (mg/L)	7	7	< 60 mg/L increase
Cr^{+6} (mg/L)	<0.01	<0.01	0.01
As (mg/L)	<0.001	<0.001	0.05
Cd (mg/L)	<0.003	<0.003	
Cr (mg/L)	<0.02	-	

TABLE 4-8: WATER SAMPLING RESULTS (TEST FOR PRESENCE OF HEAVY METALS)

Parameters	TULLAHAN RIVER	PANACA CREEK	DENR Standards (DAO 90-34)
Cu (mg/L)	<0.005	<0.005	
Fe (mg/L)	1.806	0.488	
Pb (mg/L)	<0.01	<0.01	
Ag (mg/L)	<0.01	<0.01	
Zn (mg/L)	0.037	0.037	
Hg (mg/L)	<0.0001	<0.0001	0.002

TABLE 4-9: WATER QUALITY OF TULLAHAN RIVER TEST RESULTS (BASED ON DENR RIVER MONITORING PROGRAM)

Parameters	DENR River Monitoring program	DENR Standards (DAO 90-34)
Color Units (Apparent)	Black	No abnormal discoloration from abnormal causes
Turbidity, NTU	150	
Temperature, ^{0}C	31.5	Maximum increase <= 3
Ph	8.00	6.0 – 9.0
DO, mg/L	0	3.0
BOD (5-day) at 20^{0}C mg/L	26	
Dissolved Solids, mg/L		
Total Solids, mg/L		
Suspended Solids, mg/L	20	Increase <60 mg/L
Salinity, (%)	0.18	
Conductivity, mS/cm	3.71	

Tullahan River and Panaca River are both classified as Class D Fresh Surface Waters based on the DENR Administrative Order (DAO) No. 34 Series of 1990 (DAO 34-90) on water usage, classification and quality criteria. Best usage for Class D waters are agriculture, irrigation, livestock watering, industrial water supply (Class II). The classification is also based on the quality of the rivers listed in Table 4-8 and 4-9. The results of the sampling show that they were within the range set by the DENR for Class D Fresh Surface Waters.

Based on Table 3-27 of the report, as compared to DENR effluent standards for Class C type of receiving body of water, the effluent standard is acceptable.

Table 3-27 Proposed Water Quality

Parameters	Domestic Sewage At Inlet	Domestic Sewage At Outlet	DAO 35*, Class C	Production Waste Water At Inlet	Reclaimed Water
BO D_5	≤120mg	30mg	80 mg/L	400 mg	≤10 mg
C OD	≤250mg	120mg	150 mg/L	≤300 mg	≤50 mg
S S	≤220mg	≤30mg	90 mg/L	-	≤5mg
p H	6.5 – 8.5	6 – 9	6 – 9	6.5 – 8.5	-
O rganic Matters	-	-	-	≤150 mg	-

Railways Project Section 1 Phase 1 (Caloocan – Malolos) Technical Document Contract between NLRC and CNMEG, November 2003
*Notes: *Numbers are DENR DAO 35, for Class C, OEI.*

(c) Sampling Site Map
Please refer to Figures 4.62 and 4.63.

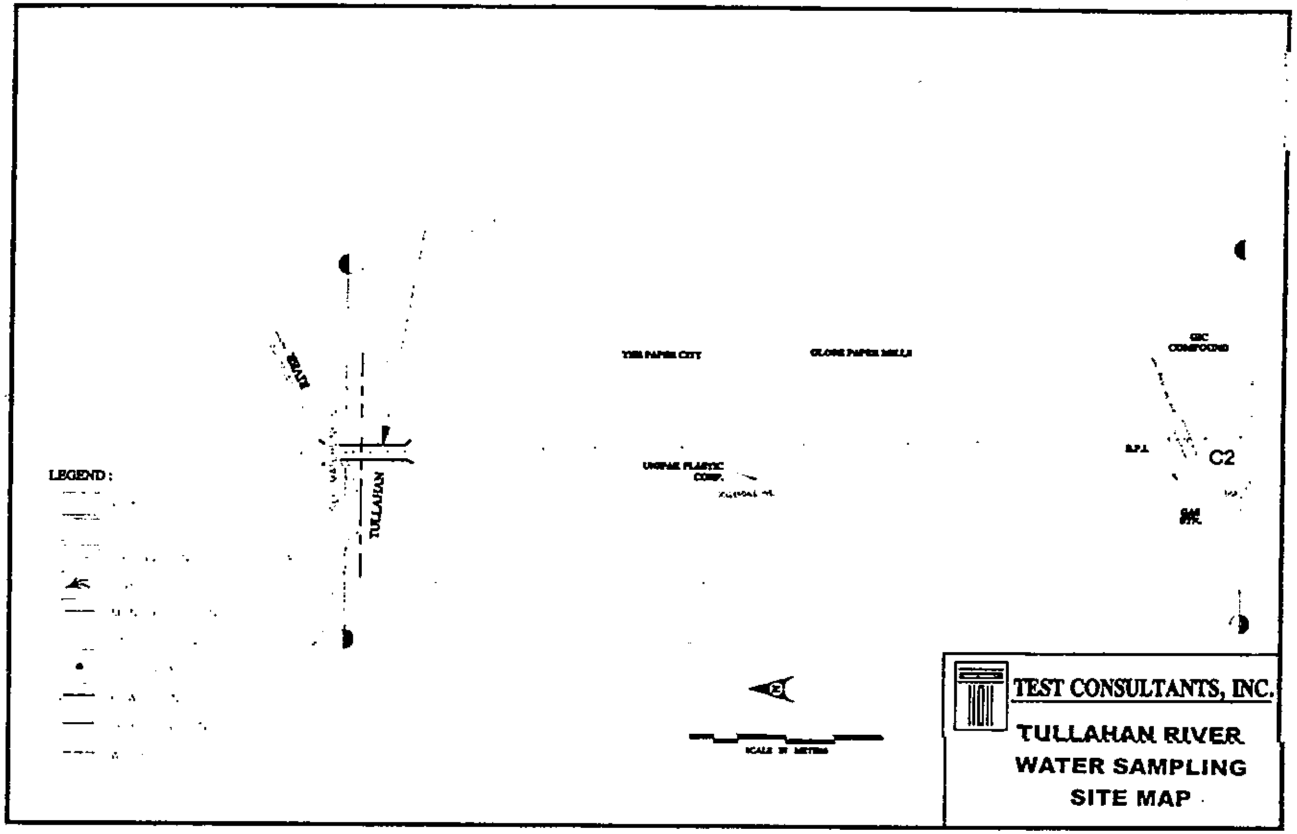

FIGURE 4.62: TULLAHAN RIVER WATER SAMPLING MAP
Source Base Map: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

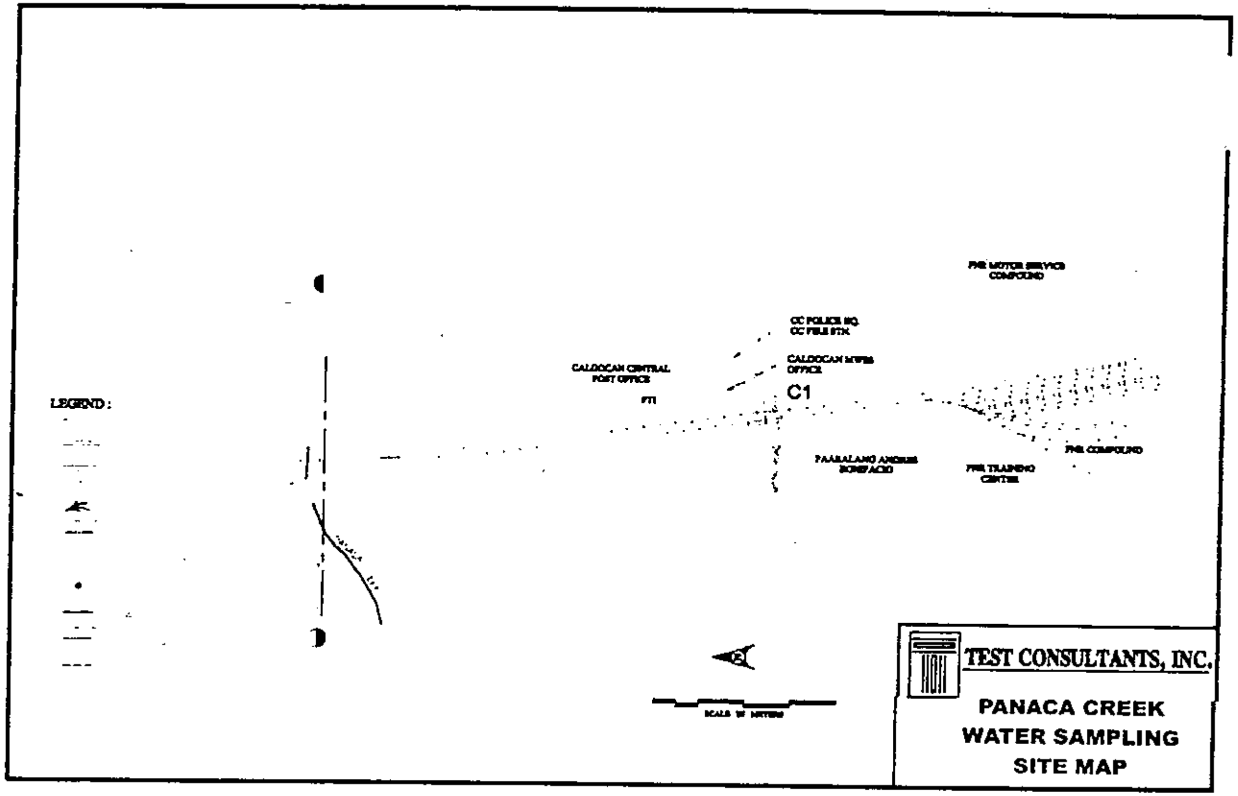

FIGURE 4.63: PANACA CREEK WATER SAMPLING MAP
Source Base Map: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

4.2.5 *Meteorology / Climatology*

(a) Monthly Average Rainfall of the Area

The Coronas classification of climate is based on the average rainfall distribution received in a locality. This Project is within Metro Manila and is included in the western portion of the island of Luzon under the Type 1 climate as indicated in Climate Map (Figure 4.64). Areas having Type 1 climate experience two pronounced seasons, generally dry from December to May, and wet from June to November. These places are commonly affected by the southwest monsoon flow and receive substantial rainfall brought about by occurrences of tropical cyclone.

(b) Climatological Normals / Extremes

Several climatological parameters affect the over-all climate in the area where the Project will be sited (Figure 4.46). The data from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) synoptic station which are representative of the various conditions in this area are obtained from the Science Garden in Quezon City. The parameters of the climate normals or averages and the historical extreme climatic conditions experienced in the area are given in Tables 4-10 and 4-11 respectively.

TABLE 4-10: CLIMATOLOGICAL NORMALS FOR SCIENCE GARDEN, QUEZON CITY

Month	Rain (MM)	No. Of RD	Temperature (°C)			RH (%)	Wind Speed		Cloud (OKTA)
			Max.	Min	Mean		Dir.	(MPS)	
Jan	18.7	4	30.2	20.1	25.2	76	NE	2	5
Feb	7.4	2	31.4	20.2	25.8	70	NE	2	4
Mar	16.7	3	33.2	21.4	27.3	67	SE	2	4
Apr	28.5	4	34.8	22.9	28.9	65	SE	2	4
May	141	11	34.6	24.1	29.3	71	SE	2	5
Jun	344.6	18	32.5	24.0	28.3	80	SW	2	6
Jul	478.6	22	31.3	23.6	27.5	84	SW	2	6
Aug	517.1	24	30.8	23.6	27.32	84	SW	2	7
Sep	402.2	22	31.1	23.4	27.3	85	SW	2	7
Oct	268.2	18	31.1	22.8	27.0	83	N	2	6
Nov	147.2	13	30.9	22.0	26.54	81	H	2	5
Dec	61.9	8	30.2	21.0	25.6	79	NE	2	5
ANNUAL	2431.9	149	31.8	22.4	27.1	77	SW	2	5

Latitude 14°39' N Elevation 43.0 m
Longitude 121°03' E Period 1961-1995
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

TABLE 4-11: CLIMATOLOGICAL EXTREMES FROM SCIENCE GARDEN, QUEZON CITY

Month	Temperature °C				Greatest Day Rainfall		Wind			Highest Sea Level Pressure(MBS)			
	High	Date	Low	Date	Amt. (mm)	Date (MPS)	Speed (MPS)	Dir	Date	High	Date	Low	Date
Jan	34.2	29-88	15.5	27-87	55.8	16-88	24/	ESE	17-72	1020.6	30-73	998.8	22-89
Feb	35.6	24-67	15.1	4-87	30.7	12-74	22/	SSE	2-92	1020.1	8-73	1002.3	9-85
Mar	36.8	26-83	14.9	1-63	44.8	15-89	26/	S	16-92	1019.0	2-87	997.8	28-88
Apr	38.0	30-88	17.2	5-63	47.2	16-79	26/	SSE	7-92	1016.3	11-72	1002.1	26-21
May	38.5	14-87	17.8	3-62	166.0	20-96	40/	N	10-92	1015.1	28-86	992.4	17-89
June	38.0	2-93	18.1	27-61	334.5	7-67	37/	SW	25-72	1014.9	7-97	978.7	26-93
July	36.1	9-92	17.7	23-61	218.0	31-72	36/	NNW	9-77	1015.0	1-79	989.2	15-78
Aug	35.8	10-62	17.8	23-64	223.0	15-79	30/	WSW	18-92	1014.1	11-97	994.2	24-78
Sep	35.4	4-88	20.0	8-64	276.5	1-70	30/	SSW	20-92	1016.0	28-97	987.4	30-95
Oct	35.0	20-89	18.6	31-67	209.3	18-75	30/	SE	11-89	1016.0	25-86	978.7	23-88
Nov.	34.2	5-87	15.6	12-62	169.9	20-66	50/	NNW	3-95	1019.1	18-79	883.1	2-95
Dec	33.7	1-94	15.1	13-88	87.2	22-94	22/	SE	22-97	1019.1	21-81	998.4	5-93
ANNUAL	38.5	5-14-87	14.9	3-1-63	334.5	6-7-67	50/	NNW	11-3-95	1020.6	1-30-73	883.1	11-2-95

Period of Record 1950-1995 1949-1995 1966-1995 1949-1997

Note:
1. - Equal Sign Means Year 1800
2. No Record for the Period 1941-1945

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

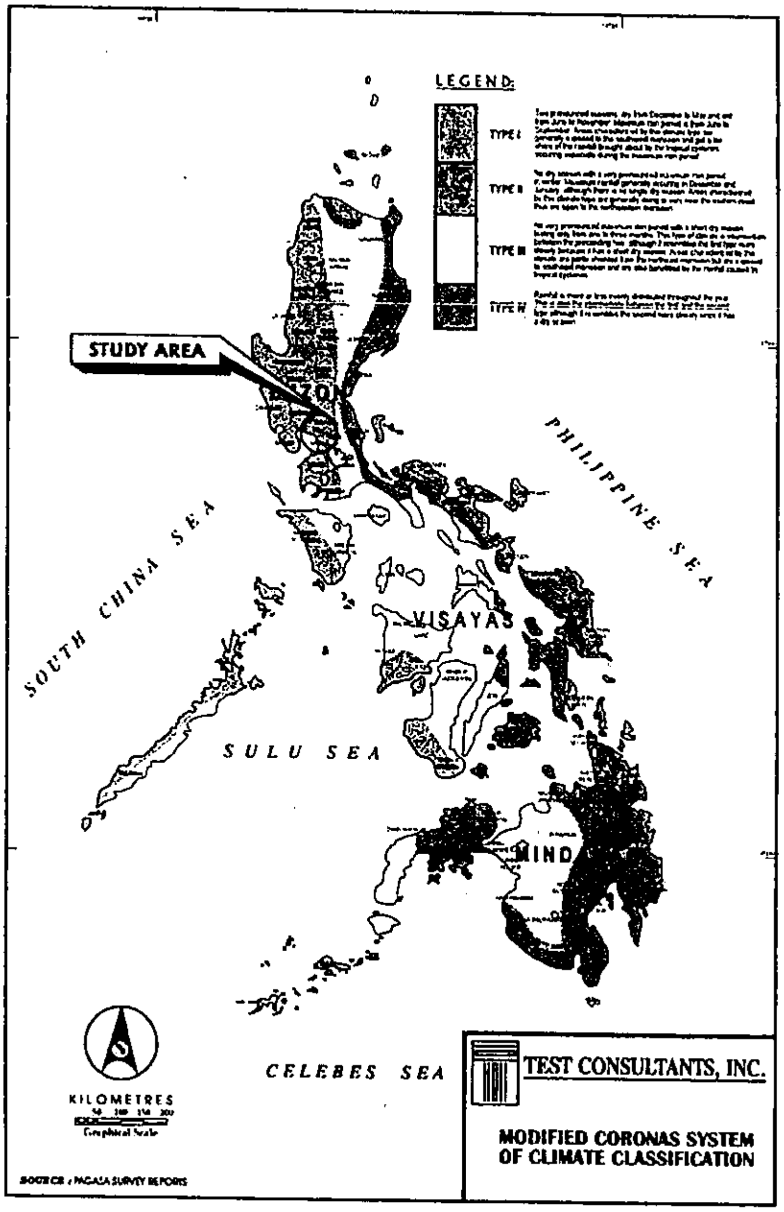

FIGURE 4.64: MODIFIED CORONAS SYSTEM OF CLIMATE CLASSIFICATION
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

(i) Temperature

The Normal monthly maximum temperature value ranges from 30.2°C to 34.8°C with an annual average of 32.0°C while the minimum temperature ranges from 20.1°C to 24.1°C. Under extreme condition, the maximum recorded temperature occurred in May 14, 1987 at 38.5°C while the coldest occurred in March 26, 1983, at 14.9°C.

(ii) Relative Humidity

Percentage water vapor amount in the air ranges in monthly values from 65% to 85%, with an annual average of 77%. These values indicate that the area is relatively humid, which could be attributed to the proximity of the area to the Manila Bay.

(iii) Prevailing Wind

The project area is affected by the northeast wind flow from November to February, the southwest wind flow from June to September, and the trade winds in between monsoons. The annual prevailing wind direction in the area is northeast. The monthly wind speed is 2 meters per second (mps) with an annual average of 2 mps. The highest extreme wind speed of 50 mps was recorded on November 3, 1995.

The typical wind conditions from 1961 to 1995 correspond to the wind condition in the project site. Please refer to Figures 4.65 – 4.71 for the monthly and annual wind roses.

(iv) Rainfall

The amount of normal monthly average rainfall ranges from 7.4 mm (February) to 517.1 mm (August), while the annual rainfall is 2431.9 mm. The highest amount of daily rainfall was recorded at 334.5 mm. last June 1967.

(v) Thunderstorms

Occasional heavy rainfall episodes occur in the area due to localized thunderstorm activities. The frequency of thunderstorm occurrence in the area during the northeast monsoon, southwest monsoon, and transition months are illustrated in Figures 4.72 – 4.74.

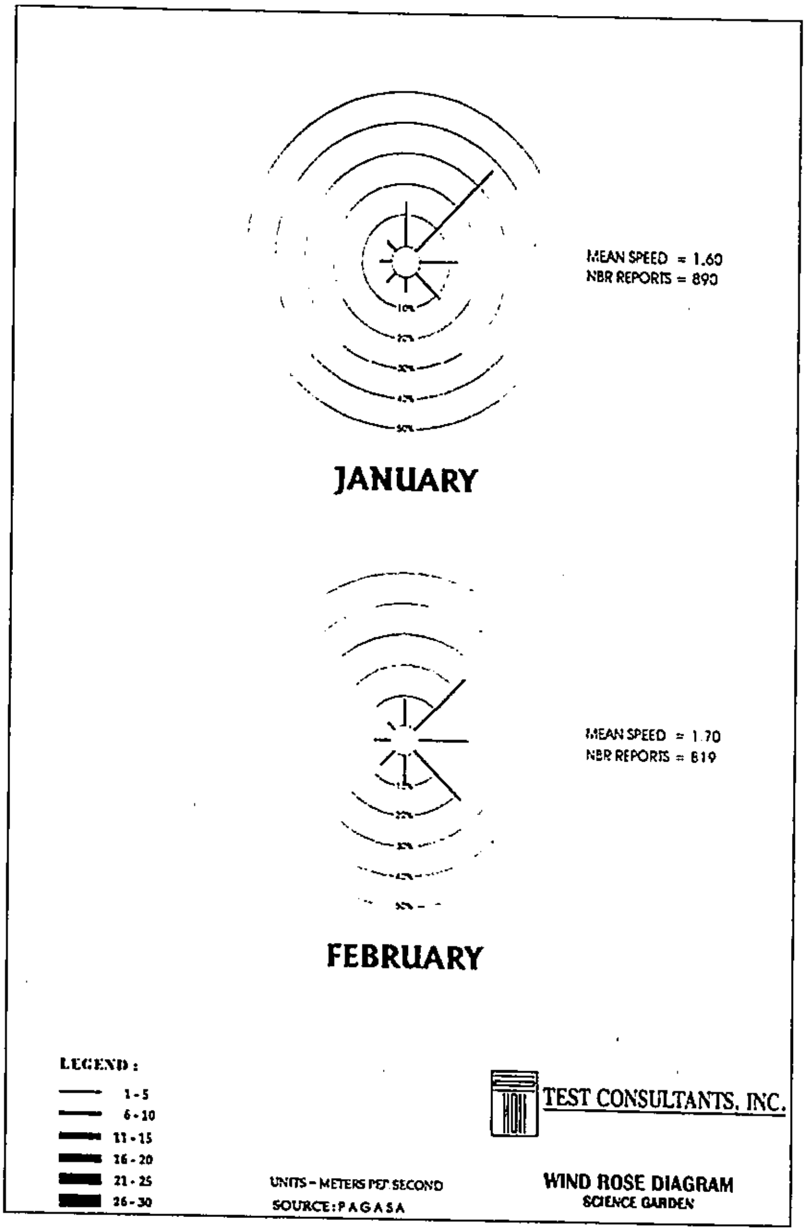

FIGURE 4.65: WIND ROSE DIAGRAM (JANUARY TO FEBRUARY)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

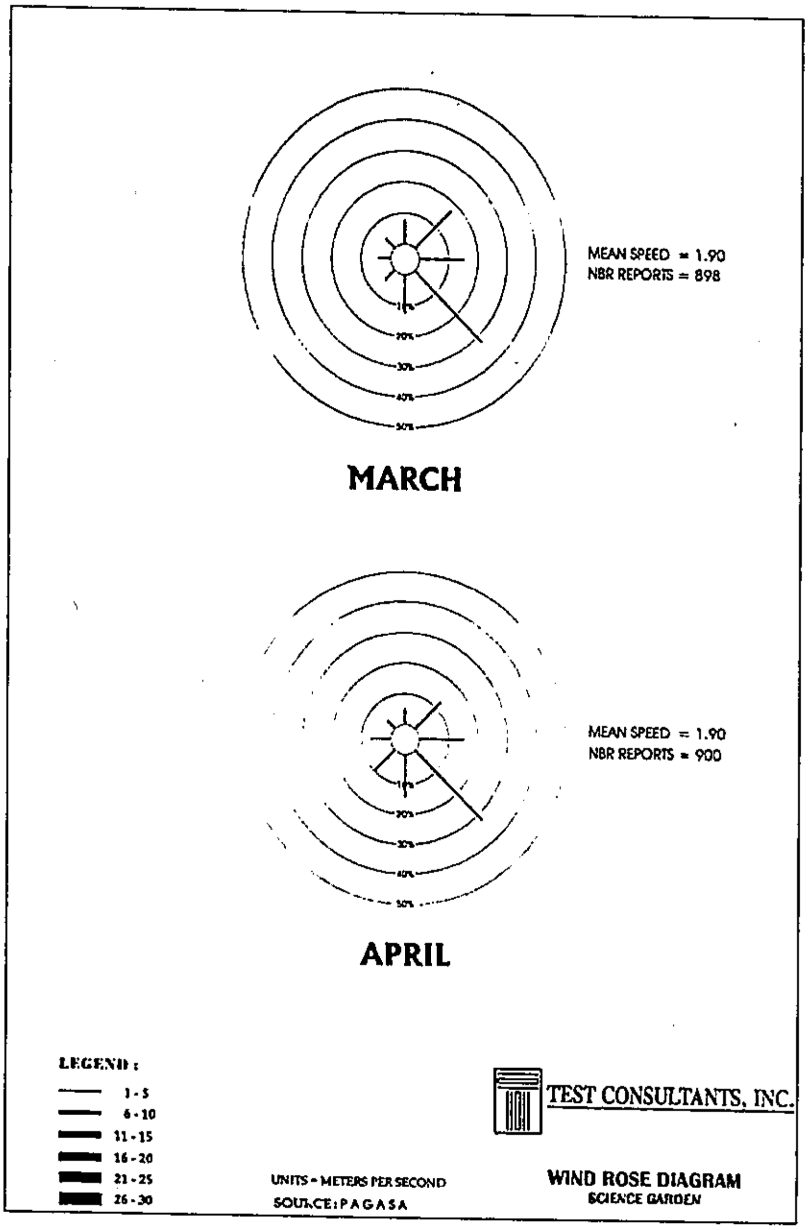

FIGURE 4.66: WIND ROSE DIAGRAM (MARCH TO APRIL)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

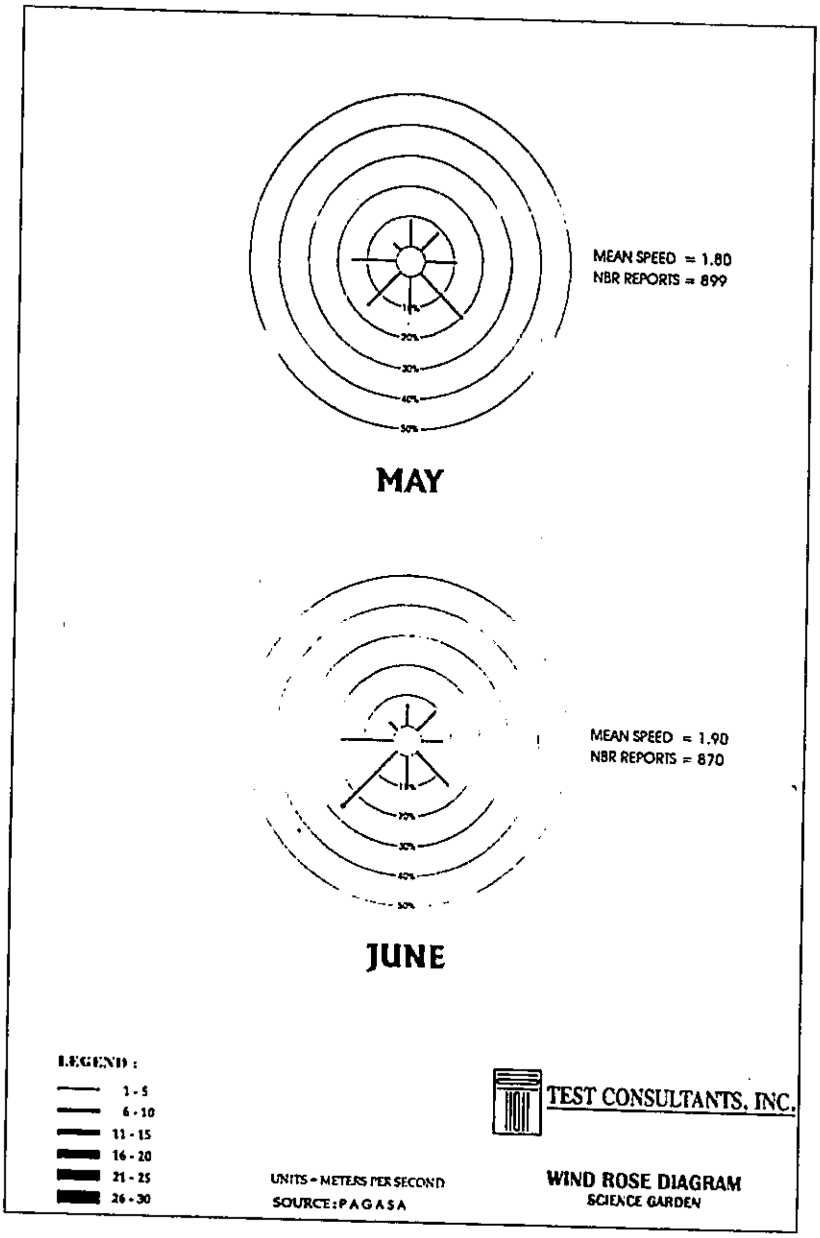

FIGURE 4.67: WIND ROSE DIAGRAM (MAY TO JUNE)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

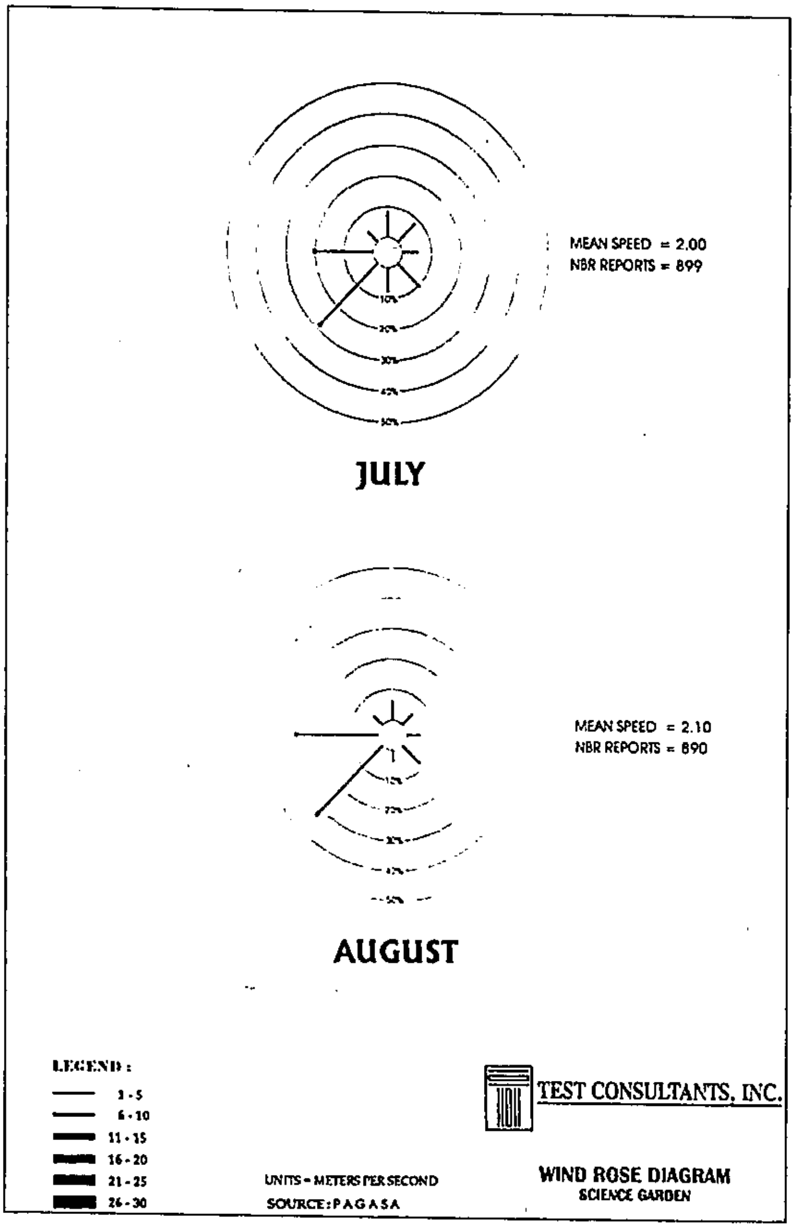

FIGURE 4.68: WIND ROSE DIAGRAM (JULY TO AUGUST)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

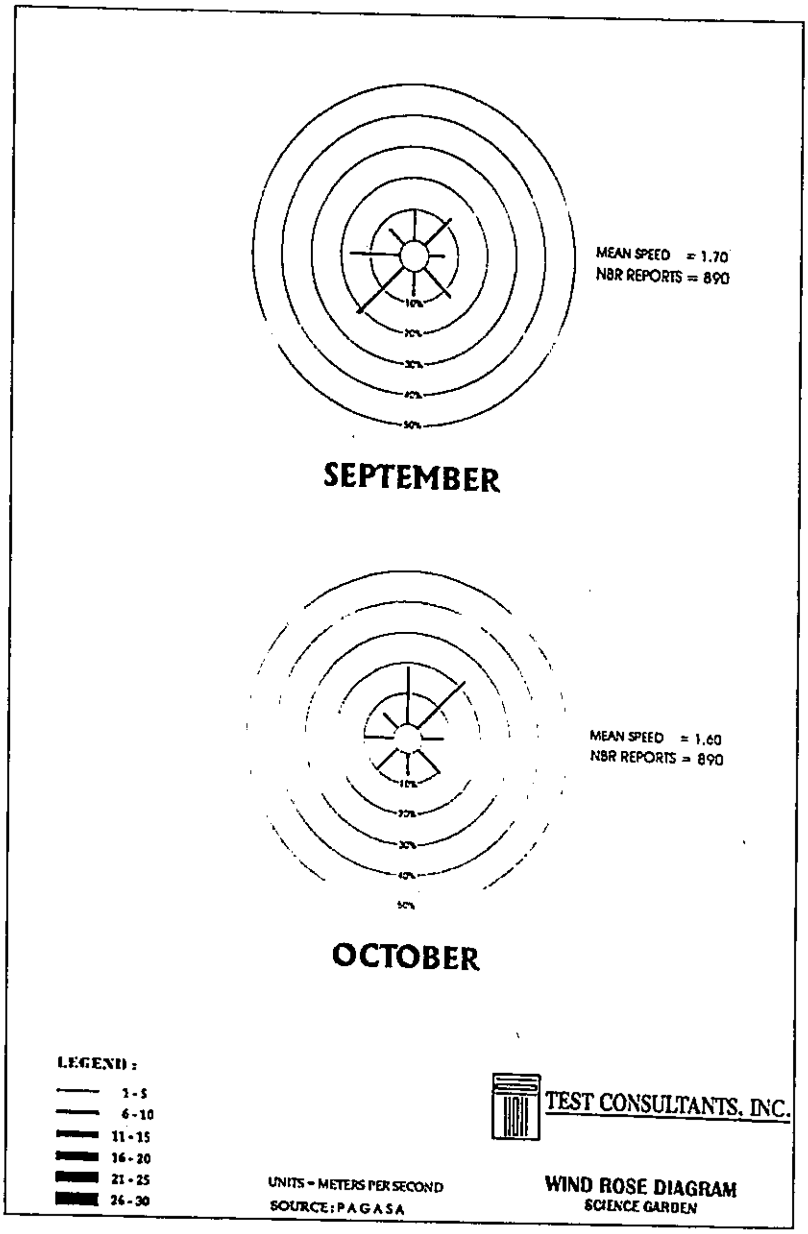

FIGURE 4.69: WIND ROSE DIAGRAM (SEPTEMBER TO OCTOBER)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

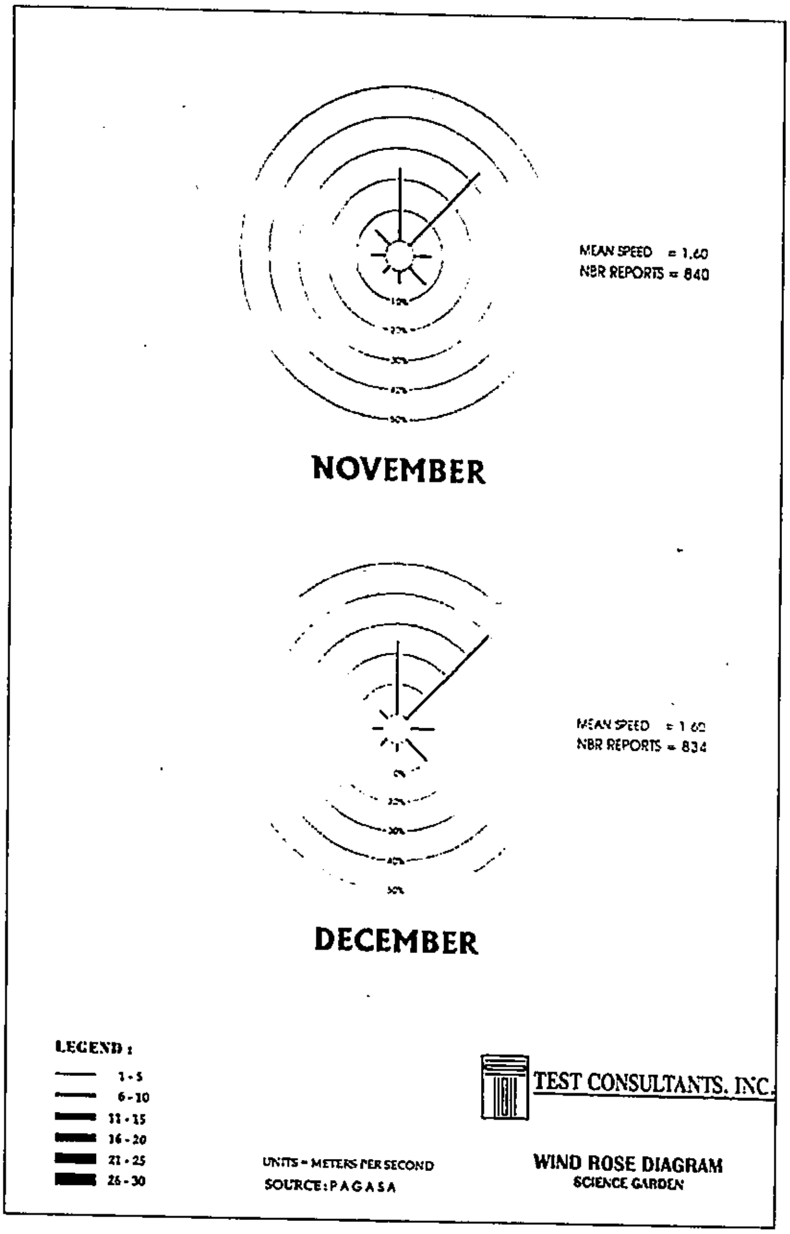

FIGURE 4.70: WIND ROSE DIAGRAM (NOVEMBER TO DECEMBER)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

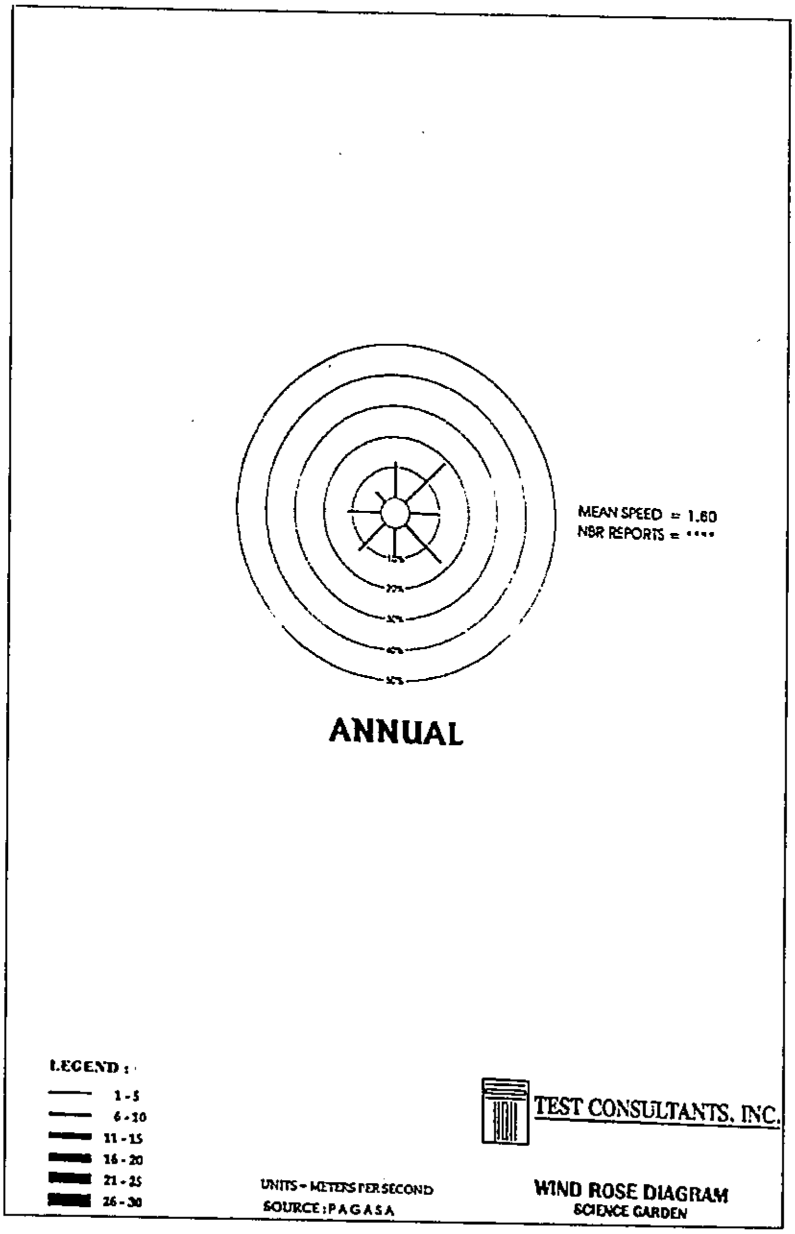

FIGURE 4.71: WIND ROSE DIAGRAM (ANNUAL)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

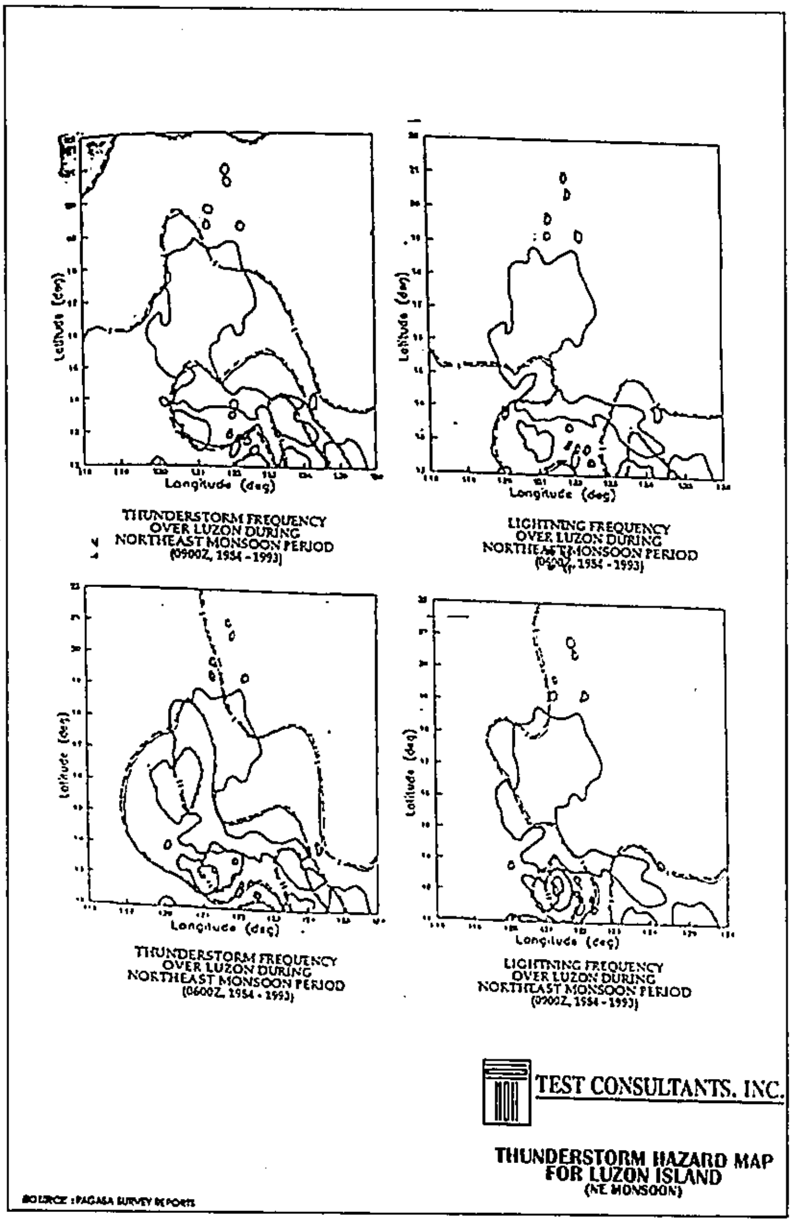

FIGURE 4.72: THUNDERSTORM HAZARD MAP FOR LUZON ISLAND (NE MONSOON)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

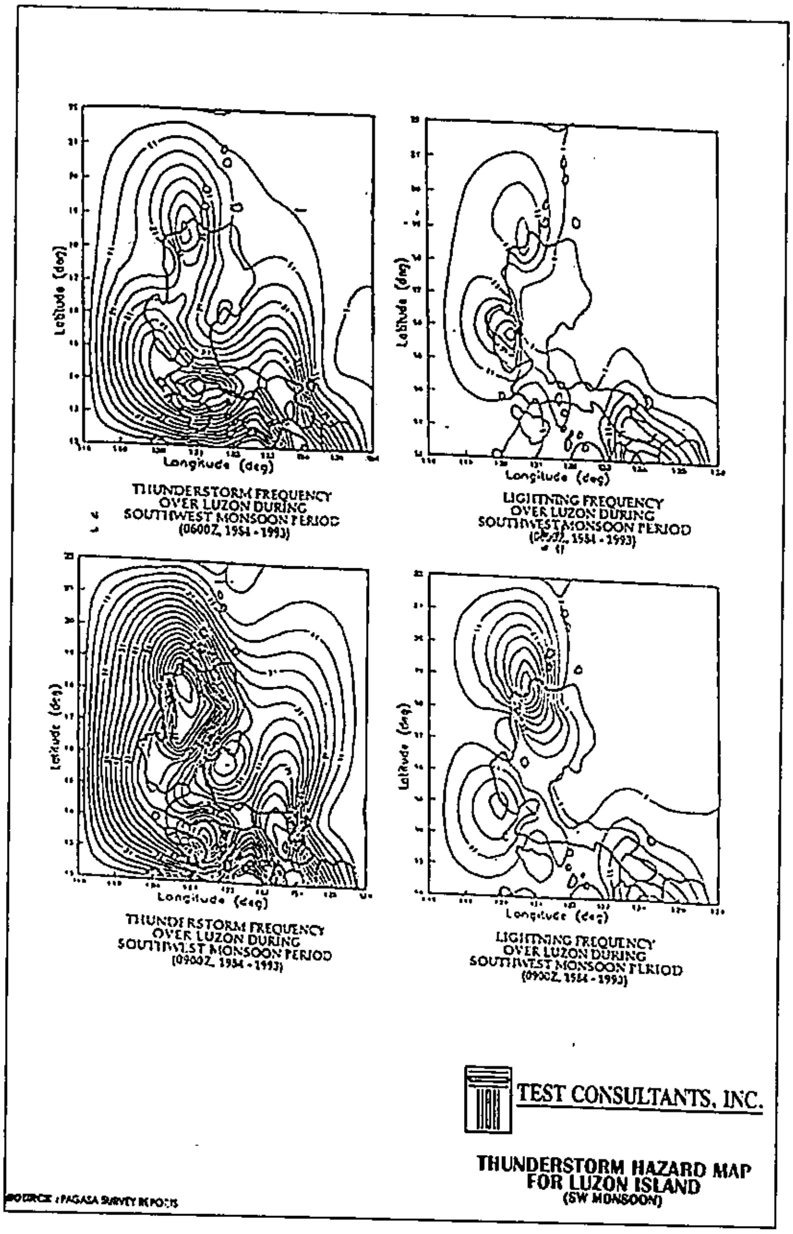

FIGURE 4.73: THUNDERSTORM HAZARD MAP FOR LUZON ISLAND (SW MONSOON)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

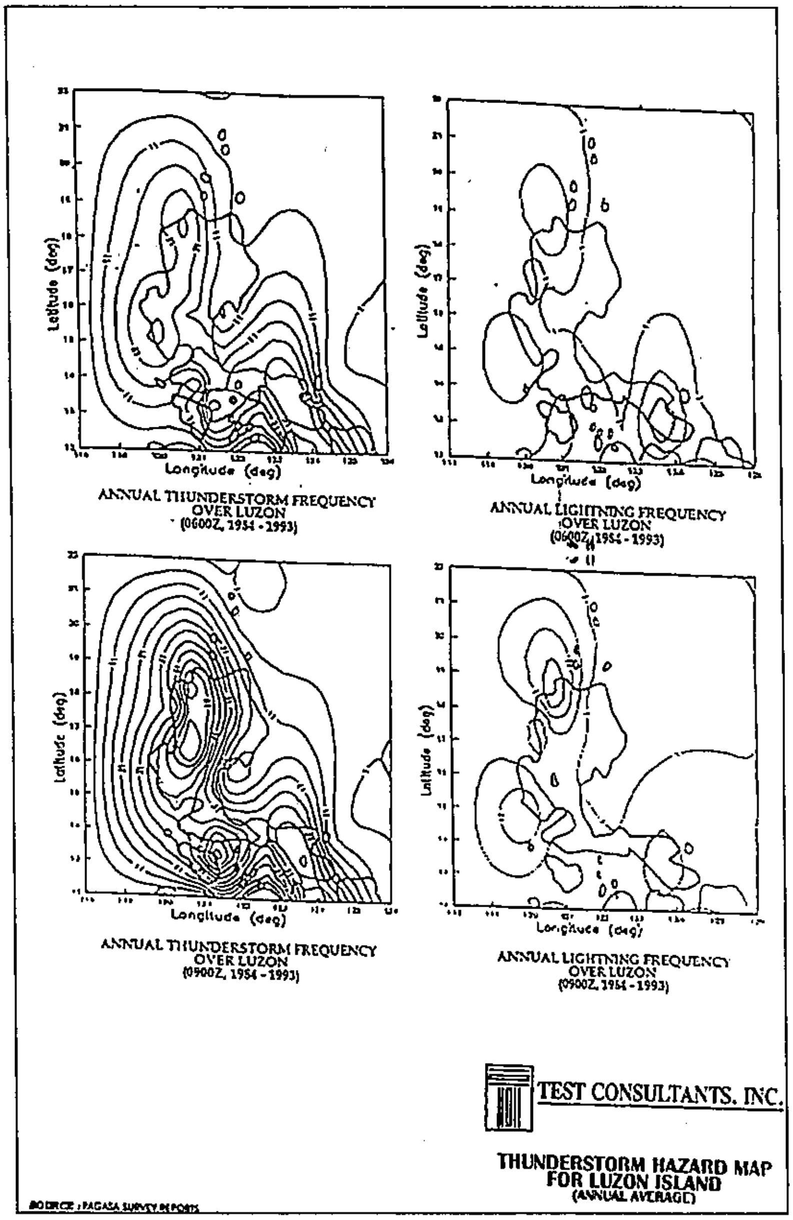

FIGURE 4.74: THUNDERSTORM HAZARD MAP FOR LUZON ISLAND (ANNUAL AVERAGE)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

(vi) Tropical Cyclones

Tropical cyclone data for the past 20 years show that the area had experience 12 tropical cyclones which had pass within 50 kilometers (km) of the project site as shown in Figure 4.75. Twelve (12) tropical cyclones (4 typhoons, 5 tropical storms and 3 tropical depressions) have occurred mostly during the second half of the year. Based on these data, at least 2 tropical cyclones pass and affect the project site on the average per year (Figure 4.76).

(c) Wind Rose Diagrams

Please refer to Section 4.2.5 (b), item (iii).

(d) Frequency of Tropical Cyclones

Please refer to Section 4.2.5 (b) item (vi).

4.2.6 *Air Quality / Noise Levels*

(a) Introduction

Actual on-site air sampling and noise measurements were conducted at eight (8) stations covering the areas from Valenzuela City to Caloocan City. The data gathered represent the ambient condition of atmospheric air and the noise levels in these areas to be traversed by this segment of the NorthRail Project. The sampling stations were purposely chosen to cover key receptors in the area such as highly populated communities, schools, hospitals, public destinations, and the proposed NorthRail stations.

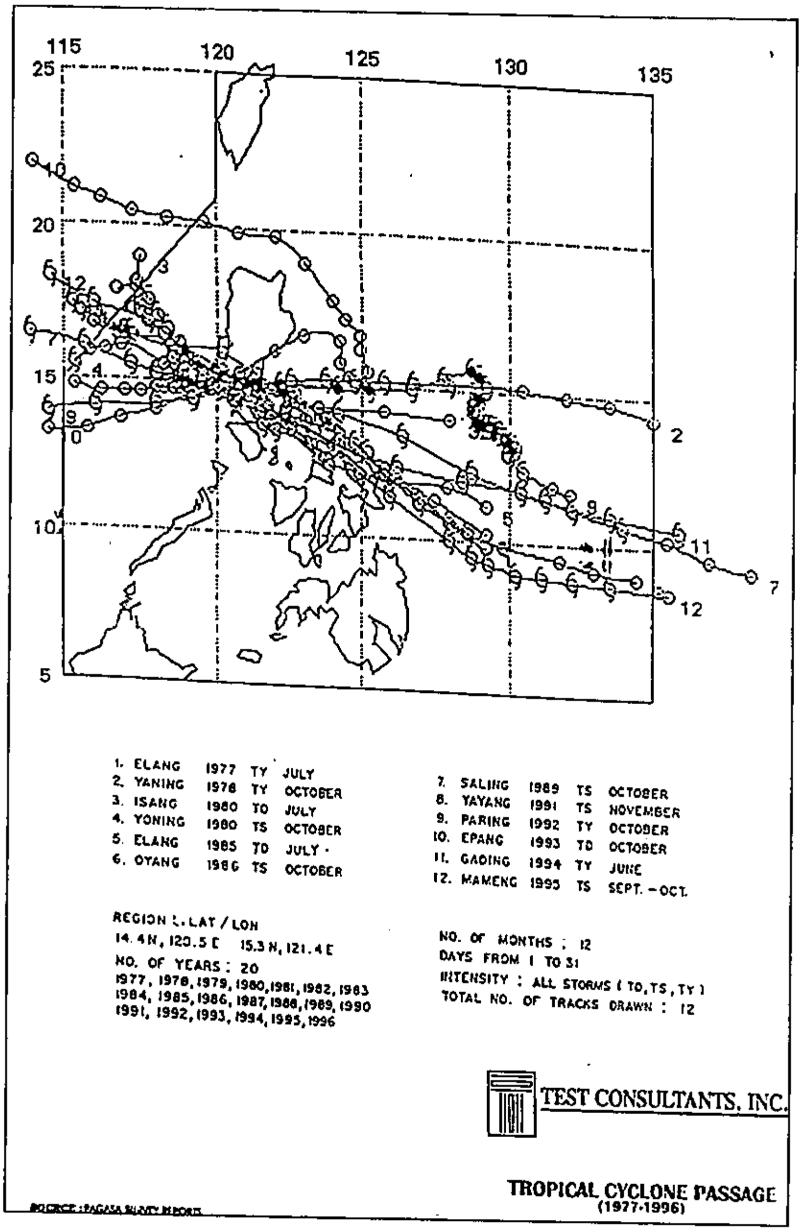

FIGURE 4.75: TROPICAL CYCLONE PASSAGE (1977-1996)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

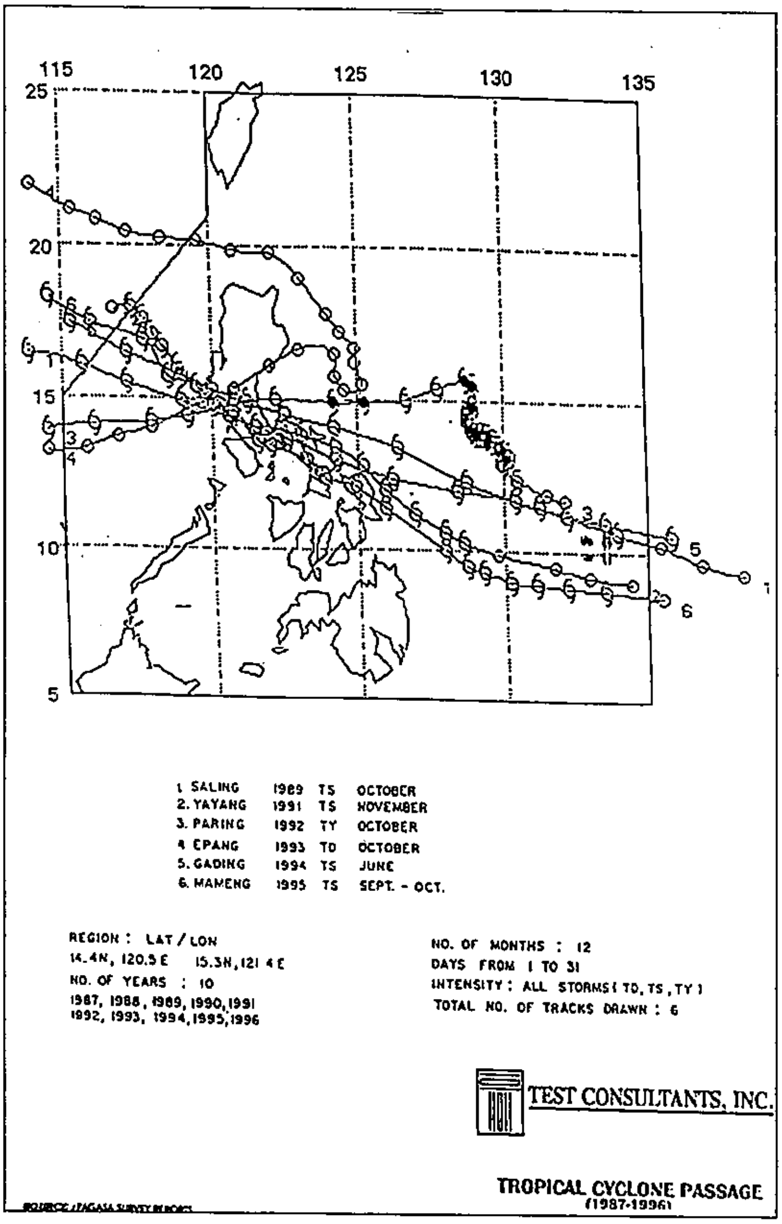

FIGURE 4.76: TROPICAL CYCLONE PASSAGE (1987-1996)
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

Table 4-12 shows the location and brief description of the sampling stations

TABLE 4-12: DESCRIPTION OF SAMPLING STATIONS

Station	Description
A_2 - 1	Located about 10 meters away from EDSA along Maskardo St. Bagong Barrio, Caloocan City.
A_2 - 2	Infront of Mercury Drug Store near Monumento about 8 meters away from EDSA, Caloocan City.
A_2 - 3	Along Dagohoy St. about 8 meters away from Samson Rd., Caloocan City.
A_2 – 4	About 30 meters away from the existing PNR Caloocan City Station and 35 meters away from the Samson Road.
A_2 – 5	Inside the compound of the Golden Dale Subdivision, along Golden Dale Avenue, and about 30 meters (Westside) from the existing railroad.
A_2 – 6	30 meters away (Westside) from the existing PNR Malinta Station, Malinta, Valenzuela, M.M.
A_2 – 7	About 30 meters (Eastside) from the existing railroad, inside the compound of the San Isidro Catholic Church.
A_2 - 8	Along NFA road, Valenzuela, M.M. about 30 meters (Eastside) from the existing railroad

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

(b) Ambient Air Quality (TSP, SO_x, NO_x, PM10, etc.) 24-hour sampling
For air sampling, the standard procedures as stipulated in the National Ambient Air Quality Standards (NAAQS) specified by the DENR were followed. A Kimoto Gas Bubbler was used to collect air samples in order to determine the concentration of sulfur dioxide (SO_2) and TSP.

NLRC was not able to conduct air sampling for NO_2. However, NLRC intends to conduct air sampling prior to actual construction.

Results of the analyses of the air samples obtained from the vicinity near the NorthRail Project alignment from Valenzuela City to Caloocan City show that generally, the quality of the air in these areas is still good, in so far as SO_2 is concerned. In the case of TSP, most of the stations are very dusty as shown by the high TSP concentrations in the samples. The dust levels may be high due to increasing vehicular activity in the area.

The results of the chemical analyses on the concentration of SO_2 and the gravimetrically derived concentration levels of TSP (dust) are listed in Table 4-13.

Station No	Date 1997	Time (hour)		Wind Direction	Wind Speed (mps)	Cloud (Okta)	TSP µg/Ncm	SO2 µg/Ncm
		Start	End					
A_2 - 1	05-21	0736	0836	VARIABLE	-	1	319	37
A_2 - 2	05-21	10913	1013	SW	0.75	1	433	17
A_2 - 3	05-21	1051	1151	VARIABLE	-	1	603	43.16
A_2 – 4	05-21	1525	1625	SW	1.0	1	739	23.74
A_2 – 5	05-21	1657	1757	SW	1.0	2	201	7.0
A_2 – 6	05-22	1507	1607	SW	1.5	1	427	53.12
A_2 – 7	05-23	1043	1142	SW	1.33	1	159	41.14
A_2 - 8	05-23	1237	1337	SW	1.0	3	230	41.39
DENR STANDARD LIMITS for Criteria Pollutants DAO 14							300	340

TABLE 4-13: RESULT OF AIR QUALITY SAMPLING
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

Note that all the values of the concentration of the pollutant, SO_2 are very much lower than the NAAQS limits for criteria pollutants as set by DENR. However, the existing levels of concentration of TSP are naturally high due to the highly urbanized condition of the area due to a high volume of motor vehicle traffic and the presence of commercial establishments.

Baseline sampling for NO_2, as agreed upon with the EMB, will be conducted on a future date. The sampling will be done prior to construction.

(c) Noise Levels
Sound or noise level determination was conducted using a portable, Extech sound level meter, taking 10-minutes average.

The results of the noise level measurements are shown in Table 4-14 below:

TABLE 4-14: RESULT OF NOISE LEVEL DETERMINATION

Station No.	Date	Time (Hour)	Noise Level Db(A)	DENR Standard Limits
A_2 – 1	05-21	0724-0734	68-73	65
A_2 – 2	05-21	0901-0911	75-78	65
A_2 – 3	05-21	1039-1049	74-78	65
A_2 –4	05-21	1513-1523	74-76	65
A_2 – 5	05-21	1645-1655	68-72	50
A_2 – 6	05-22	1455-1505	76-78	65
A_2 – 7	05-23	1030-1040	77-79	65
A_2 –8	05-23	1225-1235	77-79	65

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

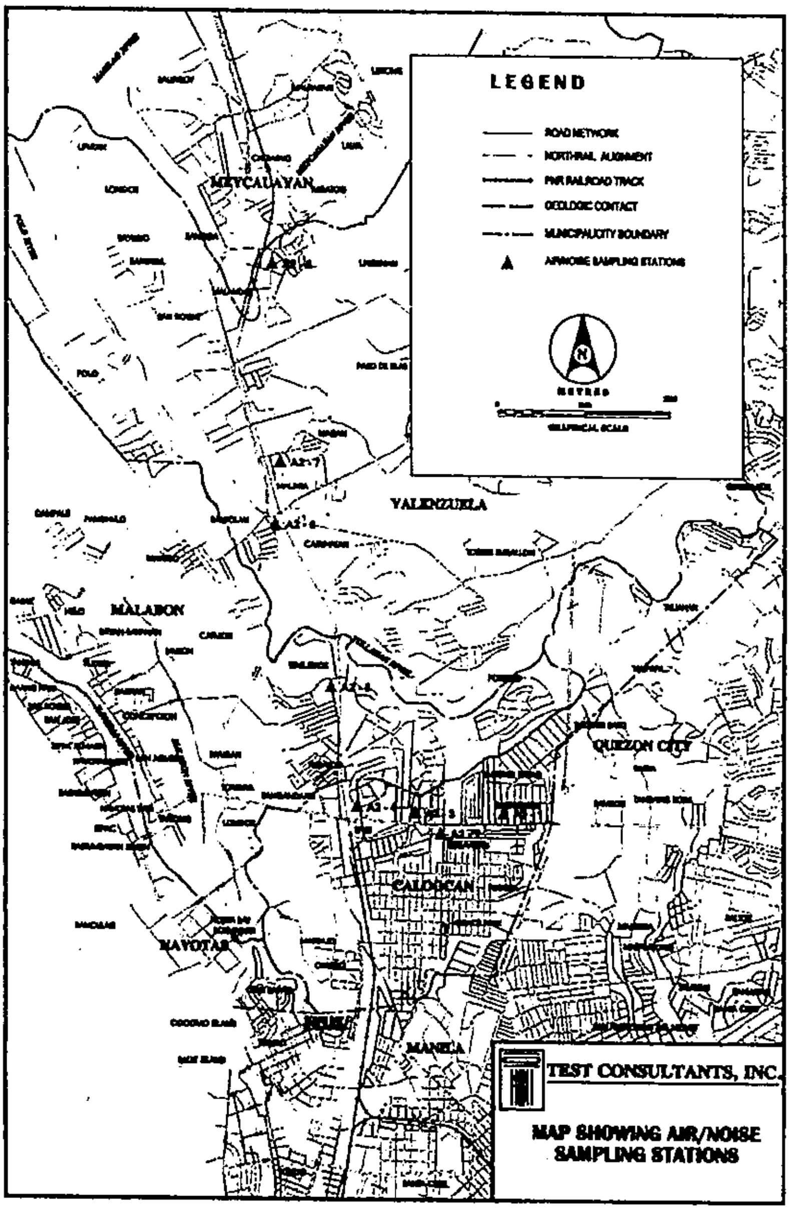

FIGURE 4.77: MAP SHOWING AIR/NOISE SAMPLING STATIONS
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

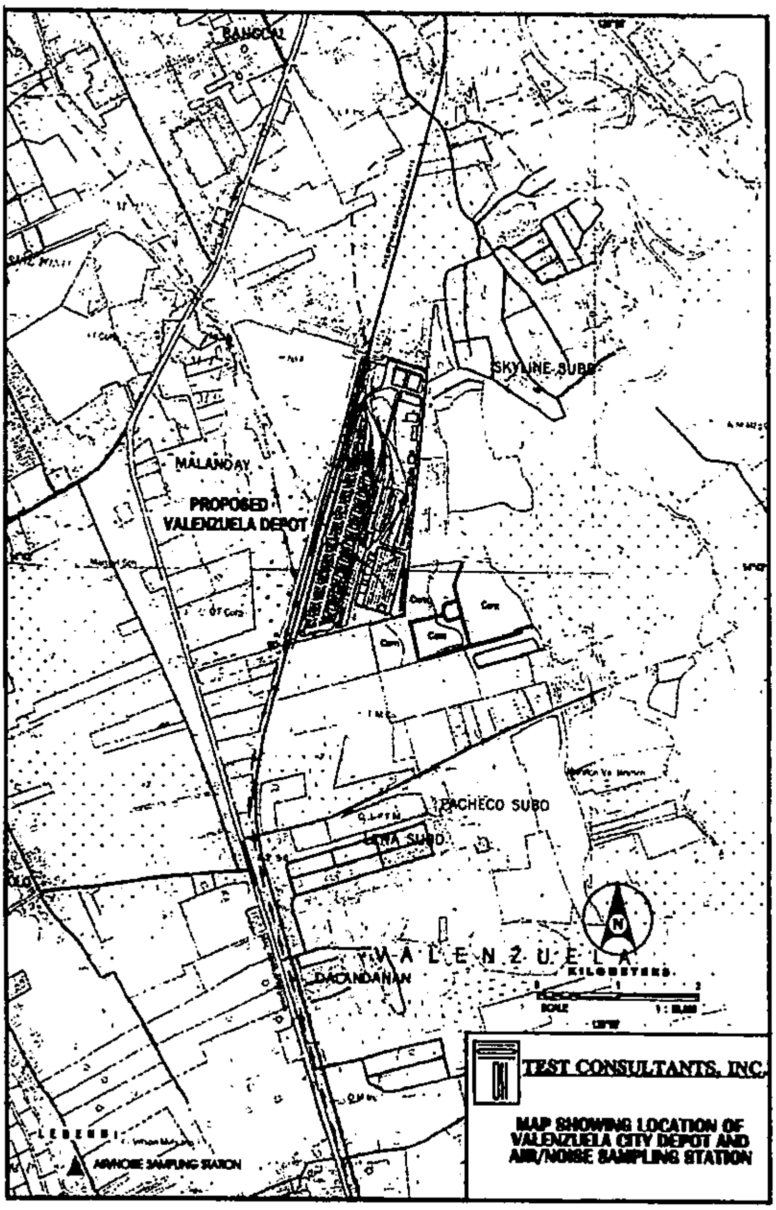

FIGURE 4.78: MAP SHOWING AIR/NOISE SAMPLING STATION AT THE DEPOT
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

The background noise levels in the two areas are also above the DENR standard limits, which is due to the presence of a high volume of motor vehicle traffic as well as people in these areas.

(d) Sampling Station Map (air, noise and vibration)
Please refer to Figures 4.77 and 4.78.

(e) Air Dispersion Diagrams / Isophlet
NLRC was unable to obtain a model (for moving source) that generates air dispersion diagram.

NLRC intends to undertake this study during the detailed design or prior to actual construction of the Project.

4.3 Biological Environment

4.3.1 Vegetation, Wildlife and Insect Profile

(a) Flora and Fauna Species Inventory or Survey
A foot-survey was undertaken to record the presence of flora and fauna along the PNR ROW from Caloocan to Valenzuela. The scope of the study was limited to counting the number of each species and their ecology of economic use.

(b) Summary of Abundance, Frequency and Distribution
Table 4-15 shows the list of identified vegetation along PNR ROW (Caloocan – Malabon). Table 4-16 shows the list of animals present along the PNR ROW (Caloocan – Malabon).

TABLE 4-15: LIST OF IDENTIFIED VEGETATION GROWING ALONG PNR ROW (CALOOCAN – MALABON)

Common Name	Local Name	Scientific Name
Hardwood/Firewood /Trees		
Ipil-Ipil	Ipil-Ipil	*Leucena Glaucata*
Fam. Cambretaceae	Talisay	*Terminalia Catapra*
Acacia	Akasya	*Acacia Auriculiforms*
Fruit Bearing Trees		
Mango	Mangga	*Mangifera Indica*
Guava	Bayabas	*Psidium Guajaava*
Santol	Santol	*Sandoricum Koet Jape*
Camachile	Kamatsile	*Pithcellosium Calmilo*
Coconut	Niyog	*Cocus Nucifera*

TABLE 4-15: LIST OF IDENTIFIED VEGETATION GROWING ALONG PNR ROW (CALOOCAN – MALABON)

Common Name	Local Name	Scientific Name
Papaya	Papaya	*Carica Papaya*
Tamarind	Sampalok	*Tanarindus Indica*
Treebery	Aratilis	*Muntigia Calobura*
Kamias	Kamyas	*Averrhoa Balimbi*
Pomegrenate	Atis	*Pumica Granatum*
Guyabano	Guyabano	*Annona Muricata*
Vegetables		
Horse Raddish Tree	Malunggay	*Morinda Oleifera*
Sweet Potato	Kamote	*Ipomoea Batataas*
Atsuete	Atsewete	*Bixa Orellana*
Pepper	Sili	*Capsicum Spp.*
Ornamental Plants		
Chinese Rose	Gumamela	*Habiscus Rosa-Sinensis*
Sampaguita	Sampagita	*Jasminium Sambac*
Rose	Rosas	*Rosa Spp.*
Bougainvilla	Bonggabilya	*Bougainvillea*
Orchids	Orkids	*Spectabilis*
Fern	Pako	*Fam. Orchidaceace Polypoduim Spp.*
Shrubs and Grasses		
Carabao Grass	Damo	*Paspalum Longfolium*

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc. (Result of the physical survey of the flora and fauna existing along the old PNR tracks on 22 September and 06 May 1997)

TABLE 4-16: LIST OF ANIMALS PRESENT ALONG PNR ROW (CALOOCAN – MALABON)

Common Name	Local Name	Scientific Name
Terrestrial Animals		
Domestic Animals		
Dogs	Aso	*Canis Spp*
Cats	Pusa	*Felis Domesticus*
Pigs	Baboy	*Sus Spp.*
Goats	Kambing	*Capra Spp.*
Fowls and Birds		
Chicken	Manok	*Gallus Domestics*
Ducks	Bibl/Pato	*Anas Spp.*
Doves	Kalapati	*Columbia Spp.*
Widlifes		
Bart Bats	Paniki	*Pteropus Spp.*
House Mice	Daga	*Rattus Domesticus*
Green Skinks	Bubuli	*Scincus Spp.*
Field Frogs	Palaka	*Rana Vitigera*
Snakes	Ahas	-
Lizard	Butiki	-

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc. (Result of the physical survey of the flora and fauna found along the old PNR tracks on 22 April and 6 May 1997.)

(c) Site Observation / Transect Walk Map
Please refer to Figures 4.77 -4.78.

4.3.2 *Aquatic Fresh*

No study was undertaken to determine the presence of aquatic flora and fauna in the Panaca Creek or in the Tullahan River as it is believed that the project will have no impact in either, except probably on the Tullahan River during bridge construction, which is insignificant and short term.

4.4 Socio-Economic and Cultural Environment

4.4.1 *Demography*

(a) Settlement Map and Population Distribution Map
Please refer to Section 5.4.2 of this Report for update of changes regarding the relocation of PAFs.

Table 4-17 summarizes the population densities of Caloocan City, Malabon and Valenzuela City.

TABLE 4-17: POPULATION DENSITY

City	No of Barangays	Estimated Land Area (sq. km.)	Population		Density per sq. km.	
			1995	2000	1995	2000
Caloocan City	188	55.8	1,023,159	1,177,604	18,336.18	21,104.[illegible]
Malabon City	21	47.0	347,484	338,855	9,301.38	10,328.[illegible]
Valenzuela City	32	32.6	437,165	485,433	10,659.02	10,394.[illegible]

Source: NSO Philippine Yearbook

(b) Land Use Map (include location of ecological, military reserves, scenic spots and areas if religious, historic and cultural significance)
Please refer to Section 4.2.2 (a).

(c) Population Growth Rate

TABLE 4-18: POPULATION GROWTH RATE

City	Population		Annual Average Growth Rate
	As of September 1, 1995	As of May 1, 2000	
Caloocan City	1,023,159	1,177,604	3.[illegible]
Malabon City	347,484	338,855	-0.[illegible]
Valenzuela City	437,165	485,433	2.[illegible]

Source: NSO Philippine Yearbook

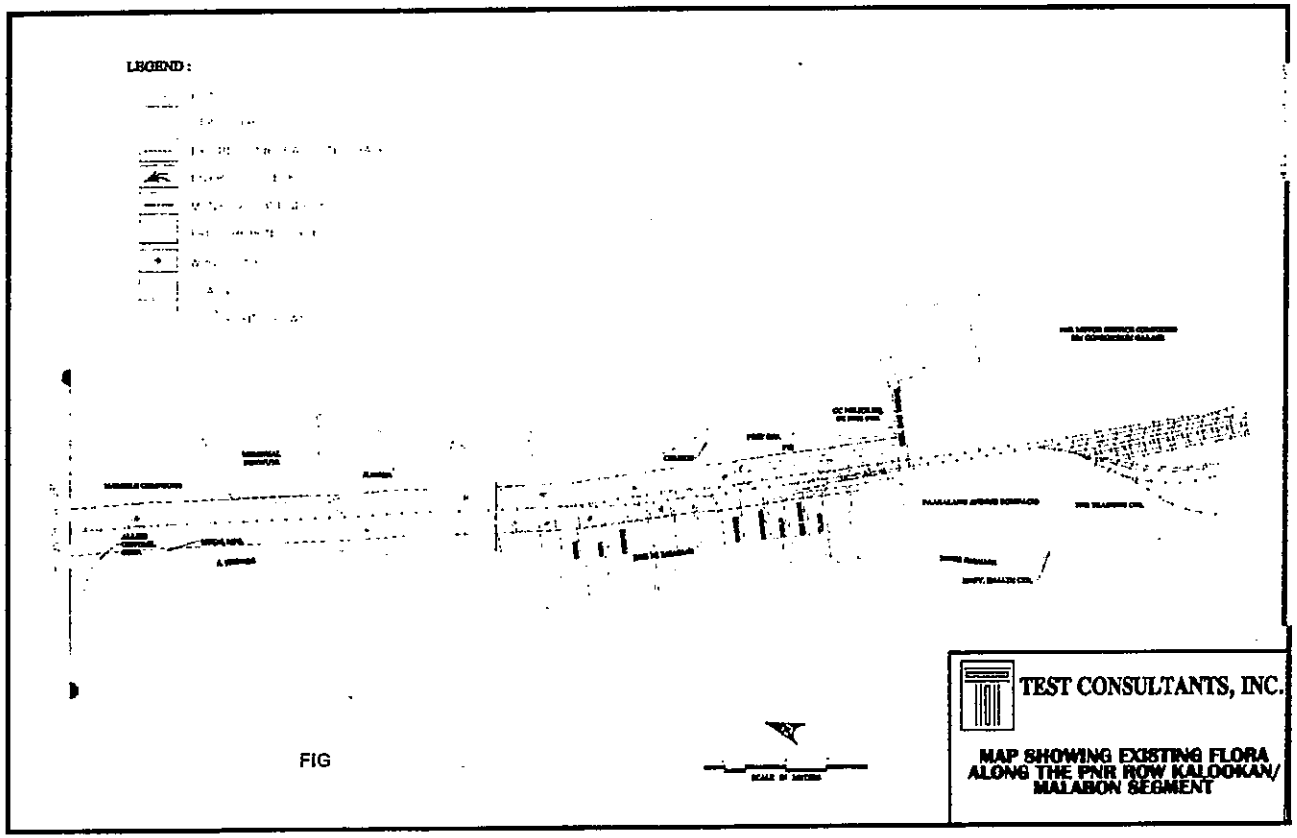

FIG URE 4.77: MAP SHOWING EXISTING FLORA ALONG THE PNR ROW 1
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

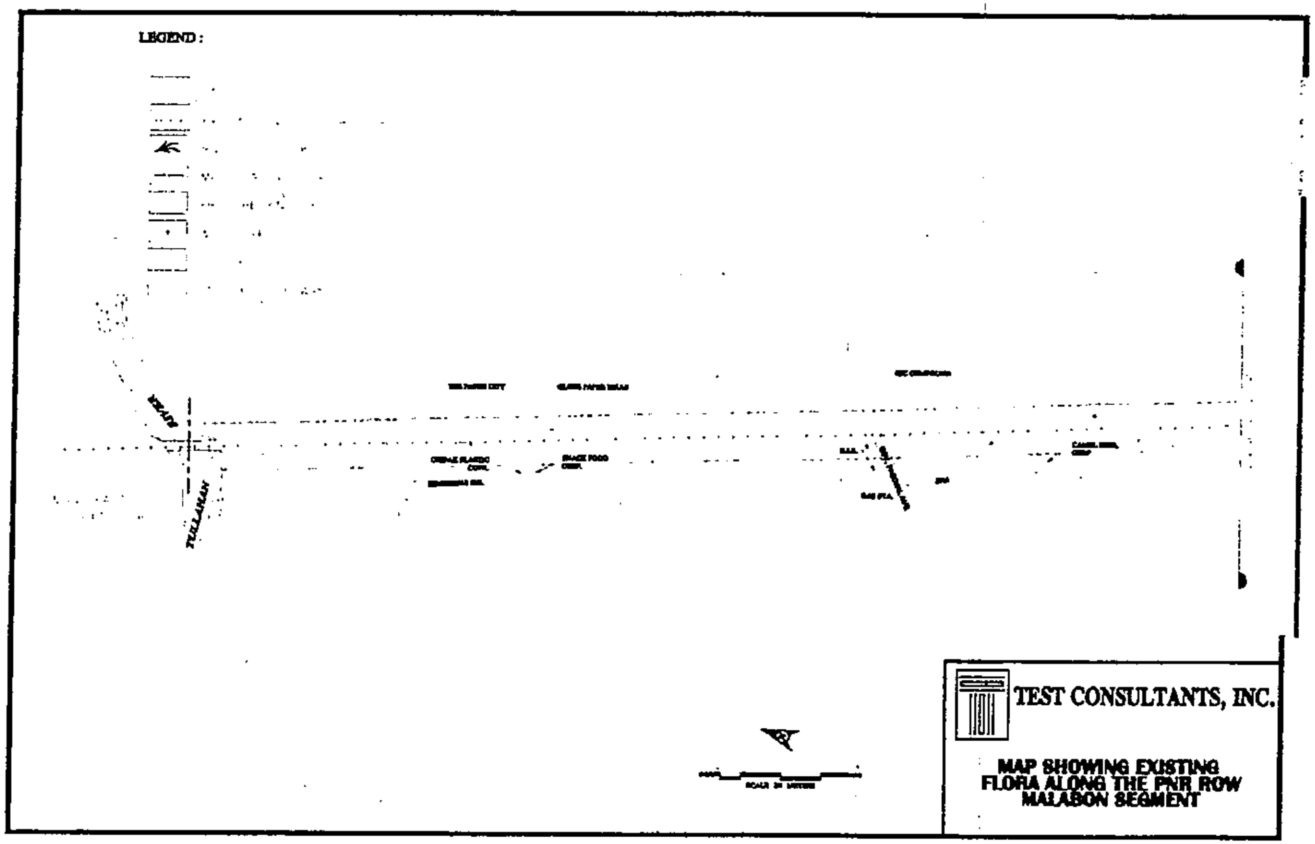

FIGURE 4.80: MAP SHOWING EXISTING FLORA ALONG THE PNR ROW 2
Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc.

d) Number of Households and Household Size by Barangay

TABLE 4-19: NO OF HOUSEHOLDS PER BARANGAY

City	Barangay	Household Population	Number of Households
Caloocan City	Barangay 01	2,709	645
	Barangay 02	5,070	1,161
	Barangay 80	2,986	597
Malabon City	Acacia	7,632	1,643
	Potrero	45,959	10,481
	Tinajeros	19,939	4,492
	Tugatog	24,676	5,345
Valenzuela City	Dalandanan	21,810	4,4776
	Karuhatan	34,604	7,613
	Malanday	14,871	3,333
	Malinta	43,565	9,232
	Marulas	55,844	12,178
	Veinte Reales	17,800	3,892

Source: NSO Data (May 2000 Census)

About 15% (365 households) were affected by the clearing of ROW within the Caloocan segment of the NorthRail Project.

(e) Summary of Demographic data per city

At present, the available demographic data for the affected areas are on a city level. The previously submitted EIS for the same section of the Project also provided demographic data on a city level. Demographic data on a per barangay basis were based on the census and tagging results from 1997. These demographic data have not been re-validated nor updated, as the re-validation survey conducted by the NHA in 2003 only included data on household membership and tenurial status of PAFs (Annex AC).

The NorthRail Project traverses 9 cities and municipalities, three of which are within the coverage of this EIS. It is more practical to present demographic data on a per city/ municipality level considering the magnitude of the Project.

(i) Land Area

Caloocan City is divided in two geographically separated areas into 16 zones and 188 barangays. The lower part is South Caloocan or District II (covering Zones 1 to 14), bounded on the north by Malabon; on the east by Quezon City; on the south by the historical City of Manila and on the west by Navotas. The upper part is North Caloocan City or District I (covering

Zones 15 and 16), bounded on the north by San Jose del Monte in Bulacan; on the east southeast by Quezon City; on the west by Meycauayan; and southwest by Valenzuela.

Malabon is composed of 21 barangays, bounded on the north and north-east by Valenzuela, on the south by Caloocan City, and on the west by Navotas.

Valenzuela City is composed of 32 barangays. It is bounded on the north by the Province of Bulacan (Meyacauayan) and Caloocan City (North); on the south-west by Malabon and Navotas; and on the north-east by Caloocan City (South) and Quezon City.

(ii) Population
Please refer to Section 4.4.1 (d)

(iii) Population Density
Please refer to Section 4.4.1 (a)

(iv) Housing and Social Services
Caloocan City registered a shortage in housing units. Only 64% of the households own the housing unit that they occupy and 63% of the house owners own the lot they occupy. As of 1994, there is an estimated 45,500 informal dwellers occupying dangerous areas, government and private properties and road ROWs.

In Malabon, there is a housing shortage of about 19,200 housing units from 1993 to 1998. The city government considers this as one of its priorities. Only 64% of the residents own the house they occupy and only 50% own the lot which the house is located.

There is a shortage of housing units in Valenzuela City. Only 70% of the households own the housing unit that they occupy and 65% of the house owners own the lot they occupy. There are about 3,770 families occupying the PNR ROW.

(v) Main Sources of Income
Caloocan City serves as the center of commerce and industry for the adjacent municipalities of Malabon, Navotas and Valenzuela City, as well as

the outlying towns of the two provinces of the north; Bulacan and Pampanga. Trading which is 90% of the total economic activities is the largest business sector, while manufacturing activities comprise the remaining 10%. Among the manufacturing activities, production of wearing apparel ranked first, followed by fabrication of metal products and production of furniture and furniture fixtures. The number of registered business establishments in Caloocan City have an average increase of 16% per year.

(vi) Sex and Age Composition

There are slightly more females (50.2% in Caloocan City and 50.3% in Malabon) than males in these localities. Both Caloocan City and Malabon have a very young age structure as majority of the population (66.3% in Caloocan City and 65.2% in Malabon) are below thirty years old. Those below 15 years of age range from 34% to 36%, while those above 64 years old range from 2.3% to 2.6%. Around 62% of the population in these localities are within the 15 to 64 years old bracket or the economically active age group which reflects a dependency ratio of 62 dependents for every 100 economically active persons. Median age in Caloocan City and Malabon is 20 and 21, respectively.

(vii) Literacy

Both Caloocan and Malabon have high literacy rates (98.9%). Literacy rates among males are slightly higher than females.

Caloocan City has 48 public and 37 private elementary schools spread out in eight school districts. It also has 17 public and 21 private secondary schools. Of the 17 public high schools, 6 are in South Caloocan City and the remaining 11 are in North Caloocan City. There are also 4 colleges and 3 universities in the city, 3 of which are located in South Caloocan City. A total of 12 Department of Education, Culture and Sports (DECS) - supervised vocational schools also operate in the city. The City Government, through its Manpower Training Program, also offers courses in dress making, beauty culture, basic course on computer, etc.

Malabon has 54 educational institutions 68% of which are public schools. There are 37 elementary schools, 13 high schools and 4 colleges/universities in the municipality.

Valenzuela City has a literacy rate of 97.36 percent. There are 38 educational institutions, 6 Tertiary Schools, 5 Technical Schools, 1 Training Center and 26 Secondary Schools, i.e. for both public and private schools.

(viii) Employment Status

In Caloocan and Malabon, about 60% of the labor force (15 years old andover) are employed while 4% are unemployed. During the past 10 years, the labor force in these two localities registered a yearly average increase of 5%, while the working force growth rate was estimated at 4.5%. The increase in labor force is attributable to the net population increase accruing to in-migration, while the slightly lower growth rate in the working force manifest the pre-disposition of the residents to avail of the educational facilities in these two localities.

The percentage of the labor force in non-agricultural occupations in Caloocan City and Malabon are 62% and 68.1%, respectively.

Valenzuela (1992) has 149,000 employed individuals and 20,000 unemployed. During the last 15 years, the labor force has a yearly average increase of 5%, but 4.6% year increase for employed individuals.

(ix) Highest Educational Attainment

For Caloocan and Malabon, approximately 1.4% to 1.5% do not have formal schooling (individuals that are 7 years or older). About 34.7% - 37.7% are in the elementary level while 37% are in high school level. About 10.6% - 12.0% are college undergraduates, while 9% are academic degree holders.

(f) Household Profile based on results of the Survey

The result of the revalidation of Census and Tagging (C&T) data as provided by NHA is attached in this Report as Annex AC.

(g) IPs/Vulnerable Groups

The PNR ROW is not a settlement area for vulnerable groups or indigenous people and therefore there will be no IPs or vulnerable groups that will be directly affected by the Project.

4.4.2 *Health*

(a) Morbidity and Mortality Rates (Infants and Adults) from Direct Impact Areas

Caloocan City registered a crude death rate of 31% per thousand population. Bronchitis and pneumonia are the common causes of illness. URTI ranks highest in terms of morbidity cause. The leading causes of mortality are vascular diseases, pneumonia and cancer.

The leading causes of morbidity are bronchitis followed by diarrhea and pneumonia, and of mortality, are vascular disease, pneumonia and cancer. Data are not available for infant mortality and morbidity.

Valenzuela City has a crude death rate of 35/1000. The leading cause of mortality is URTI with a rate of 2380/10,000 and of morbidity is pneumonia at the rate of 163/10,000. Infant mortality is due to vascular disease and morbidity is upper respiratory infection.

TABLE 4-20: 10 LEADING CAUSES OF MORBIDITY IN CALOOCAN (1998)

Disease	Number	Rate/10,000 (0-1) Pop.
Bronchitis	9,002	746
Diarrhea	8,200	680
Pneumonias	8,963	246
T.B. Respiratory	2,850	236
Influenza	2,604	216
Hypertension	865	72
URTI	698	58
Disease of the Heart	303	25
Dengue Fever	261	22
Chickenpox	175	14

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc. (Caloocan City Health Office)

TABLE 4-21: 10 LEADING CAUSES OF MORTALITY IN CALOOCAN (1998)

Disease	Number	Rate/10,000 (0-1) Pop.
Coronary Artery Disease	1,204	100
Pneumonias	963	80
Hypertensive Vas. Disease	406	34
Cancer	325	27
Tuberculosis	300	25
Accidents	270	22
Diarrhea Disease	118	10
Bronchial Asthma	89	7
Acute Renal Failure	83	7

Diabetes Mellitus	67	6

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc. (Valenzuela Municipal Health Office)

TABLE 4-22: 10 LEADING CAUSES OF MORBIDITY IN MALABON (1997)

Disease	Number	Rate/10,000 (0-1) Pop.
Bronchitis	5,134	1,366.49
Diarrhea	4,851	1,291.16
Pneumonia	1,783	474.57
TB Respiratory	1,454	387.00
Heart Disease	424	112.85
Influenza	204	54.29
Chicken Pox	179	47.64
Measles	164	43.65
Typhoid/Paratyphoid	94	25.01
Viral Hepatitis	72	19.16

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc. (Malabon Health Office)

TABLE 4-23: 10 LEADING CAUSES OF MORTALITY IN MALABON(1997)

Disease	Number	Rate/10,000 (0-1) Pop.
Vascular Disease	586	155.97
Pneumonia	189	50.3
TB All Form	113	30.07
Accidents	112	29.81
Senility	43	11.44
Diabetes	36	9.58
Septicemia	22	5.85
HPN (hypertension)	21	5.58
Liver Disease	10	2.66
Kidney Disease	10	2.66

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc. (Malabon Health Office)

TABLE 4-24: 10 LEADING CAUSES OF MORBIDITY IN VALENZUELA (1996)

Disease	Number	Rate/10,000 (0-1) Pop.
URTI	4,814	2380
Pneumonia	1,920	950
Diarrhea	1,879	930
Bronchitis	1,445	710
Nutritional Deficiency	545	270
Dermatological Condition	416	200
Influenza	53	26
Measles	47	23
TB Respiratory	30	14
Chicken Pox	16	7

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc. (Valenzuela Municipal Health Office)

TABLE 4-25: 10 LEADING CAUSES OF MORTALITY IN VALENZUELA (1996)

Disease	Number	Rate/10,000 (0-1) Pop.
Pneumonia	3	163
Septicimia	8	39
Diarrhea	7	34
Measles	7	34
Heart Disease	4	34
Burns	3	14
Protein Calorie Malnutrition	2	9
Undetermine	2	9

TABLE 4-25: 10 LEADING CAUSES OF MORTALITY IN VALENZUELA (1996)

Disease	Number	Rate/10,000 (0-1) Pop.
TB Meningitis	1	4
Dengue Fever	1	4

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc. (Valenzuela Health Office)

TABLE 4-26: 10 LEADING CAUSES OF INFANT MORBIDITY IN VALENZUELA (1997)

Disease	Number	Rate/10,000 (0-1) Pop.
Upper Respiratory Infection	18,691	425
Pneumonia	5,953	135
Dermatitis	5,772	135
Diarrhea	5,444	124
Bronchitis	5,081	115
Vitamin and Nutritional Deficiency	3,709	84
Gastro-Intestinal Disorders	1,718	39
Musculo-Skeletal Disorders	1,245	30
Influenza	840	19
Tuberculosis		

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc. (Valenzuela Health Office)

TABLE 4-27: 10 LEADING CAUSES OF INFANT MORTALITY IN VALENZUELA (1997)

Causes	Number	Rate/10,000 (0-1) Pop.
Vascular Diseases	348	0.792
Heart Diseases	196	0.446
Pneumonia	150	0.341
Accident/Medico Legal	135	0.030
Cancer	123	0.280
COPD (Chronic Obstructive Pulmonary Disease)	103	0.234
Tuberculosis	79	0.179
Septicimia	62	0.041
Diabetes	41	0.093
Asthma	19	0.033

Source: MCRRS Phase 1A-2 EIS, Test Consultants, Inc. (Valenzuela Health Office)

(b) Local Health Resources (Government and Private)

Caloocan City has 24 health centers, 11 privately owned hospitals, and 4 government hospitals.

Malabon has 21 health centers and one community hospital (Pagamutang Bayan ng Malabon).

(c) Environmental Health and Sanitation Profile:

(i) Water Supply

Caloocan City, Malabon and Valenzuela are served by MWSI which supplies water from its reservoir in Quezon City. In Caloocan City, 75% of the households are served by MWSI, 23% use deep and shallow wells, while 2% rely on other sources. In Malabon, 77% of the households are served by MWSI, 19% depend on water pumps, while 4% rely on artesian wells. Both Caloocan City and Malabon frequently experience low water pressure probably due to old and worn-out pipes, which need immediate rehabilitation.

To serve the barangays in Valenzuela a water pipeline of MWSI crosses the PNR ROW alignment in Barangay Polo to provide water to the service connections of the consumers. However, since there is no water source within the ROW families located within the ROW buy water from nearby households outside the ROW for their water supply requirements.

(ii) Human Excreta Management

There is no centralized sewerage system in the localities. Households generally rely on individual septic tanks for the treatment of domestic liquid waste without further effluent stabilization, while industries have their own wastewater treatment system. It is estimated that 88% and 82% of the households in Caloocan City and Malabon have sanitary toilet facilities.

(iii) Waste Management and Disposal Systems and Food Hygiene

Solid waste generation per day in Caloocan City and Malabon is estimated at 300 tons and 128 tons, respectively. Collection of solid waste in Metro Manila has been devolved to the local government units. Garbage collection in Caloocan City is conducted in two shifts per day by contracted dump trucks with varying capacities from 5 to 12 cubic meters.

In Malabon refuse collection is under contract to two (2) private garbage collection contractors which have 17.8 cubic meters garbage trucks, two compactor units and 18 Woodencabs-Trashbusters. Malabon maintains its own dumpsite in Barangay Catmon, while Caloocan City uses the Payatas Dumpsite in Quezon City.

4.4.3 *Other Social Services / Utilities*

(a) Water Supply and Demand

Please refer to Section 4.4.2 (c) item (i).

(b) Transportation

There are about 173 km of roads serving South Caloocan City and 157 km in North Caloocan City. The major roads in Caloocan City include Rizal Avenue Extension, EDSA, A. Mabini St., C-3 Road (5th Avenue), C-4 Road (Gen. San Miguel-Samson Road), and part of the NLE. These are roads serve as the main transport routes in north-western part of Metro Manila. However, only C-4 Road (Gen. San Miguel-Samson Rd.) crosses the PNR ROW in this locality.

Various modes of transportation exist in Caloocan City. Buses ply on major roads while jeepneys and tricycle serve as feeder trips. LRT Line 1 along Rizal Avenue Extension serves the city with its north end terminal located at Monumento in South Caloocan City.

The basic road system of Malabon consists of national, provincial, municipal and barangay roads totaling to about 116,868 kms. Gov. Pascual Avenue is the only road that crosses the PNR ROW. Malabon also has 21,033 registered vehicles (4,826 private cars, 679 PUJs, 10,844 utility vehicles, 15 buses, 1,901 MC/MTCs, 2,213 cargo trucks and 554 retailers). Malabon has 3 inter-municipal and 17 intra-municipal routes. The average inter-municipal route is 8,625 kms. In addition, jeepneys or public utility buses coming from adjacent areas move in and out of the municipality.

Some of Malabon's roads have reached their volume capacities, aggravated by lack of discipline and absence of traffic lights at major intersections. Traffic congestion from adjacent Caloocan City and Navotas affects the municipality's traffic or vehicular movements. Malabon has 75.77 vehicles per 1,000 population, as against National Capital Region's (NCR's) 216.73 per 1,000 population. Based on a survey, only 10% of all households own a car or other types of motor vehicle.

There are a number of buses and jeepney stations from Manila to the towns of Bulacan and beyond along the General MacArthur Highway, the NLE, Governor Pascual Avenue and A. Mabini-Juan Luna Streets. Due to increase in ridership and the corresponding increase in the number of vehicles plying the northbound roads, traffic congestion is being experienced in all the major roads north of Metro Manila.

(c) Power Supply and Demand
The MERALCO provides power to Metro Manila. For Caloocan, there are about 91,744 customers 91% of which are for residential use. About 88% of the households have electricity. For Valenzuela, about 495 households within the PNR ROW are connected to the system. Those not served by the system use gas as substitute.

4.4.4 *Public Participation and Social Acceptability*

(a) Public Perception Survey Questionnaire and Results Summary
In 1997, TCI together with representatives from NLRC conducted scoping activities as part of its preparation for this Project's EIA. Thereafter, NLRC have been constantly coordinating with the LGU officials, barangay leaders and people's organization. These coordination meetings serve as a venue to inform the concerned LGUs regarding the project's progress including the changes in its design.

(b) Endorsement / Proof of consultation with LGUs / RDC
The Caloocan local government unit (LGU) was instrumental in the relatively smooth relocation of PAFs from Caloocan. During the several general assemblies held in the social hall of the Caloocan City Hall and at the PNR Caloocan Station Grounds, the NLRC has presented the new design parameters for the NorthRail Project. The support provided by the Caloocan LGU during the relocation activities is proof of its support for the Project itself.

In 2003, NLRC formed Local Inter-agency Committees (LIACs) for each of the LGUs in the alignment being considered in this EIS in order for the Project to be fully appreciated by the LGUs, and at the same time provide the necessary vehicle to ensure proper coordination between the LGUs, PAFs, HUDCC, NHA, Commission on Human Rights (HRC), the Presidential Commission for the Urban Poor (PCUP), people's organizations (POs), the Philippine National Police (PNP), the Department of Social Welfare and Development (DSWD), and other concerned agencies. These agencies are represented in the LIACs, with permanent and alternate members.

The Valenzuela LIAC is currently chaired by Mayor Jose Emmanuel L. Carlos, while the Malabon LIAC is currently chaired by its Acting Mayor

Mark Yambao. The chairmanships of these two LIACs by the respective heads of the local government themselves also manifest the support for the project by these LGUs.

Last 23 September 2003, members of the Regional Development Council (RDC) Region III unanimously decided to reiterate the endorsement it previously granted to the NorthRail Project, incorporating in its endorsement the new design and parameters of the Project. At the moment, the NLRC is securing the formal endorsements of the LGUs for the NorthRail Project.

(c) Endorsement / Proof of consultation with NGOs/POs
LIAC meetings are also attended by the concerned non governmental organizations (NGOs)/POs of the respective cities. The minutes of the meetings held by the respective LIACs and their attendances are proofs of consultations with the NGOs/POs. An Open Letter from the Home Along the Riles Valenzuela (HARV) Federation (Annex AD) is one expression of support to the modernization project for the railway. Support for the project is expressed by the continued attendance of the respective NGOs and POs to the LIAC meetings.

5 Project Impacts and Mitigating Measures

5.1 Land Features and Uses

5.1.1 Land Use

Impact	Mitigation
Since PNR has abandoned the train operation on the MLN (Caloocan to San Fernando, La Union) a long time ago, informal settlers have occupied a large portion of the PNR ROW. These informal occupants are currently using the tracks as their residences and their source of livelihood as some of them have also constructed commercial and industrial establishments within the area.	NHA will clear the PNR ROW by relocating the PAFs. PNR will terminate existing lease agreements with business establishments by issuing a 30-day notice prior to demolition of property. No construction of facilities or structures for the NorthRail Project will be carried out unless the ROW has been cleared of informal settlers and HUDDC / NHA have formally turned over the PNR property (or sections of the PNR property) to NLRC.
NLRC will utilize the PNR ROW for the construction of the rail infrastructure. The rail alignment shall be adopted at sections where be designed, as much as possible or practicable within the existing PNR ROW. However it is anticipated that the battery limit of the project infrastructure in some locations will invariably fall outside the boundary of the existing PNR ROW, giving rise to the need for acquisition / expropriation of additional land.	By Design, in order to reduce new acquisition of land, retaining wall will be adopted at sections where applicable. The Supply Contractor shall submit to NLRC on the completion of the Engineering Survey a list of additional land which will need to be acquired or expropriated. NLRC will negotiate with the owner for acquisition of the required land and buy the property at fair market value.

Impact	Mitigation
During operations, intruders may enter the PNR ROW	Barriers will be constructed along the ROW for the entire alignment including enclosures for the bridges to prevent unauthorized access to the rail system
Repositioning of affected utilities during construction may temporarily disrupt their services.	Proper coordination with utility companies prior to utilities diversion.

5.1.2 *Topography / Physiography*

Impact	Mitigation
Since the alignment will be running on the old PNR track, no permanent adverse impact on the physical environment is foreseen.	With the introduction of the NorthRail Project, PNR ROW will serve its original purpose as opposed to functioning as habitat for informal dwellers which is at present, an unsightly view.

5.1.3 *Geology / Soils*

Impact	Mitigation
Construction activities such as cutting and fill, diversion road and temporary occupation of land during execution may disturb existing irrigation facilities, natural appearance and ecological environment along the alignment.	Establishment of temporary facilities and camp for the construction will be made to avoid disturbing nearby areas.
Soil erosion may occur	Local bush and vegetation with strong roots will be planted to the embankment slope to prevent it from being washed

Impact	Mitigation
Procuring suitable filling material will inevitably lead to some extent, damage to surface vegetations and natural balance at the borrow areas	Suitable material excavated, if any, will be used for refilling at maximum extent. Borrowing will be undertaken as much as practically possible from area(s) without much damage to the agriculture or forestry. The borrow pit will be reinstated if possible with assistance from affected LGUs.
The result of the Engineering Survey may reveal that some portions of the existing alignment are of weak bearing capacity and deformation module does not satisfy the requirement of settlement and stability of the sub- grade.	• Shallow soft soil will be replaced with suitable material • Pre-load earth fills in conjunction with wick drains in other sections • In case the weak layer is thick and deep or in the transition between embankment approaching stretch and bridge where reinforced earth retaining wall is applied, consolidation including auger injecting piles or cast-in-place concrete piles (diameter = 500mm) will be adopted. • Specifications for all earthwork materials for the embankment shall be described in the Engineering Design • The value of 0.15g is to be adopted for the design as the acceleration speed of peak value for seismic force.
Leaking of oils from DMUs during operation	The DMU will be designed to prevent oil from leaking along the tracks.

The DMU will be designed to prevent oil from leaking along the tracks:

a. The DMU will be designed in such a way that normal leakage from diesel engine are prevented from contaminating the environment by having properly designed sump collection under the engines.

b. In any event of an oil, fuel and grease leak along the tracks, the ballast will be the one to absorb the oil, fuel and grease leaks. The first measure is to remove the ballast, then wash it with grease, oil or fuel cleaning detergents. The second measure is to use oil and grease absorbing chemicals to clean the oil/fuel leakage.

c. If there will be oil, fuel, grease leak along the track, it will not be a large scale leak since the train fuel storage tank has a capacity to carry only 600 liters of fuel.

d. If there will be oil, fuel and grease leak detected, the train could be stabled in the emergency sidetracks for emergency repair, or it could be brought to the train maintenance depot for repair and maintenance thereby avoiding further leaks along the tracks.

e. The DMU is designed in such a way to prevent oil and fuel leak along the tracks by encasing the fuel and oil storage tanks in thick steel plates that will be the one to absorb the forces from splinters, stones and other hard objects that may hit the fuel and oil tanks while the train is running.

f. The steel-encased storage tank is also installed with a steel 4" X 4" angular bar barrier strategically placed at least half meter away from the encased storage tank that serves as buffer to any object that would cross the path of the storage tank.

g. The fuel storage tank is also placed below the train's body but the bottom of the steel encasement is elevated to almost two feet above the tracks surface.

h. The fuel and hydraulic hoses are made of flexible high-grade rubber hoses which were strategically elevated to avoid wear and tear while the train is running.

5.1.4 *Aesthetics*

Impact	Mitigation
Temporary adverse impacts are expected during the construction phase of the Project.	Proper mitigating measures such as temporary fencing to enclose the construction site shall be carried out to minimize these adverse impacts.
During construction, solid wastes from construction debris will be generated. The contractor's camps will also have some domestic garbage.	Concentrated stacking of construction debris and domestic rubbish will be performed with timely removal from constructions site to appropriate dumpsite.
Main solid wastes during operations include industrial and domestic garbage in Depot, stations and passenger train: • Domestic garbage disposed by passengers in the train • Domestic garbage disposed by passengers at stations • Domestic and industrial waste (worn parts) disposed from workshops, office and handling buildings at the Depot	During operation, proper maintenance of the entire rail system will be carried out to ensure that the station buildings as well as other infrastructures are kept clean. Rubbish shall be cleared so that it will not accumulate within the area. Where applicable, some areas will be landscaped. NLRC will place rubbish bins at strategic areas within the entire rail system. The collected wastes will be transported to appropriate disposal sites. Facilities to temporary hold solid domestic and industrial garbage shall also be designed according to DENR requirement.

5.2 Species and Ecosystems

5.2.1 Terrestrial Fauna and Flora

Impact	Mitigation
Existing plants and trees within the PNR ROW could impede the NorthRail operations.	The plants will be removed as part of the clearing of the PNR ROW. For trees to be cut, NLRC will secure permit to cut trees from DENR prior to the clearing activities. It should be noted that planting of trees and other vegetation for landscaping will depend on land availability and operations requirement. It is also anticipated that the removal of flora will force the insects, birds and other wild life to leave the area and migrate to adjacent areas.
Explanation on whether the project will allow passage of animals after construction of "Berlin Wall"	There are several avenues for the passage and migration of flora and fauna between the two sides of the tracks. The "Berlin Wall" will obviously have no significant effect for airborne animals and plants that propagate by means of dispersion through wind. Aquatic plants and animals will still be able to migrate to either side of the alignment as waterways (rivers, ditches, canals, etc.) will be provided with bridges or culverts, whichever is appropriate. Terrestrial animals may be able to cross the "wall" through road crossings and pedestrian crossings provided in the design

Basis for re-planting of trees and other vegetation along the ROW:

- Only grass type of plants will be allowed to grow on the sides/slopes of embankments with a sole purpose of providing additional strength of holding soil together and to prevent erosion.

- For areas with enough width of ROW, areas adjacent to the perimeter fence will be planted with shrubs, or medium sized trees with bushy or dense foliage. This will provide a psychological reduction of noise levels, and help conceal the view of areas that are not pleasant to the view of commuters, such as squatter communities just outside the PNR ROW.

- In certain sections of the alignment where there are no squatter communities just outside the PNR ROW and the PNR ROW has enough width, short bushy shrub will be planted.

- The areas surrounding train stations will be planted with deep rooted shady trees and ornamental plants for aesthetic purposes

5.2.2 *Aquatic Fauna and Flora*

Impact	Mitigation
The project will not have adverse negative impact on the existing aquatic flora or fauna in Panaca Creek and Tullahan River.	None

5.3 Air and Water

5.3.1 *Air Quality*

Impact	Mitigation
During construction, air pollution may be generated from the dust due to transport and storage of construction materials.	Water spraying shall be performed regularly at the construction site to prevent dispersion of dust particles.
Exhaust gas emitted by the construction vehicles and equipment can also cause air pollution.	All industrial equipment, vehicles and stand-by generators to be used during construction and operations should meet the acceptable standards set by the DENR for their exhaust gas emission system.

Impact	Mitigation
Accidental spills of oil, deleterious chemicals and/or combustible materials may cause fire or contaminate air.	Extreme care and safety measures will be strictly adhered to avoid spills of oils and other harmful chemicals
During operations, possible sources of air pollution include exhaust gas from DMUs, stand-by generators and other industrial equipment at the Depot or stations containing SO2 and Nox.	NLRC recently obtained a certification from the Supply Contractor of DMUs to be used for this Project. Based on the said document, the DMUs will be equipped with highly reliable, environmental protected MTU diesel engine. (Annex J)

Emission from DMU is predicted in the Table 5.1 below:

TABLE 5.1: RELEASE FROM DMU

Unit: t/a

Source		Fuel Consumption	Major Pollutants		
			Exhaust	SO2	NOx
Passenger Train	Incipient Term (2009)	11,820.2	180.0	37.8	224.6
	Near Term (2016)	15,178.2	230.7	48.6	288.4
	Long Term (2031)	22,431.4	341.0	71.8	426.2

5.3.2 *Noise and Vibration*

Impact	Mitigation
Construction equipment and batching plants (if any) will cause noise within and near the project construction site.	During the construction, equipment with low noise and less vibration shall be selected, with proper arrangement of work time. Night time work shall not be, as far as possible, executed at noise-sensitive places, so as to minimize the construction noise impact on the surrounding environment.
Noise and vibration caused by train's operation will impact the sensitive areas near the railway alignment.	Sound barrier screens will be placed at sensitive areas and areas where the noise is exceeding the limits.

Activities in the depot that may cause potential nuisance to the nearby communities and the corresponding mitigating measures are provided in Table 1.5 and is provided in this document in Annex AL.

Impact	Mitigation
During operations, noise may be generated by passing trains.	• Repair of rolling stock and other rail equipment will be done during daytime • Proper maintenance of rolling stock (including brakes) and rail tracks • For workshops in the Depot, acoustic wall with soundproof material shall be adopted to minimize noise. Air compressor shall be of environment protective type. • Sound column with low noise will be applied to broadcasting equipment to minimize impact on surroundings.

The designed target speed for passenger train is 120 km/h. Noise value for the maximum travel speed of DMU according to the maximum design speed is summarized in Table 5-2 below.

TABLE 5.2: NOISE VALUE LEVEL ESTIMATE Unit: dB

Max. Speed 120 km/h	Caloocan ~ Malolos	
Impact range to the railway line	Daytime	Night Time
30m	66.6	57.9
40m	65.5	56.7
50m	64.6	55.8
60m	63.9	55.1
30m	67.7	58.9
40m	66.5	57.7
50m	65.6	56.8
60m	64.9	56.1
30m	69.3	60.5
40m	68.1	59.2
50m	67.2	58.3
60m	66.4	57.6

5.3.3 *Surface Water Quality*

Impact	Mitigation
During the construction of the rail bridge on Tullahan river; the impact will be temporary and insignificant.	None
The old PNR Tullahan Bridge will be demolished and replaced by a new bridge. In case water course or surface runoff is blocked due to improper construction of this bridge and culverts, flooding may occur.	The bridges and culverts shall be properly designed considering a 1/100Y and 1/50Y flooding frequency, respectively, so as to streamline the watercourse / ground water flow and to mitigate erosion to preserve the ecological environment.
During construction, the source of wastewater is mainly from construction activities, domestic and industrial activities discharged from the site.	During construction, liquid wastes will be discharged at existing main sewers. Human excreta will be managed by installing portalets. Solid wastes will be properly disposed at appropriate dump sites. Minimal industrial wastes will be generated during construction since bio-dissolvable detergent or other solutions will be used in order to protect the environment.
During operations, sewage source is from domestic and industrial activities caused by repair shop at the Depot in stations and depot. The main pollutants are suspended solids (SS), chemical oxygen demand (COD), biochemical oxygen demand (BOD), and petroleum.	All kinds of wastewater with oil shall be stored and disposed carefully with oil traps and oil separators, and septic tanks will be utilized for the treatment of dejected sewage, so as to reduce impact on surrounding environment. Domestic sewage from every station shall be discharged only after disposition of septic tank. A water treatment plant will be constructed at the Depot where industrial sewage shall be treated accordingly. Wastewater with oil should be separated in oil separators while those with acid or alkali shall be treated in neutralizing tank. It will be further treated with collected domestic sewage for two to three stages such as bio-chemical processing, coagulating, air floatation and filtering. The output will be

	reused as recycling water for all industrial section and part of domestic applications. Bio-dissolvable detergent and other solutions will be utilized in the Depot. The discharged sewage will be delivered through pipes into municipality sewers.

Oil and grease mitigation (oil and water separation).

An oil removal tank is adopted for separating the oil from the water by the oil rising method, the rate of stabilized effect of the oil removal could be more than 70%. Air flotation is affected by a mass of tiny air bladder produced by dissolved-air, which adherence with the solid or liquid particulate with the consistency close to that of the water, come in being the air floatation body with the consistency lower than that of the water, and with the result of the floatage, coming up to the surface of the water, and make the result of separating the solid from the water or water from other liquid. The rate of suspended solid removal is more than 90%, and the COD removal is more than 80%.

There are three status oil subsistence in the sewage: First is the floating oil which the grain sizes are usually bigger than 100μm, staying on the surface of the water easily; The second is the dispersal oil and the emulsify oil distributed as the colloid form, in which the grain sizes of the dispersal oil are usually 10 ~ 100μm, forming the floating oil after standing for some time, the grains sizes of the emulsify oil are less than 10μm, generally 0.1 ~2μm. The surface active agent usually turn the oil droplet into the stabilized emulsify oil; the third, a fraction of dissolved oil which the grain sizes are less than that of the emulsify oil, are the fine particles dissolved into the water. The floating oil and the dispersed oil could be removed during the process which carried out in the oil removal tank, the removal rate is about 60~70%, but the emulsify oil and the dissolved oil could only be removed by the air float process during which the flocculating agent will be used.

Impact	Mitigation
Due to regular maintenance, light and heavy repair of diesel powered rolling stocks (DMU), waste fuel, lubricant oil, cleaning chemicals and the like will accumulate in the flushing bay, workshop or stabling line in the Depot. These wastes will be hazardous to the environment particularly to the paddy fields, ponds and water streams if not properly disposed.	To prevent these wastes from contaminating the surrounding areas, the drainage conduits and pumps in the Depot will be designed with special linings & proofing. The fluid flushed in the drainage will be treated in the recycling facilities for further use. Waste diesel fuel or lubricant fishing collected in isolated containers will be removed regularly by special vehicles to the designated dealers for the purpose of recycling. Facilities such as tanks, dispensers, etc. at the refuelling bay will be constructed and installed as a measure to eliminate the possibility of pollution or contamination.
Since the Project site is already prone to flooding, improper design and construction of Tullahan bridge and culverts may cause more flooding in the area.	• Height and direction of flooding will be considered in bridge/culvert design, and spans shall be sufficiently wide to ensure the free flow of waterway. • All excess soil, slurry and foreign materials from foundation excavation shall be appropriately disposed immediately during and after bridge construction. • River bed will be properly dredged with necessary draining. Also, the banks will be protected with grouted rip-rap or lining. • Shape and type of bridge shall be designed in such a way that it will be harmonized with surrounding natural view.

Impact	Mitigation
	• For the bridges located near the downtown area, sound barriers and shock absorbent elastic bearings will be used. • Setting of bridges and culverts will be in the direction of natural flowing, and the spans of bridges and culverts shall be designed to constrain the water flowing in order. All excess soil, waste material and slurry produced by foundation excavation shall be properly disposed of. Lining protective treatment at upstream and downstream will be provided for major rivers. Types of bridges will be in harmony with the adjacent natural scenes. Sound barriers and elastomeric bridge bearings will be adopted for all bridges.

5.3.4 *Ground Water Quality*

Impact	Mitigation
The existing wells and pumps within the PNR ROW will be closed and sealed.	NLRC will coordinate with LGUs to determine the purpose of the wells and hand pumps within the PNR ROW. Abandonment of wells and hand pumps with or without replication or installation of new ones outside the PNR ROW will be on a case to case basis.

Impact	Mitigation
	Generally, NLRC's policy is: • For wells and hand pumps installed within the PNR ROW by the informal settlers for their consumption, these are to be sealed and abandoned. The relocatees will have water supply at relocation site as part of the basic necessities stipulated by law. • For those wells and hand pumps installed by the LGUs for purposes of serving not only the informal dwellers within PNR ROW but also the nearby communities, these are also to be sealed and abandoned. However, provision for replication of these wells and installation of new hand pumps outside the PNR ROW will be coordinated with concerned LGUs.

5.4 Socio-economic / Cultural Considerations

5.4.1 *Population / Settlement / Cultural Considerations*

Impact	Mitigation
The construction of the NorthRail Project on the old PNR tracks will have adverse impacts on PAFs despite the fact that the area is considered a danger zone.	Under the Urban Development and Housing Act of 1992 (UDHA), the responsibility for preventing the proliferation of informal settlers and for providing humane and acceptable relocation or resettlement sites are vested primarily on the LGUs. For the NorthRail Project, the HUDCC and the NHA have taken the lead in the resettlement and relocation of PAFs. NLRC's inputs insofar as the resettlement or relocation of informal settlers along the ROW will only be limited to the issuance of its construction timetable to the HUDCC/NHA for guidance in drawing up their own timetable for the

Impact	Mitigation
	resettlement or relocation activities. Towards this end, the LGU and HUDCC/NHA shall closely coordinate with concerned government agencies such as the PCUP, DSWD, Department of Health (DOH), CHR, and others to ensure that the affected informal settlers are resettled in an orderly and humane manner.
Some stakeholders will be fenced out and lose mobility due to right-of-way	For this segment, there is practically no road crossing that will be foreclosed, as the only road crossing in Malabon is the Governor Pascual, which will be kept open, and the entire Valenzuela segment is practically on viaduct. Mobility will only be limited in the sense that direct crossing of the right-of-way, as what is happening now, will no longer be possible.
Demand of stakeholders in Barangay 73 who are claiming that the land being used by the project are theirs and must be given to them. A problem borne out of the E.O. 48 of 2001 which promises to sell PNR land not used for operation	As far as PNR is concerned, the area which is being allotted for NorthRail in Caloocan (or any lot within the Main Line North alignment) has not been the subject of disposition. This is due to the fact that PNR has already earmarked the PNR ROW covered by Main Line North to NorthRail.

It is important to note the direct positive impact of this project to PAFs:

- Land tenure as they would be allocated resettlement sites where their eventual land/property ownership is guaranteed;

Status of relocation in Malabon, Caloocan and Valenzuela as of August 2004 with regard to:

- Site and area
- Number of facilities resettled and when.
- Cost
- Funding source.

The Caloocan segment has been cleared of informal settlers. The Project area from Samson Road to the Panaca Creek (boundary between Caloocan and Malabon) has been cleared since April 2003. NHA has formally turned-over the site to NorthRail last 02 May 2003. The relocation process took several public hearings, including two that was attended by then Secretary Michael Defensor, Chairman of the HUDCC. After these public hearings, regular relocation activities were conducted beginning end of March until end of April 2003. 148 families were relocated to Towerville in San Jose del Monte City, Bulacan; 16 families transferred to Camarin; 159 opted for "Balik-Probinsya"; while 31 chose to be relocated to other places (mostly to shelter/home of relatives). These numbers do not include those families that were previously relocated by NorthRail to Harmony Hills I and II in San Jose del Monte City, Bulacan in the year 2000. Relocation cost for the Caloocan segment was more than PhP 40 Million (includes cost of serviced lots, housing materials loan, livelihood assistance loans, manpower for demolition and trucking assistance, electricity and power connection and other costs). NorthRail has advanced the amount of PhP 130 Million to NHA for this purpose (and partly for Valenzuela relocation activities).

Resettlement of families from the Malabon and Valenzuela segments are likewise completed.

For the Malabon families, voluntary relocation was the predominant mode adopted by the relocatees. Families were given the option t oeither relocate to Towerville, or accept a grant of Housing Financial Assistance (HFA) in the amount of PhP 50,000.00. Most of the families who belonged to an organization opted for the HFA, and bought their own relocation site (either in Malabon, or a site identified and acceptable to them). Funding for the relocation cost was released by the Department of Budget and Management to NHA.

Just as in Malabon, the Valenzuela families had been prepared and organized since 1998. They had previously opted for in-city relocation through the Community Mortgage Program (CMP). However, in order to expedite the acquisition and development of the sites (there were 2 sites identified by the people's organizations), the NHA took over the program. The 51st Engineering Brigade of the Philippine Army undertook the development of these relocation sites. While the Towerville and HFA options were also offered to the families, most opted to be relocated to their identified relocation sites. Funding for the relocation of the Valenzuela families was also released by the DBM to NHA.

Actual costs for the relocation of the above families are still being finalized by the NHA.

- Improvement in living conditions because the resettlement sites are developed with provision for all of the basic facilities and utilities, water, power, transportation; and

- An environment that is truly conducive for residential purposes with the required open spaces and community facilities such as health centers, educational facilities and parks.

5.4.2 *Update on Relocation of Informal Dwellers*

Her Excellency, President Gloria Macapagal-Arroyo instructed that the relocation of informal dwellers within the PNR ROW for both the NorthRail and the South Rail Projects be undertaken by the key shelter agencies, to be headed by the HUDCC. HUDCC subsequently identified the NHA as the implementing agency for the relocation program.

During the 67th Cabinet Meeting held last 07 March 2003, President Arroyo instructed BCDA to provide some Pesos 100 Million for NLRC to advance to NHA for initial relocation. A Memorandum of Agreement (MOA) was subsequently signed between NLRC, NHA and HUDCC wherein NLRC advanced the amount of P100 Million to NHA for the relocation of PAFs in Caloocan (please refer to Annex Z).

A Multi-Partite MOA (attached as Annex AA) by and between HUDCC, the Department of Budget and Management (DBM), the National Development Company (NDC), BCDA, NLRC, the Home Development Mutual Fund (HDMF), NHA and PNR was signed on 03 May 2003 for the NorthRail Relocation Program and to identify the funding source for the program.

On 09 April 2003, NLRC sent a letter to HUDCC advising of the target dates for the clearing of the PNR ROW for the Caloocan to Malolos section (please refer to Annex Y). The schedules were determined on the basis of NLRC's Work Breakdown Schedule (WBS) to meet the schedule set by President Arroyo. HUDCC was further requested to advise PNR directly regarding the issuance of the 30-day notices to PAFs.

On 06 June 2003, NLRC again advised HUDCC (please refer to Annex Y) on the revised timetable for the relocation program. The adjustments were due to the discussions on the Tanza site for the Malabon PAFs. The Tanza site at the moment is still not ready for relocation. HUDCC was further advised that while it is possible to relocate families from Valenzuela ahead of the Malabon families, the Malabon area still has to be cleared by end of September 2003.

It was stressed in the last letter of NLRC to HUDCC that with the new schedule, NLRC has no more slack in its construction schedule. This means that any delay in relocation activities will result to a delay for the Project.

A LIAC were established for Caloocan City, Malabon City and Valenzuela City to serve as venue for proper coordination between NLRC, concerned LGUs, concerned government agencies, and POs regarding relocation activities and issues (please refer to Annex AD).

To date, the relocation of PAFs in Caloocan has been completed. The PNR ROW was formally turned over to NLRC. This section of the PNR ROW is currently being manned by NLRC security.

As for the Malabon City and Valenzuela City PAFs, off-site in-city relocation will be implemented.

Please refer to Annex AB for the project status and funding requirements of the resettlement project for the Metro Manila section (Valenzuela City, Malabon City and Caloocan City) of the NorthRail Project Phase 1 Section 1 as per report of NHA to NLRC last 17 September 2003.

Status on management of informal dwellers
The management of informal dwellers affected by the Project and are to be relocated has been transferred to the Housing and Urban Development Coordinating Council (HUDCC). HUDCC in turn designated the National Housing Authority to implement the relocation program (for both NorthRail and South Rail Project affected families).

Local Inter-Agency Committees (LIACs) have been established for the three Local Government Units (LGUs): Caloocan, Malabon and Valenzuela. These LIACs are chaired by the respective mayors and co-chaired by the NHA. Other members of the LIAC include representatives from NorthRail, the Presidential Commission for the Urban Poor (PCUP), Human Rights Commission (HRC), Philippine National Police (PNP), the Department of Social Welfare and Development (DSWD), the Department of Education, Department of Health, and the various People's Organizations in the respective areas.

NorthRail has a current Memorandum of Agreement signed with the National Food Authority (NFA) for the use of 5.8121 hectares out of the total 13.618 hectares of their property in Valenzuela. Please see Annex 8. MOA between NorthRail and National Food Authority (NFA).

The said MOA (Annex AT) provides for the use of ___ hectares for purposes of putting up temporary facilities for the construction of the Project. Currently, the facilities that are in place are the following:

The MOA also provides for an option for NorthRail to utilize the remaining areas for purposes other than temporary facilities. NorthRail is actually locating the Valenzuela station within the said area. Also, with the potential problems being faced with the Caloocan depot option, NorthRail is seriously considering locating the depot also within the NFA property.

Negotiations pertaining to the Lease Agreement for the 13-hectare property are currently on-going between NorthRail and NFA.

ROW issues at Caloocan to Valenzuela route

The PNR right-of-way (ROW) from Caloocan to Valenzuela comprises about 7 kilometers of the Project. From the various public hearings that had been conducted then and until recently, the following discussions are the common issues that pertain to the PNR ROW. Please note that socio-economic issues are not included under this item as these issues are discussed separately under items 28 through 30.

- <u>Width of the PNR ROW:</u> The PNR ROW does not have a fixed width. Rather, the width of the ROW, or the ROW itself, is determined by the Technical Description as stated in the Original Certificate of Titles and Transfer Certificate of Titles under the PNR. Also, the existing rails do not necessarily fall on the geometric centerline of the ROW. In some cases, the rails are "shifted" to either side of the ROW in order to maximize turning radii and other design aspects. It is therefore not correct to establish the metes and bounds of the PNR ROW by specifying "x" distance from the rail centerline.

  In order to establish the PNR property, the NLRC engaged the services of Geodetic Engineers who have conducted geodetic surveys along the PNR alignment. Based on PNR OCTs and TCTs and backed-up by intensive research, the PNR ROW metes and bounds have already been determined for the Caloocan to Valenzuela and the Meycauayan to Malolos segments. The PNR ROW has been marked accordingly.

  At the moment, the NLRC is preparing for the bidding process for the geodetic survey (including ortho-photogrammetry) of the Malolos to Clark segment.

- <u>Will the Project use the entire PNR ROW?:</u> Ideally, a double-tracked railway requires about 30 meters of ROW for economic, safety and riding comfort considerations. While the PNR ROW varies in width, the NorthRail Project will maximize the use of the ROW and therefore utilize the entire width of the PNR ROW.

- <u>What will NLRC do in areas where the PNR ROW is narrow?:</u> The Project will be designed with the consideration of areas with limited ROW. However, in areas where the ROW is insufficient to accommodate a double-tracked rail system, or where engineering solutions would prove less economical than acquiring additional ROW, then the NLRC would have to acquire the required ROW.

Social Development Plan

In addition to the program provided in Section 7.3 of the EIS, the following information is added:

Towerville Option (open to Malabon and Valenzuela relocatees)

- Towerville relocation site is an existing community, with adequate existing and planned community facilities for the relocatees. Aside from this, since the relocation is considered off-city, the relocation package includes an option for the relocated families to avail of a PhP 25,000 livelihood assistance loan. The loan is payable in 25 years without interest.

- Subdivision plans for the Towerville site have been approved by the receiving LGU

Malabon Relocation

- Malabon families only had the Towerville option or the PhP 50,000 HFA grant, as the site identified by the families as relocation site (located in Panghulo, Malabon) was inundated, requiring massive backfill, which will result to higher cost/square meter of developed land, which will render the site too costly for socialized housing, and was therefore not acceptable to NHA.

- Families who opted for the Towerville option also received the same benefits / package as those from Caloocan.

- Most of the families who opted for HFA were members of organizations who have agreed among themselves to procure a site acceptable to them (including the Panghulo site, other sites identified by other organizations were in Sta. Maria, Bulacan). While this undertaking is already a private agreement between the landowner and the families, the Government, through the NHA, PCUP, NorthRail and other agencies (both national and local) have extended their support by providing technical expertise and assistance for these families.

Valenzuela Relocation

- While the relocation sites for Valenzuela are new development sites, community facilities have been provided for in the planning and construction of the sites. In fact, more than 200 families have already relocated to the Bignay site even while the 51st Engineering Brigade were still doing development works.

- The Bignay site is within an existing barangay, the Barangay Captain of which has already accepted the relocatees. Further, Mayor Sherwin Gatchalian of Valenzuela has been very supportive of the program and has taken an active role in its implementation.

- Through proper coordination with the DepEd, the Bignay Elementary School has put up temporary classrooms to accommodate the schoolchildren.

Expansion works of the school facilities were undertaken to accommodate the students with more permanent structures.

Caloocan

- Replacement of Barangay 1: Barangay Hall which was demolished 5 years ago:

  In principle, the parties involved in the demolition and replacement of the said Barangay Hall have agreed (prior to its demolition) that NorthRail will replace the said structure. What was needed was the proper documentation to affect the agreement.

  NorthRail initially drafted the Memorandum of Agreement in accordance with the arrangement. The MOA was between the Barangay (represented by its Barangay Captain) and NorthRail. However, for some reason or another, the MOA was revised and the new signatories to the agreement were NorthRail and the City Government. The revision took time and was never signed until the election in 2007. Unfortunately, the incumbent Mayor lost.

  During the focused group discussion held in Caloocan last December 21, 2005, Chairwoman Ofelia Borja brought the subject of the replacement and NorthRail responded positively to the request, stating that there is still a need to finalize and execute the MOA. At that time, the Chairwoman was given the contact numbers of NorthRail and those of the FGD coordinators. However, there were no calls to NorthRail neither to the FGD coordinators.

  NorthRail will try to contact the LGU and coordinate the construction of the New Barangay Hall.

- Unpleasant behavior of security guards, antagonizing the stakeholders:

  NorthRail does not tolerate nor condone unpleasant behavior from its employees, much more from contracted personnel such as security guards. In cases where such behavior are reported or were made known to NorthRail, the concerned personnel are accordingly sanctioned (after a thorough investigation).

5.4.3 *Employment / Livelihood*

Impact	Mitigation
The construction of the NorthRail Project will generate employment opportunities especially for residents of the affected LGUs.	NLRC will hire both unskilled and skilled laborers and will give priority to those residing in the affected LGUs.

5.4.4 *Cultural and Historical Value*

Impact	Mitigation
NLRC made some initial coordination with the National Historic Institute (NHI) through PNR to identify existing PNR stations with historical significance (please refer to Annex N). For this section of the NorthRail Project Phase 1 Section 1, the old PNR Polo station located in Valenzuela City was identified by the PNR and NHI to have historical significance.	NLRC conducted an ocular survey of the Old PNR Polo Station and found out that the said structure is currently being occupied by the Valenzuela PNP as one of its detachment. The Prime Contractor will use its best endeavors to preserve / integrate the old PNR Polo station building. The Prime Contractor shall notify NLRC in the event that preservation / integration is not possible or practical according to the Engineering Survey. The Prime Contractor shall provide the reasons as to why preservation / integration are not possible.

5.4.5 *Road Safety/Traffic Management*

Impact	Mitigation
Some of the construction activities may cause traffic congestions in the Project area. Also, some of the existing access roads (road crossings) may be permanently closed affecting some residents / business establishment within the Project area.	NLRC previously submitted a conceptual traffic management plan (TMP) to the MMDA and was approved in principle (please refer to Annex O). As mentioned in the said conceptual TMP, NLRC will hire a consultant to undertake a detail traffic management study not only to ensure that the anticipated traffic problems will be addressed but also to analyze the effect of existing road crossings to be permanently closed and provide alternative solutions to minimize negative impact of such closure to the adjacent road networks.

Impact	Mitigation
Road related accidents at designated RCs may occur during construction and operations.	As a general assumption for the design of the road crossings, all RCs will be grade separated. Standard clearance for the said structure will be in accordance to the Department of Public Works and Highways (DPWH) standards. During construction of the RCs, temporary facilities will be installed to make sure that the construction will not cause any danger to those who will pass through the corridor. Early warning devices will be provided in order to advise the road users for temporary closure of road (if necessary), or advise the road users that a construction is on-going and traffic will be expected. During operations, regular inspection of the road crossing as well as proper maintenance is part of the work to be undertaken by the NorthRail Project Phase 1 Section 1 operator.

5.4.6 *General Health and Safety Management Plan*

Site Safety

The Prime Contractor shall take all measures necessary to safeguard the health and welfare of all persons entitled to be upon the Site and shall ensure that the Works are carried out in a safe and efficient manner.

The Prime Contractor, his sub-contractors and all persons employed by him on the Site shall comply in every respect with the provisions of any relevant statutory regulations as may be considered applicable to the Works.

Safety Regulations and Emergency Procedures

The Prime Contractor shall submit for the approval of NLRC detailed proposals for safety regulations and emergency procedures.

Approved copies of such safety regulations and emergency procedures shall be produced by the Prime Contractor and distributed and displayed at each place of work, together with any other documents, posters, notices boards, and other items of the same nature which are required by law. The Prime Contractor shall revise, replace, maintain or remove the notices, regulations and the like as required by legislation.

Safety Enforcement

The Prime Contractor shall provide and enforce the wearing of efficient safety helmets, and when necessary, eye goggles, ear protections, and other personal protection equipment for all personnel.

The Prime Contractor shall employ full time qualified and experienced safety officers and assistants for ensuring that the Works are carried out in a safe manner.

Regular Site Safety meetings will be conducted to discuss general or particular matters of safety and health. The Prime Contractor shall act without delay to the decisions or recommendations made in the said meeting.

Fire Protection

The Prime Contractor shall construct, equip and administer fire control points to provide adequate service for the protection against fire at each site, and in accordance with local fire regulations.

Enclosures

The Prime Contractor will provide, install and maintain for the duration of construction all required scaffolds, tarpaulins, barricades, canopies, warning signs, steps, bridges, platforms and other temporary construction necessary for the protection of the public and the proper completion of the Works in compliance with all safety and other regulations.

Accommodation for Watchman, Workers and Emergency Personnel

Temporary living accommodation for the use of watchmen, security guards and a limited number of workers and emergency personnel only may be provided within the Site. The accommodations shall be kept in a clean and sanitize condition at all times.

Training and Orientation

New employees are provided orientation concerning the safety requirements, job rules and job conditions prior to assignment to a crew.

Safety and health training for concerned employees will be conducted from time to time. The topics will relate to the facility's operations and work activities.

Inspections

The Safety Inspector and Supervisors shall make daily inspection of work areas. Inadequate and deficient protection measures and unsafe work practices that are noted shall be brought to attention to the appropriate Supervisor immediately for correction.

Inspections of all flammable storage areas, shops, warehouses and other buildings shall be made at regular intervals.

The Project Safety Program will also be subject for inspection by outside organizations including government-related agencies.

Accidents

Project management will implement the emergency response plan and direct specific in individuals to carry out the required procedures according to the circumstances.

Fully documented reports are required for those accidents resulting in injury, property damage, and "near misses", meaning, with near possibility of injury and/or property damage. The Safety Manager will act as a resource to the investigating official and assist in the investigation when necessary.

Sanitation

The Prime Contractor will be responsible for maintaining a high standard sanitation throughout the Works. He shall construct and maintain a system of surface drainage and waste disposal. Sanitary conveniences for the use of persons employed on the Works shall be provided and maintained by the Prime Contractor in accordance with the appropriate laws and regulations enforced in the Philippines. All persons connected with the Works shall be obliged to use them.

The Prime Contractor shall keep all work areas, offices, stores, clean and litter free, and they shall be run and maintained in an efficient condition in accordance with the standards of the appropriate authority during the period of the Contract. All buildings must at all times be open to the inspection of the officers of the public health authorities. Any instruction given for the proper cleaning, disinfection, and general maintenance in sanitary and hygienic condition of any building must also be carried out by the Prime Contractor. The Prime Contractor shall be responsible for dealing with all forms of vermin at Site during the Contract.

In order to keep the Site in a clean, tidy and sanitary condition, rubbish shall be cleared daily and not allowed to accumulate on Site. Any Temporary Works, Construction Plan, materials or other things, which for the time being are not required for use shall be stored on Site in an orderly manner.

Medical Arrangement

The Prime Contractor shall have adequately trained personnel available for the Site treatment of casualties and sick persons in first-aid units, and shall provide the means whereby injured sick personnel may be removed expeditiously to hospital or receive necessary medical attention. The Prime Contractor shall comply with all applicable local regulations and recommendations for first aid practice for the time being enforced.

The Prime Contractor shall provide at each place of work copies with emergency telephones, suitable accommodations, transport, and first aid equipment including stretchers.

Prime Contractor's Safety Organization

Below is an illustration of the proposed Prime Contractor's Safety Organization subject to final approval by NLRC with detailed discussion of the responsibilities of each key person in the said organization.

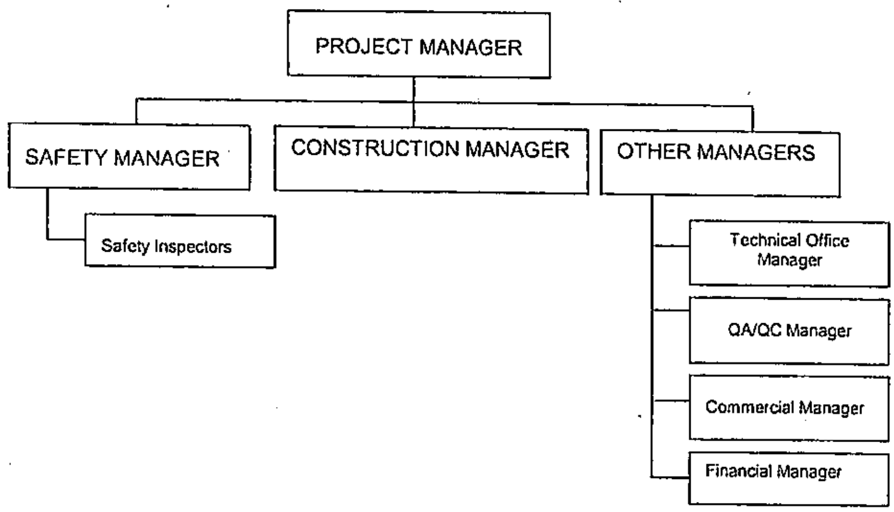

FIGURE 5.1: PROPOSED HEALTH AND SAFETY ORGANIZATION

Responsibilities of the Prime Contractor's Safety Organization Key Personnel

Project Manager

The Project Manager has the overall responsibility and authority for the Safety and Health (S&H) policies and programs appropriate for their location, including the project safety records. Specific responsibilities include:

- Be knowledgeable of S&H policies and programs which are applicable, according to the scope of the Works

- Ensure that all individuals in the organization are knowledgeable of their duties and responsibilities for S&H policies and programs, and old them accountable for performance of the same
- Provide the personnel, supplies, equipment and training necessary to successfully implement the S&H policies and programs
- Ensure that hazards are identified and controlled or corrected in a timely manner
- Lead the investigation team for all accidents, resulting in injury or property damage and ensure that appropriate action is taken to eliminate or control the causes
- Attend and/or conduct Project Safety Audits quarterly
- Attend Regular Safety Management Committee Meeting

Construction Manager

The Construction Manager has the responsibility and authority to implement and enforce the S&H policies and procedures appropriate to the activities and facilities he is responsible for. Specific responsibilities include:

- Ensure that employees are knowledgeable of S&H policies and procedures to the work activities
- Enforce the S&H policies and procedures, including issuing and/or reviewing safety violation notices to affected employees
- Address S&H policies and procedures in the work planning activities
- Inspect the work area for hazards, and implement the appropriate action to promptly correct and/or control those hazards
- Investigate accidents and/or near accidents; ensure that accident and/or near accident causes are corrected in a timely manner
- Inspect tools and equipment and ensure that defective items are tagged-out and the hazardous condition corrected
- Ensure that injured employees are evaluated and transported as necessary to the nearest medical facilities as soon as practicable
- Provide necessary personnel protective equipment, safety equipment, first aid training and first aid equipment to employees
- Attend and/or conduct Safety Working Group meetings
- Attend and/or conduct Safety Management Committee Meetings
- Attend and/or conduct Project Safety Audits
- Review all Job Hazard Analysis (JHA) before implementation

Safety Manager

The Safety Manager has the specific responsibility and authority for the development and implementation of the S&H policies and programs on the Project. Specific responsibilities include:

- Be knowledgeable of the country, local and client regulations governing S&H concerns at the work locations
- Be knowledgeable of the Prime Contractor's S&H policies and programs
- Develop specific S&H programs which are appropriate for the locations
- Monitor the implementation of the S&H policies and programs and report results, including recommendations to the Project Manager
- Identify specific hazards in the workplace to be controlled and corrected in timely manner. The Safety Manager has the authority to enforce compliance with S&H requirements, including signing individual violation notices, and to suspend operations pending control to hazards.
- Participate in the investigation of all accidents, whether they result in injury or not; ensure that the cause(s) and actions taken (or planned to be taken) are reported to prevent reoccurrence and verify that the action taken was effective
- Maintain S&H records and compile the required reports on occupational injuries and illnesses
- Accompany NLRC's Safety Management representatives during inspections at the project site
- Provide training and orientation to all employees in the S&H policies and programs
- Facilitate the planning for S&H problem prevention for the daily and future work planning activities
- Establish first-aid, medical treatment, and emergency plans and procedures for the project
- Provide materials to promote S&H education to all employees
- Provide technical assistance in S&H matters to all employees
- Coordinate S&H policies and procedures with NLRC's Safety Management representatives to ensure compliance with the Prime Contractor and NLRC's policies and procedures
- Attend and/or conduct Safety Working Group Meetings

- Attend Safety Management Committee meeting
- Attend and/or conduct Project Safety Audits
- Prepare JHA for the leading activities of the contract.

Safety Inspector

The Safety Inspectors have the responsibility and authority for accident prevention and safety practices of the crews. Specific responsibilities include:

- Provide training and orientation of employees in construction safe practices and safety rules
- Conduct continuous inspection and follow-up for work conditions, safety instructions and practices, including tools and equipment, which affect the safety of the crew(s) under their supervision
- Promptly correct hazardous conditions or practices within the supervisor's authority to correct; promptly report those hazardous conditions or practices to the Safety Manager when such are beyond the supervisor's authority to correct; and stop work in any area when encountering an imminently dangerous condition.
- Promptly report all job related injuries to the Safety Manager and ensure that proper medical attention is provided to the injured employee
- Participate in the investigation of all accidents, involving the crew member(s) under their supervision
- Discuss all S&H policies, programs and concerns in work planning activities and provide specific safety instructions to the crew member(s) under their supervision
- Ensure that personal protective equipment and tools are used in a safe manner
- Attend and/or conduct Safety Working Group meeting
- Conduct Tool Box Safety Meeting
- Attend Project Safety Audits
- Assist in preparation of JHA

6 Environmental Risk Assessment

6.1 Introduction

6.1.1 *Background*

This section of the EIS has been prepared to identify the potential environmental hazards and pathways associated with the proposed Caloocan – Valenzuela segment of the NorthRail Project and characterize the risks to human health and the ecosystem. A discussion of methods and strategies to manage these risks is also included. Analyses and results presented are based on information and data gathered during preparation of this EIS and FS of the NorthRail Project Phase 1 Section 1 (Caloocan – Malolos) performed for the Project.

6.1.2 *Objectives*

The primary objective of this assessment is to identify the risks to the environment associated with the Project activities with focus on the air quality, water quality and on the structures to be built. These risks occur from a variety of conditions, which may ultimately result in a release of substances harmful to the environment.

Once the risks were identified, a hazard characterization was performed to evaluate adverse impacts, estimate the levels of risk and prepare methods to minimize those risks. Analyses completed to satisfy this program consisted of the following:

- Identification of materials to be stored and used within the site;
- Identification of methods of materials release;
- Identification of pathways that allow the introduction of materials into the environment;
- Identification and evaluation of risk management tools and methods to reduce risks and control impacts.

Risk characterization and assessments can be done using either a qualitative or quantitative approach. Descriptive assessments and systematic characterization form the basis of the qualitative assessment. This is best applied to accidents or events with little or no data pertaining to frequencies of occurrence or ecosystem and health impacts. The quantitative method uses a probability approach and attempts to quantify the risk using frequency and probabilistic models. This is sometimes difficult to complete in a manner that provides reasonable and accurate results. There were limited data available for the Philippines that can be used for statistical analyses.

6.1.3 *Method of Assessment*

The assessment method can generally be defined as an engineering reliability method known as Failure Modes and Effects Analysis (FMEA). This approach is a systematic characterization and evaluation of sources of risks to the environment. It can be considered as a qualitative approach based on expert opinions. The primary objective of this approach is to identify the risks, prioritize those risks, identify risk tradeoffs, and identify means and methods to reduce the risks. Four questions must generally be answered to fully satisfy the process:

- What can go wrong?
- What is the range of severity of the adverse consequences?
- How likely are those adverse consequences to occur?
- What can be done to reduce risks that are unacceptable?

A schematic diagram of the approach used in this type of assessment is shown on Figure 6.1.

6.2 Hazard Identification

Hazards associated with this Project can be grouped into seven (7) categories:

- Rail system failure
- Structural failure
- A breach or release of harmful chemicals at maintenance Depot
- A breach or release of toxic substances during transport
- Fire
- Terrorism attacks
- Construction related accidents

Additional information relative to the specific hazards and risks associated with those hazards is presented below.

6.2.1 *Rail system failure*

This includes failure of rail equipment particularly rail tracks, signalling / communication systems, and rolling stock. Failure of these devices due to natural hazards (flood, earthquake, volcanic eruption and the like), natural wear and tear of rail parts, terrorists attacks or other forms of accidents may result to derailment.

6.2.2 *Structural Failure*

Structural failure as a hazard is related to buildings at the Depot and stations as well as all infrastructures where the rail tracks are laid. Failure of these structures due to natural or man-made hazards may result to damage of property and/or loss of human life.

6.2.3 *Harmful chemicals*

The chemicals used for maintenance activities at Depot are not harmful when properly handled. However, if accidental spills during their usage or a breach in containment unit occur, these chemicals may cause hazard to air and surface water.

6.2.4 *Transport of toxic substances*

Freight service will be introduced into the rail system upon the completion of at least Phase 1 (Manila – Clark) of the NorthRail Project or when the system has been developed to warrant the introduction of this service.

However, since this Project is a transportation facility, some passengers may opt to carry with them "dangerous" goods that they need to transport. These goods may be accidentally spilled or released from its containers during transport and may cause fire, damage to property and/or loss of human life.

6.2.5 *Fire*

Fire normally occurs during summer season due to excessive heat. It can also occur due to accidents and equipment failure. Fire may result to damage of property and/or loss of human life.

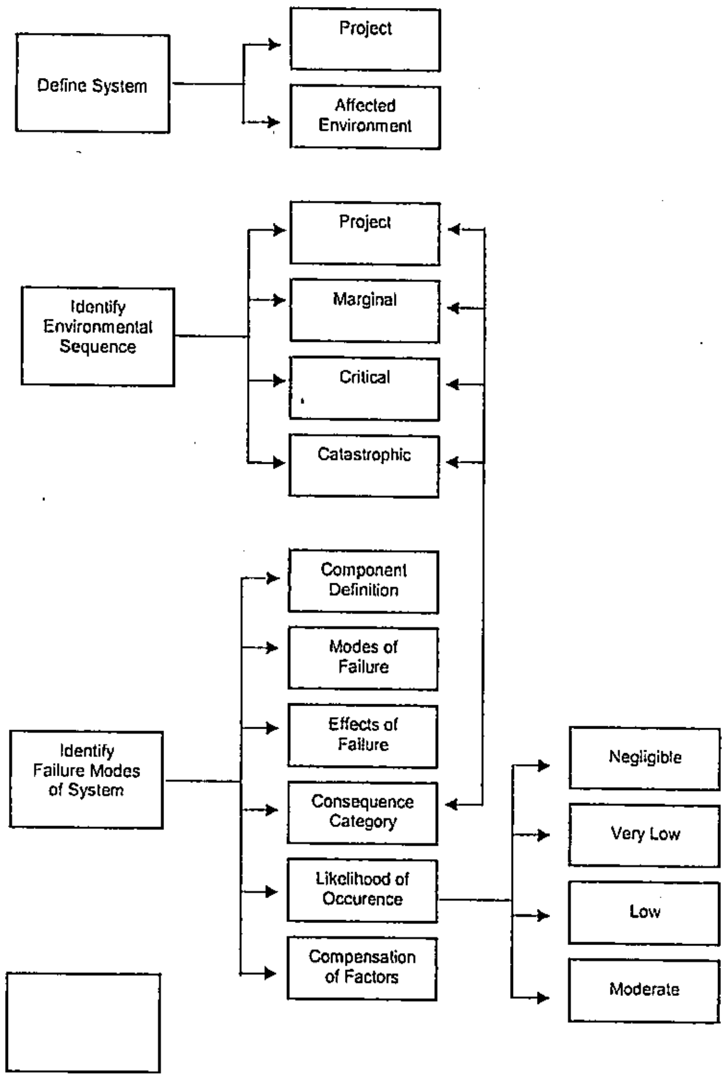

FIGURE 6.1: QUALITATIVE ASSESSMENT PROCESS
Source: Failure Modes and Effects Analysis

6.2.6 *Terrorism Attacks*

The Rizal Day bombing of LRT Line 1 followed by the September 11 terrorists attack claimed lives and destroyed properties and thus became a valid concern to all types of public transport facilities especially mass transport systems like this rail project.

6.2.7 *Construction related accidents*

During construction, all personnel assigned at the project site may be subject to accidents if health and safety management plan are not properly carried out.

6.3 Environmental Pathways

6.3.1 *Air*

Air can only become an environmental pathway when substances are in gaseous state. Vapors from hazardous chemicals and other substance are volatile. If these substances are released, they may diffuse into the air.

6.3.2 *Ground*

Ground can be considered as an environmental pathway when liquid substances travel through it by seepage or surface runoff.

6.3.3 *Water*

Water is one the fastest and most short-term pathway for potential pollutant impact. In many cases, this pathway is also a combination of surface water runoff and groundwater. The physical and chemical processes that affect migration of contaminants with both surface water and groundwater pathways are similar. Additionally, topographic and geomorphologic conditions also influence this pathway.

6.4 Accident Scenarios

A "what if" type of procedure was used to construct the different accident scenarios using an Event Tree type of procedure. This approach begins with consideration of a component failure and follows a "forward" analysis to identify how these failures can lead to major accidents. Variations in these scenarios can result in a large number of accident scenarios and risk characterization analysis. These accidents can rank from minor to severe. Some have a much higher probability of occurrence while others are significantly less probable. This study focuses on the scenarios of "what can go wrong" that have the potential to adversely affect the environment and human health. Seven (7) accident scenarios were prepared and are described below.

- Scenario 1 – Failure of rail component may result to derailment.
- Scenario 2 – Failure of structures
- Scenario 3 – Release of liquid and vapors from harmful chemicals may contaminate air and surface / ground water
- Scenario 4 – Release of liquid and vapors from toxic substances during transport may contaminate air and surface / ground water
- Scenario 5 – Fire may occur due to extreme hot temperature, equipment failure and other accidents.
- Scenario 6 – Construction related accidents
- Scenario 7 – Terrorists attacks may damage properties and affect human health.

6.4.1 *Scenario 1 – Failure of Rail Component*

Failure of any components of the rail system can occur due to natural or man-made hazards, normal wear and tear of rail system parts or other forms of accidents. Natural or man-made hazards may come in the form of fire, seismic events, terrorism attacks, etc. Other forms of accidents include failure due to materials defects or lack of proper maintenance of the system equipment.

NLRC will comply and incorporate in its performance specifications a number to design standards and codes (both local and international) in order to secure the necessary permit requirements. Once the rail system is built, the Prime Contractor together with NLRC will conduct testing and commissioning prior to acceptance of the NLRC for the works. For the maintenance of its rail equipment during operations, NLRC will utilize a third party contractor to operate and maintain the rail system.

The above activities will ensure that the operation of the rail system will be safe. Moreover, the Rail Operator will have to set up safety measures and emergency procedural plans to ensure timely and proper response to emergency situations caused by rail system failure.

6.4.2 *Scenario 2 – Structural Failure of Buildings and other Structures*

Failure of the buildings and other structures may only occur as a result of natural hazards. It usually takes a catastrophic event for this failure to be considered as a risk that may lead to damage of buildings or structures as well as injury or death of human beings.

NLRC will have to comply with the necessary codes and standards (i.e. the Philippine National Structural Code and National Building Code) in order to obtain the required permits. This will serve as an assurance that the facilities are structurally sound.

NLRC will produce an emergency procedural plan that will serve as guidelines for emergency response crew during accidents or occurrence of natural calamities.

6.4.3 *Scenario 3 – Release of liquid and vapors from harmful chemicals can contaminate air and surface / ground water*

This is in relation to accidental spills of chemicals (especially diesel fuel) used during operations and maintenance activities. Even on storage, breach in containment unit may accidentally happen allowing the chemicals to diffuse into the air or be spilled on soil and surface / ground water.

The fuel containers will be properly designed to ensure its safety and durability. Personnel who will be assigned at Depot will be trained to ensure safety of handling chemicals for maintenance activities.

6.4.4 *Scenario 4 – Release of liquid and vapors from toxic substances during transport can contaminate air and surface / ground water*

This can be due to accidental spills or breach in containment unit of toxic substances while in transport.

The design of rail facilities to handle storage of toxic substances during freight service should be in accordance with applicable local and international codes and standards. Inspection of containment units of toxic substances for transport will be handled by qualified NLRC personnel.

6.4.5 *Scenario 5 – Fire*

Fire may occur due to excessive heat, failure of equipment and other accidents.

NLRC will comply with the Bureau of Fire Protection requirements as part of its application for building permits. Fire fighting facilities (fire hydrants, fire extinguishers) will be placed at strategic locations within the project site. The emergency response plans will ensure timely and proper response to emergency situations caused by fire.

6.4.6 *Scenario 6 – Terrorism attacks may damage properties and claim human life*

Terrorism attacks are prevalent in mass transport systems these days.

Tight security measures will be implemented during construction and operation stages to avoid occurrence of this risk. Please refer to Annex M for certifications of the approved security plans (during construction and operations) issued by the Philippine Marine Corps Intelligence Division.

6.4.7 *Scenario 7 – Construction related accidents*

Similar to other construction activities, risk may occur due to construction related accidents.

Examples of these accidents include:

- ☐ collapse of scaffolding
- ☐ falling of construction materials while being lifted by a crane boom
- ☐ fire or electrocution from welding and use of other electrical equipment
- ☐ personnel being overrun by heavy equipment
- ☐ accidental fall of workers while in elevated location
- ☐ injury from construction debris and materials

Health and safety management plans required for the Works will be setup by the Prime Contractor. Safety regulations should be followed by all personnel.

The Prime Contractor will also provide an all risk insurance to cover for all types of accidents prior to commissioning.

6.5 Failure Mode and Effects Analysis

Based on the previous discussions of hazard identification, environmental pathways and accident scenarios, a FMEA were performed. This is primarily a qualitative assessment approach but does provide a systematic characterization and evaluation of the risks. The analyses combine subjective ratings or categories of likelihood and consequences of various events, which are identified in Tables 6.1 & 6.2 below:

TABLE 6.1: LIKELIHOOD CATEGORIES FOR RISK ASSESSMENT

Subjective Category	Likelihood Occurrence	Likelihood Occurrence
Negligible	$< 10^{-6}$	Less than 1:1,000,000
Very Low	10^{-6} to 10^{-4}	1:1,000,000 to 1:10,000
Low	10^{-4} to 10^{-2}	1:10,000 to 1:100
Moderate	10^{-2} to 10^{-1}	1:100 to 1:10
Significant	$> 10^{-1}$	Greater than 1:10

TABLE 6.2: ENVIRONMENTAL AND HEALTH CONSEQUENCE CATEGORIES FOR RISK ASSESSMENT

Subjective Category	Environmental and Health Consequences
Safe	Negligible effect on environment and human health
Marginal	Failure will cause some environmental degradation but no major or long-term damage. Minor Injury or Illness.
Moderate	Failure will cause significant environmental degradation but no long-term damage. Major Injury or Illness.
Critical	Failure will degrade environment, and if not mitigated will cause significant and permanent damage. Permanent Disability
Severe	Failure will cause major and irrevocable environmental damage. Fatalities.

A summary of these analyses using these categories as applied to the seven (7) accident scenarios is presented on Table 6.3.

To further describe the accident scenarios, a Fault Tree analyses was performed. Also considered a type of FMEA, this can be used to supplement the tabular evaluation and provides a graphical representation of the overall risk assessment. Fault trees are shown in Figures 6.2 - 6.8.

6.6 Risk Assessment Conclusions

As indicated in the FMEA analyses, a number of individual events would need to occur in a near simultaneous fashion to result in potential occurrence of these risks. Individually, each event has a low probability of occurrence. When taken as a joint occurrence, the probabilities are even lower. As such, only a catastrophic event would present a potential environmental hazard.

TABLE 6.3: TABULAR SUMMARY OF FAILURE MODES AND EFFECTS ANALYSIS

Accident Scenario	Description and Failure Mode	Project Phase	Effects	Consequences		Likelihood		Compensating Factors
				Category	Confidence	Category	Confidence	
1	Failure of rail component may result to derailment	Operational Phase	Possible damage to property and injury / loss of human life.	Minimal to Moderate (Environmental Degradation)	High	Very Low	High	Design of rail system should conform with known standards
2	Structural Failure of Encapsulation Facility By Seismic Events	Construction and Operational Phase	Possible damage to property and injury / loss of human life.	Minimal to Marginal (Environmental Degradation)	High	Very Low	High	Structural Designs follows or exceeds Code Requirements
3	Release of harmful chemicals during maintenance activities	Operational Phase	Possible damage to property and injury / loss of human life.	Minimal to Moderate (Environmental Degradation)	High	Very Low	High	Safety training for Depot personnel and proper design of Depot facilities
4	Release of toxic substances during transport of dangerous goods	Operational Phase	Possible damage to property and injury / loss of human life.	Minimal to Moderate (Environmental Degradation)	High	Very Low	High	Inspection of goods for transport by qualified personnel and design of rail facility to handle transport of dangerous goods
5	Fire	Construction and Operational Phase.	Possible damage to property and injury / loss of human life.	Minimal to Moderate (Environmental Degradation)	High	Very Low	High	Installation of fire fighting facilities
6	Terrorism Attack	Construction and Operational Phase	Possible damage to property and injury / loss of human life.	Minimal to Moderate (Environmental Degradation)	High	Very Low	High	Tight security measures within the project site
7	Construction related Accidents	Construction Phase	Possible damage to property and injury / loss of human life.	Minimal to Moderate (Environmental Degradation)	High	Very Low	High	Follow health and safety regulations

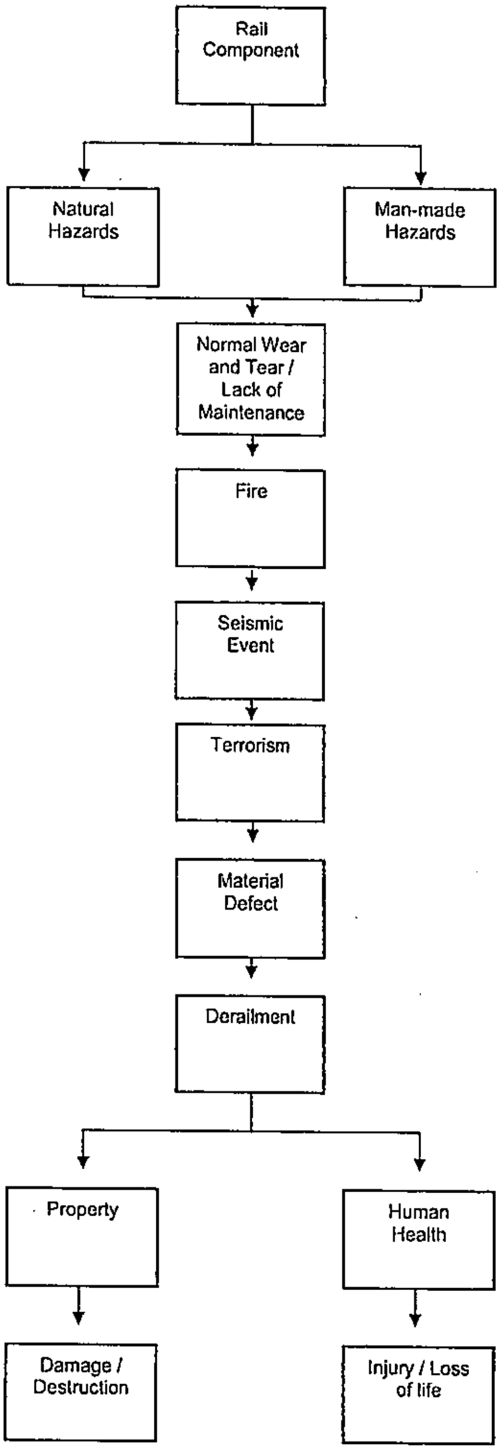

FIGURE 6.2: RISKS AND CONSEQUENCES (RAIL COMPONENT FAILURE)

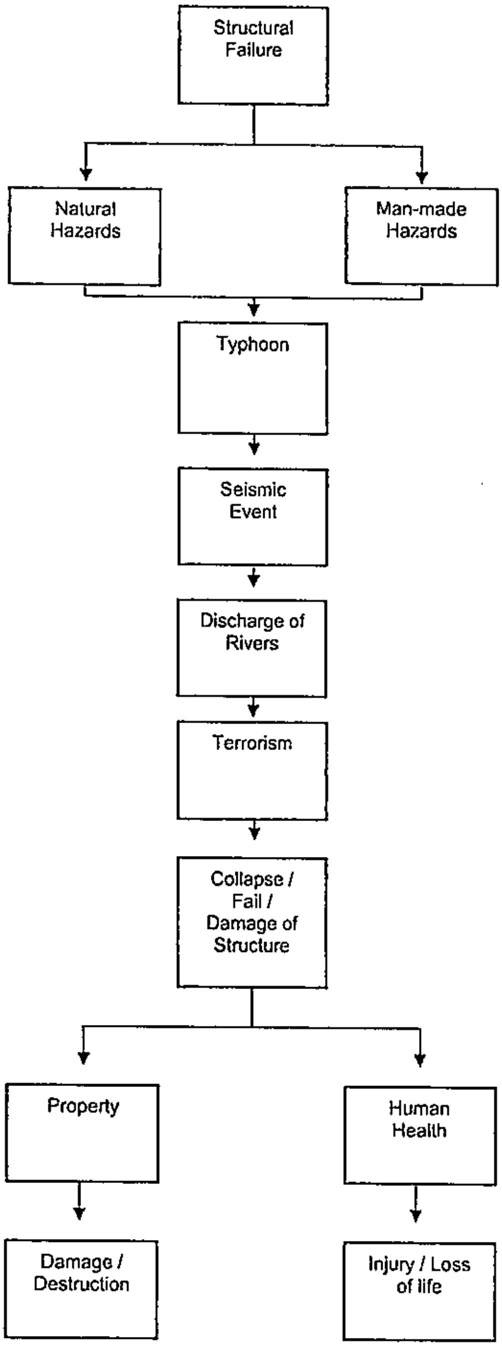

FIGURE 6.3: RISKS AND CONSEQUENCES (STRUCTURAL FAILURE)

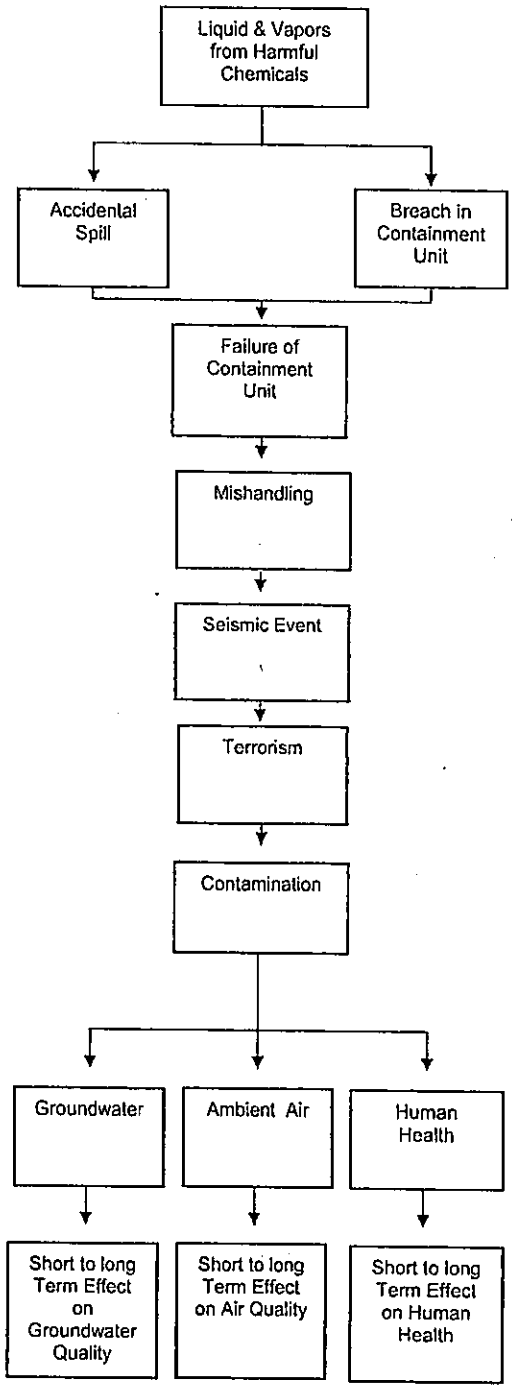

FIGURE 6.4: RISKS AND CONSEQUENCES
(RELEASE OF LIQUID OR VAPOR OF CHEMICALS AT MAINTENANCE DEPOT)

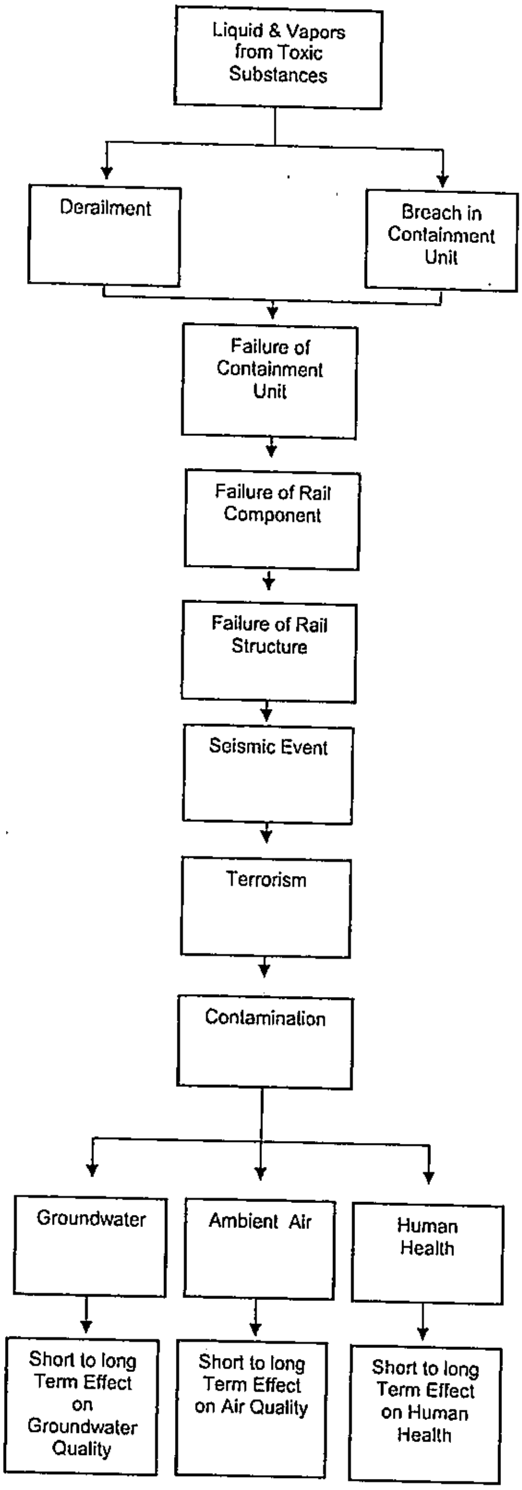

FIGURE 6.5: RISKS AND CONSEQUENCES
(RELEASE OF LIQUID OR VAPOR OF TOXIC SUBSTANCES DURING TRANSPORT)

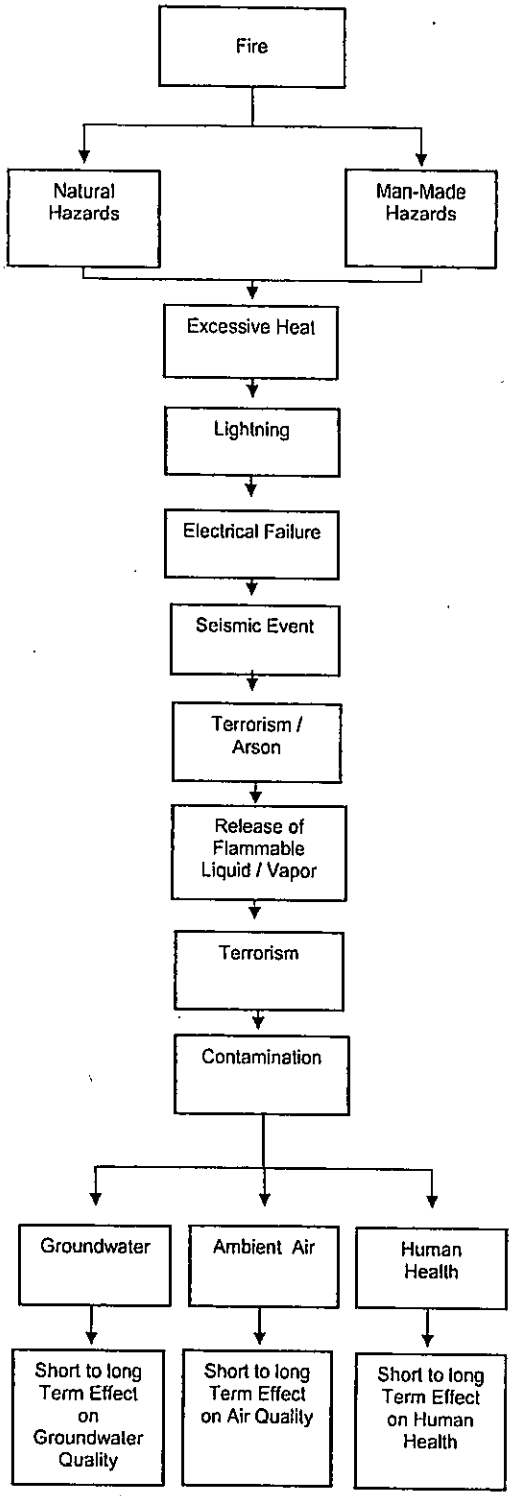

FIGURE 6.6: RISKS AND CONSEQUENCES (FIRE)

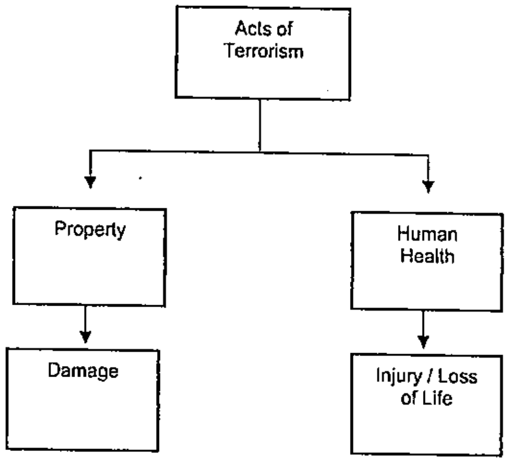

FIGURE 6.7: RISKS AND CONSEQUENCES (TERRORISTS ATTACKS)

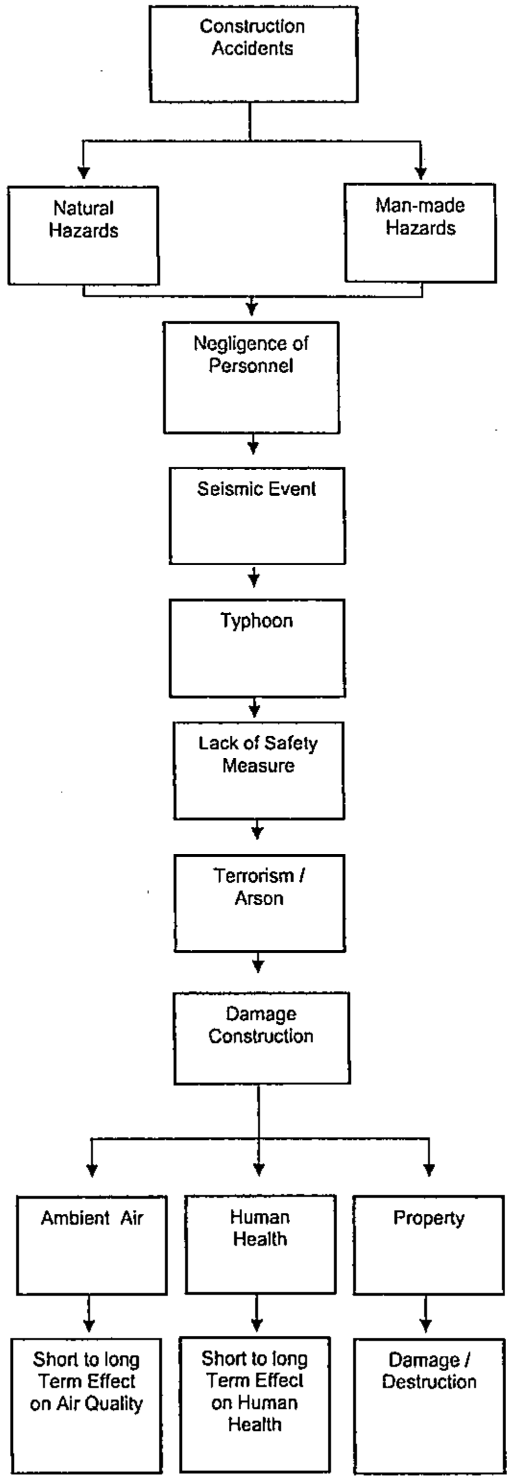

FIGURE 6.8: RISKS AND CONSEQUENCES (CONSTRUCTION RELATED ACCIDENT)

7 Environmental Management and Monitoring Plan

7.1 *Impact/s Mitigation Plan*

Please refer to Table 7-1 below.

7.2 *Detailed Monitoring Plan with Costing (EMF)*

Monitoring activities to be carried out are discussed in Table 1.6. Estimate costs to carry out these activities are detailed in Table 7-2 below:

TABLE 7-2: ESTIMATE COST OF MONITORING ACTIVITIES

Monitoring Activities			No. of Samples	Frequency of samples (yearly)	Unit Cost	Estimate Amount
During Construction (3-year period)						
Capital Expenses (Equipment)						
Vibration Meter		1 unit			50,000.00	50,000.00
Noise Meter		1 unit			50,000.00	50,000.00
					Subtotal	**100,000.00**
Monitoring Activities to be carried out						
Air Quality	Daily ocular	Organic personnel of NLRC				
Noise	Daily ocular					
Vibration	Daily ocular					
Hydrology	Daily ocular					468,000.00
Air/Noise/Vibration	Air Sampling	Use high volume sampler	3	4	6,050.00	223,850.00*
Water	Water Sampling	Panaca creek and Tullahan river	2	4	3,465.00	86,625.00
			Subtotal (during 3 year construction)			**878,475.00**
During Operations (annual)						
Air Quality	Daily ocular	O&M personnel				
Noise	Daily ocular					
Vibration	Daily ocular					
Hydrology	Daily ocular					156,000.00
Air/Noise/Vibration	Air Sampling	Use high volume sampler	3	4	6,050.00	72,600.00
Water	Water Sampling	Panaca creek and Tullahan river	2	4	3,465.00	27,720.00
			Subtotal (annually during operations)			**256,320.00**

*Includes baseline sampling for NO_x

It should be noted that the frequency of sampling may vary depending on the recommendations of the MMT and assessment of the in-house Environmental Unit.

7.3 *IEC and Social Development Program*

The social and economic benefits of the NorthRail Project to affected LGUs cannot be measured in pecuniary terms. However, it must be emphasized at the onset that the Project is aimed to address the national government's thrust towards poverty alleviation.

The records show that the PNR ROW is currently occupied by informal dwellers. Through its squatter relocation program, the Project will improve the lives of these PAFs by providing them with resettlement sites that are truly conducive for residential purposes with provision for all of the basic facilities and utilities. In addition, the relocated PAFs are guaranteed of their eventual land or property ownership of their new abode. Thus, the relocation program also coincides with the national government's program of housing for the poor to improve the quality of their lives.

Moreover, this Project which is a major transport infrastructure opens the affected LGUs to commerce. As a result, there will be inflow of small to medium scale investments which would necessarily bring in employment opportunities to the residents of the affected LGUs. Quality of life within the affected LGUs will naturally be enhanced when the rail infrastructure is in place since the basic goods and services (including health services like medicines) coming from different regions in the country are brought to their areas at a timely manner and cheaper price.

On a larger scale, this national government project is part of the Strong Republic Transit System (SRTS) that aims to improve the movement of people and goods in the country. At present, the traffic situation in northern part Metro Manila is heavily congested. This hampers possible commercial activities such as transhipment, warehousing, etc due to long travel time from the area to existing seaports and airports and vice versa. With the introduction of this rail project, traffic situation within the area will improve due to expected shift of commuters from road based to rail based transport system. Also, movements of goods by rail will be more efficient once the freight service is introduced. Thus, the improved traffic situation will encourage potential foreign investments and demonstrate positive economic growth. The positive economic effect may be intangible but cannot be discounted.

Supplementary social development programs, if any, will form part of the relocation activities being spearheaded by the NHA. The affected LGUs ("Sending" and "Receiving") will coordinate these initiatives to NHA and NLRC during LIAC meetings. The social development programs are yet to be identified after which, specific community development activities will be laid out prior to implementation.

7.4 *Emergency Risk Management and Emergency Response Program*

Possible causes of emergency situations due to man-made and natural hazards are being considered in the Design to reduce the chance of their occurrence. There are a number of design standards and codes that NLRC will have to comply with and incorporate in its performance specifications. These standards are part of the requirements of the local agencies concerned in order to grant permits and licenses to NLRC.

7.4.1 *Construction Stage*

Emergency situations that could occur during construction are construction-related accidents and fire. The Prime Contractor will set up safety measures required for the Works. This would include the following:

- The Prime Contractor shall provide and enforce wearing of efficient helmets, and where necessary, eye goggles, ear protection, safety harnesses, and other personal protection equipment for all the personnel.
- The Prime Contractor shall submit for the approval of NLRC detailed proposals for safety regulations and emergency procedures.
- Approved copies of such safety regulations and emergency procedures shall be produced by the Prime Contractor and distributed and displayed at each place of work, together with any other documents, posters, notices boards, or the like which are required by law. The Prime Contractor shall revise, replace, maintain, or remove the notices, regulations and the like as required by legislation.

- The Prime Contractor shall provide at designated stations within the site emergency telephones, suitable accommodation, transport, and first aid equipment including stretchers.
- The Prime Contractor will provide adequate service for the protection against fire at the site in accordance with local fire regulations.

7.4.2 *Operation Stage*

Safety considerations during construction and operation

For the operation stage, emergency situations that could occur are as follows:

TABLE 7-3: PREVENTIVE MAINTENANCE DURING EMERGENCY SITUATIONS

Emergency Situation	Preventive Measures
Derailment	NLRC will procure emergency re-railing and rescue equipment. These are part of the depot equipment.
Fire	Chinese Standards will be principally used as the design criteria of this Project except only in respect of fire fighting and environment protection which the requirements imposed by the laws of the Philippines shall be complied with to the extent of any inconsistency with the Chinese Standards. In the event that clarifications on the Design are required by either NLRC or a third party (for purposes of securing permits and licenses), the Prime Contractor will provide an English translation of the pertinent information from the Chinese Standards to such extent as to provide clarity and adequate explanation on the required clarification(s). The matrix for the probable location and causes of fire due to chemicals and the corresponding fire-fighting equipment and other measures that will be adopted are presented in Annex 4.
Typhoon	Regulations to follow for each typhoon signal no.: 1 - speed restriction for trains (60 kph max) 2 - speed restriction for trains (30 kph max) 3 - speed restriction for trains (30 kph max) 4 - suspend operation
Flood	The bridge design will be carried out for a 50 and/or 100 yr. return period high water level with a minimum safety margin clearance of 1 m. and/or 0.5 m., respectively whichever is the greater. In addition, all drainage will be replaced, and in most cases by a better system. NLRC will conduct periodic maintenance or when necessary for its drainage and water systems.
Failure of Structure	NLRC will comply with international and national standards to ensure that the structures are designed and built in accordance with these safety standards.
Seismic occurrence	Structures will be designed to withstand ground acceleration value of 0.15.
Transport of Dangerous	NLRC will eventually have a freight service apart from its

TABLE 7-3: PREVENTIVE MAINTENANCE DURING EMERGENCY SITUATIONS

Emergency Situation	Preventive Measures
Goods	commuter and airport services. NLRC have no immediate plans for the transport of dangerous goods. Should NLRC, however, consider transporting explosive substances and articles, the type of its rolling stock will be in accordance with the *Union Internationale des Chemins de fer* (UIC) procurement standard applicable to the particular, type of goods for vehicles transporting dangerous goods. Prior to the introduction of dangerous goods trains, NLRC train crew and emergency re-railing and rescue crews would receive specific training on the emergency procedures associated with the specific types of goods carried.
Medical attention required by passengers	For every station, security guards will be equipped with first aid kits. During extreme emergency cases, medical services including ambulance would be summoned to the nearest station by the central supervising station.
Criminal Acts	NLRC will provide security services to ensure the safety of passengers, crew and office workers.

Safety considerations during construction and operation (e.g. derailment) are provided in Annex 6.

NLRC will produce an emergency procedural plan, which shall include, but not limited to, the following:

- Policy, purpose, scope and definitions
- List of participating agencies and signatures of executives signing for each agency
- Safety procedures during emergency situations
- Purpose and operation of CTC and alternate CTC
- Purpose and operation of command post and auxiliary command post
- Communication facilities available for use during emergency cases
- Operating manuals of all specialized rescue equipment
- Maps and plans of complex areas of the system
- Any additional information and data that the particular agencies require to have in the plan

LGUs and other participating agencies within the locality shall be summoned by NLRC to cooperate and assist depending on the nature of an emergency which would include:

- Medical services
- Building department
- Fire department
- Police department
- Utility companies
- Other transportation agencies

Training for emergency response crew for the operation stage will be programmed. This would include training programs:

- Sponsored by equipment suppliers for their rescue equipment, fire fighting equipment and the like
- Courses being offered by some government agencies such as DSWD, Bureau of Fire Protection, etc.
- Evacuation of passengers from train, to a point of safety along the guideway
- Evacuation of passengers from stations (surface and underground)
- Emergency procedures to be controlled from the CTC within the Depot control center, including co-ordination of participating agencies such as fire service, police, ambulance, public works and utility companies, etc.

(a) Earthquake, Ground Settling and Liquefaction Risks

<u>Guideway Structures</u>

NLRC shall perform regular inspections by routine patrol of all guideway structures and perform maintenance and repairs. A detailed structure inspection shall be performed at least once per year.

The general condition of the structure as viewed from the track shall be included in the item list of all route patrols, which are carried out on a regular basis.

All structures will be catalogued and numbered in a register of structures that records the conditions, inspection requirements, results and any corrective actions.

Main structures such as the elevated sections of the route and other special features such as bridge sections shall be the subject to periodic structural inspections. These inspections will be designed and performed according to general practice according to the structure types, materials (steel or concrete), foundations and any specific examination of components such as bearings and expansion joints.

Stations and Depot buildings will also be inspected using route patrolling and general route inspections. The inspections will be supplemented with fault reports made by the operational staff and the NorthRail Project users.

<u>Tracks</u>

NLRC shall inspect, maintain, adjust and replace defective, excessively worn or broken running rails, cross ties, special trackwork components, ballast, direct fixation fasteners, and other track materials, related hardware and support equipment.

NLRC shall also inspect and adjust the smoothness of the alignment and levels of the track geometry.

In addition to the patrols described above, there will be inspections for:

- track geometry and ride quality
- turnouts (which may be combined with regular lubrication and cleaning)
- ultra-sonic testing of rail joints and turnout components. These tests will be based on an annual test in each of the first two years and then scheduled as necessary according to the initial results.

Should periodic inspections detect signs of ground movement, services shall be suspended or be run at reduced speed. If services are allowed to continue, detailed monitoring of the site would be instigated. If services shall be suspended, passengers would be de-trained at the next available station stop. Detailed investigation into the improvements required would be undertaken before services are recommenced or speed restrictions be lifted and such work would be put in hand as soon as reasonably

In case of earthquake:

TABLE 7-4: MITIGATING MEASURES IN CASE OF EARTHQUAKES

Intensity Scale	Description	Mitigating Measures
I. Scarcely Perceptible	⇒ Perceptible to people only under favorable circumstances ⇒ Delicately balanced objects are disturbed slightly ⇒ Still water in containers oscillates slightly	None
II. Slightly Felt	⇒ Felt by few individuals at rest indoors ⇒ Hanging objects swing slightly ⇒ Still water in containers oscillates noticeably	None
III. Weak	⇒ Felt by many people indoors specially in upper floors of buildings. Vibration is felt like the passing of a light truck. Dizziness and nausea are experienced by some people ⇒ Hanging objects swing moderately ⇒ Still water in containers oscillates moderate	Passenger announcements at stations and on board trains to reassure the public.
IV. Moderately Strong	⇒ Felt generally by people outdoors. Light sleepers are awakened. Vibration is felt like the passing of a heavy truck. ⇒ Hanging objects swing considerably. Dinner plates, glasses, windows and doors rattle. Floors and walls of wood framed building creak. Standing motors may rock slightly. ⇒ Water containers oscillates strongly ⇒ Rumbling sound may sometimes be heard	Automatic speed restriction of 30 kph mode, trains run to nearest station and stop to let off passengers. Announcements made at stations and on board trains. CTC contact the Philippine Institute of Volcanology and Seismology (PHILVOCS) for likelihood of aftershock event before services recommence.

TABLE 7-4: MITIGATING MEASURES IN CASE OF EARTHQUAKES

Intensity Scale	Description	Mitigating Measures
V. Strong	⇒ Generally felt by most people indoors and outdoors. Many sleeping people are awakened. Some are frightened; some run outdoors. Strong shaking and rocking are felt throughout the building. ⇒ Hanging objects swing violently. Dining utensils clatter and clink; some are broken. Small, light and unstable objects may fall or overturn. Liquids spill from filled open containers. Standing vehicles rock noticeably. ⇒ Shaking of leaves and twigs of trees is noticeable.	Trains automatically stop under CTC control. Trains are authorized to proceed to next station at 10 kph to evacuate passengers when event ceased.
VI. Very Strong	⇒ Many people are frightened; many run outdoors. Some people lose their balance. Motorists feel like driving with flat tires. ⇒ Heavy objects and furniture move or may be shifted. Small church bells may ring. Wall plaster may crack. Very old or poorly-built houses and man-made structures are slightly damaged though well-built structures are not affected. ⇒ Limited rockfalls and rolling boulders occur in hilly to mountainous areas and escarpments. Trees are noticeably shaken.	Trains automatically stop under CTC control. Passengers are evacuated along the guideway. CTC contact PHILVOCS for likelihood of aftershock event before services recommence. Routine structural inspections are made before services recommence.

TABLE 7-4: MITIGATING MEASURES IN CASE OF EARTHQUAKES

Intensity Scale	Description	Mitigating Measures
VII. Destructive	⇒ Most people are frightened and run outdoors. People find it difficult to stand in upper floors. ⇒ Heavy objects and furniture overturn or topple. Big church bells may ring. Old or poorly built structures suffer considerable damage. Some well-built structures are slightly damaged. Some cracks may appear on dikes, fish ponds, road surface, or concrete hollow blocks. ⇒ Limited liquefaction, lateral spreading and landslides are observed. Trees are shaken strongly.	Trains automatically stop under CTC control. Passengers are evacuated along the guideway. Detailed structural inspections are made and associated repairs are made to structures before services recommence. Initial services may run at restricted speed in only temporary repairs can be effected
VIII. Very Destructive	⇒ People are panicky. People find it difficult to stand even outdoors. ⇒ Many well-built buildings are considerably damaged. Concrete dikes and foundations of bridges are destroyed by ground settling or toppling. Railway tracks are bent or broken. ⇒ Tombstones may be displaced, twisted or overturned. Utility posts, towers and monuments may tilt or topple. Water and sewer pipes may be bent, twisted or broken. ⇒ Liquefaction and lateral spreading cause man-made structure to sink, tilt or topple. Numerous landslides and rockfalls occur in mountainous and hilly areas. Boulders are thrown out from their positions particularly near the epicentre. Fissures and fault rupture may be observed. Trees are violently shaken. Water splashes or slops over dikes or banks of rivers.	Trains automatically stop under CTC control. Passengers are evacuated along the guideway. Detailed structural inspections are made and associated repairs are made to structures before services recommence.

TABLE 7-4: MITIGATING MEASURES IN CASE OF EARTHQUAKES

Intensity Scale	Description	Mitigating Measures
IX. Devastating	⇒ People are forcibly thrown to the ground. Many cry and shake with fear. ⇒ Most buildings are totally damaged. Bridges and elevated concrete structures are toppled or destroyed. ⇒ Numerous utility posts, towers and monuments are titled, toppled or broken. Water and sewer pipes are bent, twisted or broken. ⇒ Landslides and liquefaction with lateral spreading and sandboils are widespread. The ground is distorted into undulations. Trees are shaken very violently with some toppled or broken. Boulders are commonly thrown out. River water splashes violently or slops over dikes and banks.	Trains automatically stop under CTC control. Passengers are evacuated along the guideway. Detailed structural inspections are made and associated repairs are made to structures before services recommence. System may be temporarily abandoned before it is possible to consider repairs in light of other facilities which may take priority.
X. Completely Devastating	⇒ Practically all man-made structures are destroyed. ⇒ Massive landslides and liquefaction, large scale subsidence and uplifting of land forms and may ground fissures are observed. Changes in river courses and destructive seiches in large lakes occur. Many trees are toppled, broken or uprooted.	Trains automatically stop under CTC control. Passengers are evacuated along the guideway. Detailed structural inspections are made and associated repairs are made to structures before services recommence. System may be permanently abandoned as other government infrastructure must take the precedent for reconstruction.

Volcanic Ash Fall

TABLE 7-5: MITIGATING MEASURES IN CASE OF VOLCANIC ERUPTION (ASH FALL)

Vehicle Movement	Rail borne vehicles can safely move providing the top of rail is clear of obstruction and debris. Ash fall deposits up to 150mm can be tolerated if the vehicles are temporarily fitted with miniature ploughs to clear the top of rail as the vehicles pass. These are primarily used in Europe and North America to remove snow, but can equally cope with any powdery material prone to compaction.
Visibility	As a safety measure during periods of limited visibility such as during typhoon or fog conditions, speed of vehicles is reduced depending upon the available visibility, this is pre-programmed through the signalling system from the CTC. These precautions would apply equally during reduced visibility due to volcanic ash fall.
Blockage or airways	As a pre-caution for air-cooled equipment, air filters would be removed and cleaned each 18 hours to remove volcanic ash debris. Air conditioning equipment would be run in re-cycled air mode or be switched to re-circulating ventilation only depending upon severity of conditions.
Vehicle cleanliness	Vehicle exterior cleaning would be performed daily to remove volcanic ash debris and additional personnel would be deployed at night to clean vehicle interiors.
General precautions	In between heavy ash showers, ash that has accumulated on rooftops should be scraped off to prevent the collapse or destruction of structures. After monitoring the volcanic ash fall conditions for a period of more than three days, vehicles would be withdrawn from service for a thorough inspection and cleaning of exposed equipments.

TABLE 7.1: ENVIRONMENTAL MANAGEMENT PLAN

PROJECT ACTIVITIES (PRE-CONSTRUCTION, CONSTRUCTION, OPERATIONS, ABANDONMENT)	IMPACT DESCRIPTION PER PARAMETER (PHYSICAL, BIOLOGICAL, VISUAL, SOCIO-ECONOMIC)	MITIGATION (IF NEGATIVE) OR ENHANCEMENT (IF POSITIVE)	COST OF MITIGATION OR ENHANCEMENT	INSTITUTIONAL PLAN	TARGET SCHEDULE	GUARANTEES (MOAs, ETC.) CONTRACTS
A. PRECONSTRUCTION STAGE						
A.1. Land and Resource Use						
• Land Use						
Demolition of illegal structures and removal of old PNR tracks	Displacement of households living within PNR ROW: • Valenzuela City – 3,995 (2003 figures) • Malabon City – 3,331 (2003 figures) • Caloocan City – 365 (2003 figures)	• Off-site in town relocation program • "Balik Probinsiya" relocation program	• Resettlement Cost for in-town off site relocation program is approx. pesos 0.20M per family; most of the components of this cost are recoverable (P100,000 for serviced lots; P50,000 for housing materials loan, should the family opt to avail of this loan option); government provided a grant of P25,000 per family; interest rate is fixed at 6%, payable in 30 years; housing materials loan is payable in 30 years, with no interest • Cost for "Balik Probinsiya" program is approx. pesos 10,000 per family (for Malabon, a special package was offered, P50,000 non-recoverable cash compensation)	• HUDCC/NHA • LIAC members (for each City) • PNR • NLRC Valenzuela City: • Office of the Valenzuela City Mayor • Office of the Congressman of Valenzuela City • Urban Poor Affairs Office (UPAO) • Confederation of informal settlers organizations (KASARIVAL, HARV) Malabon City • City Government of Malabon • Confederation of Informal Settlers Caloocan City: • City Government of Caloocan	Valenzuela City: • Completed Malabon City Completed Caloocan City: • Completed	• Valenzuela City: Multi-partite MOA between the City Government of Valenzuela, HUDCC, NHA, Pagtutulungan sa Kinabukasan: Ikaw, Bangko, Industria at Gobyerno (PAG-IBIG), PNR, NLRC and other concerned agencies • Malabon City: Multi-partite MOA between the City Government of Malabon, HUDCC, NHA, PAG-IBIG, PNR, NLRC and other concerned agencies • Caloocan City: Multi-partite MOA between the City Government of Caloocan, HUDCC, NHA, PAG-IBIG, PNR, NLRC and other concerned agencies • MOA between PNR and NLRC (please refer to Annex W)

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▪ **Soil**						
Scraping of soil for embankment foundation	Need suitable soil in order to replace excavated soils	▪ Importation of soil of suitable quality from borrow areas .	Part of US$72.26M estimated cost for Caloocan – Valenzuela section civil works. A more accurate estimate will be determined during the engineering surveys and preparation of the detailed design.	▪ Prime Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ Terms of Reference (TOR) ▪ Supply Contract between NLRC and CNMEG
Refilling of excavated areas	Soil erosion due to presence of loose soil	▪ Newly laid soil will be well compacted in layers to a stable condition as soon as practicable after deposition and in a manner appropriate to the location and to the material to be compacted ▪ Disposal of unused portion	Part of US$72.26M estimated cost for Caloocan – Valenzuela section civil works. A more accurate estimate will be determined during the engineering surveys and preparation of the detailed design.	▪ Prime Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
A.2. Water Environment						
Demolition of structures	Nil or insignificant Erosion or loose soil	▪ None. Soil erosion siltation will be minimal and temporary	None	▪ Prime Contractor ▪ Other Contractors (if any)	▪ 2004 – 2005 (completed)	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
Closure of wells	Household depending on these wells will be deprived of water supply	▪ Wells constructed by informal settlers will be closed, including those constructed by LGUs to serve informal settlers. There will be adequate water	Amount to be determined during the engineering surveys. Cost of closure of wells included in US$72.26M. Adequate water supply at relocation site is part of the relocation site	▪ Concerned LGUs ▪ LIAC members ▪ PNR ▪ NLRC ▪ Prime Contractor ▪ Other Contractors (if any)	▪ 2004 – 2005 (completed)	▪ Relocation Sites Master Plan ▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG

TABLE 7.1: ENVIRONMENTAL MANAGEMENT PLAN

PROJECT ACTIVITIES (PRE-CONSTRUCTION, CONSTRUCTION, OPERATIONS, ABANDONMENT)	IMPACT DESCRIPTION PER PARAMETER (PHYSICAL, BIOLOGICAL, VISUAL, SOCIO-ECONOMIC)	MITIGATION (IF NEGATIVE) OR ENHANCEMENT (IF POSITIVE)	COST OF MITIGATION OR ENHANCEMENT	INSTITUTIONAL PLAN	TARGET SCHEDULE	GUARANTEES (MOAs, ETC.) CONTRACTS
		supply at relocation sites ▪ Proper Sealing of well begins with removing any pumping equipment and debris that may have entered the well. When obstructions have been cleared, the well will be sealed by filling it with cement or other approved material from the bottom of the well to within two feet of the surface. The well casing is then cut off below plow depth, or at least two feet below the surface and the hole filled with soil. The type of material used to fill the well is dependent upon the type of well, and the density of the soil that is penetrated. (Refer to **Annex AR** for the Requirements and Procedures for Proper Sealing of Wells)	development cost.			
Clearing of area, sodding, landscaping	Water infiltration to groundwater	▪ Sodding / tree planting depending on land availability	Included in the Project Cost Estimate. Amount to be determined during	▪ Prime Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR

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PROJECT ACTIVITIES (PRE-CONSTRUCTION, CONSTRUCTION, OPERATIONS, ABANDONMENT)	IMPACT DESCRIPTION PER PARAMETER (PHYSICAL, BIOLOGICAL, VISUAL, SOCIO-ECONOMIC)	MITIGATION (IF NEGATIVE) OR ENHANCEMENT (IF POSITIVE)	COST OF MITIGATION OR ENHANCEMENT	INSTITUTIONAL PLAN	TARGET SCHEDULE	GUARANTEES (MOAs, ETC.) CONTRACTS
		and operations requirement	the engineering surveys and preparation of the detailed design and up to operations.			▪ Supply Contract between NLRC and CNMEG
A.3. Air Resource						
▪ **Air Quality**						
Demolition of structures and removal of debris	Generation of dust or particulate emissions is minimal and temporary	▪ Water spraying of unpaved grounds (roads, parking lots, etc.) or use of crushed gravel to minimize dust.	Water spraying activity is part of construction; therefore cost of mitigation is part of US$72.26M.	▪ Prime Contractor ▪ Other Contractors (if any)	▪ 2004 – 2005 (completed)	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
▪ **Noise**						
Demolition and trucking of debris and re-usable materials, if any, to squatter relocation sites or other identified dump sites	Minimal noise during operation of equipment and hauling vehicles	▪ Proper equipment maintenance ▪ Place suitable enclosures such as portable perimeter ▪ Limit noise generating work to be carried out during daytime	Fencing cost is part of the US$72.26M. Equipment maintenance is part of the requirements from contractor or sub-contractor (if any).	▪ Prime Contractor ▪ Other Contractors (if any)	▪ 2004 – 2005 (complete)	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
A.4. Biological Resource						
▪ **Terrestrial Flora/Fauna**						
Cutting of trees and vegetation	Cutting / removal of trees deprive birds/ other wild life of habitat	▪ None. It is assumed that the wild life will find a new habitat	None			
Sodding/re-planting of trees	Water infiltration to ground water table	▪ Sod all areas and plant trees depending on land availability and operations requirement or limit.	Water spraying activity is part of construction, therefore cost of mitigation is part of US$72.26M.	▪ Prime Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
A.5. Aesthetic/Visual Resource						
Cutting down of trees, landscaping	Improvement of visual effects after clearing and landscaping the area	▪ Rubbish shall be cleared daily so that it will not accumulate	Part of US$72.26M estimated cost for Caloocan – Valenzuela	▪ Prime Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008 and onwards	▪ Technical Document of Contract ▪ TOR

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PROJECT ACTIVITIES (PRE-CONSTRUCTION, CONSTRUCTION, OPERATIONS, ABANDONMENT)	IMPACT DESCRIPTION PER PARAMETER (PHYSICAL, BIOLOGICAL, VISUAL, SOCIO-ECONOMIC)	MITIGATION (IF NEGATIVE) OR ENHANCEMENT (IF POSITIVE)	COST OF MITIGATION OR ENHANCEMENT	INSTITUTIONAL PLAN	TARGET SCHEDULE	GUARANTEES (MOAs, ETC.) CONTRACTS
		on site ▪ Temporary landscape of the area ▪ Erection of construction fencing	section civil works. A more accurate estimate will be determined during the engineering surveys and preparation of the detailed design.			▪ Supply Contract between NLRC and CNMEG
A.6. Socio Cultural, Economic Effects						
Census and Tagging (C&T) Operation	Inclusion or non-inclusion (in the relocation program) of household members living within the PNR ROW in Valenzuela City, Malabon City and Caloocan City	▪ C&T has been completed by Test Consultants, Inc (TCI) for the Metro Manila Section of NorthRail Project Phase 1 (Valenzuela City, Malabon City and Caloocan City) in close partnership with PNR, NLRC and other concerned LGUs ▪ NHA validated the C&T results in Valenzuela, Malabon and Caloocan ▪ Resulting Masterlist was one of the bases for the inclusion (or non-inclusion) into the Relocation Program	▪ Conduct of C&T by TCI funded by NLRC ▪ Budget for re-validation of C&T results was advanced by NLRC to NHA	▪ NHA/HUDCC ▪ Concerned LGUs ▪ PNR ▪ NLRC ▪ Respective LIACs	▪ Valenzuela City – completed ▪ Malabon City – completed Caloocan City – completed	▪ Valenzuela City: Formation of LIAC ▪ Malabon City: Formation of LIAC ▪ Caloocan City: Formation of LIAC
Removal of the existing PNR rails and installation of rails	Disposal of PNR rail tracks	▪ The existing route of the PNR will be demolished and the existing track will be disposed without being reused in the	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2005 (completed)	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG

AL PLAN	TARGET SCHEDULE
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		concerned LGUs and coordinate with business establishment owner that have lease agreements				
Demolition of structures / relocation of PAFs	Demolition of social, health and religious facilities	▪ Advance information to affected users ▪ Coordination with concerned LGUs ▪ PNR as the owner will assist NLRC/concerned LGUs and coordinate with institutions that have lease agreements	Nil	▪ Concerned LGUs ▪ LIAC members ▪ PNR ▪ NLRC ▪ Prime Contractor ▪ Other Contractors (if any)	▪ 2001 – 2006	▪ Multi-partite MOA between concerned LGUs, HUDCC, NHA, PAG-IBIG, PNR, NLRC and other concerned agencies ▪ MOA between PNR and NLRC ▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
	Demolition of walls and other private structures encroaching PNR ROW	▪ Advance notice to owners ▪ NLRC to seek PNR assistance in coordinating with affected owners ▪ NHA and PNR undertook this activity	Nil	▪ PNR ▪ NLRC ▪ Project Contractor ▪ Other Contractors (if any)	▪ 2001 – 2006	▪ MOA between PNR and NLRC ▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
	Repositioning of electrical posts within PNR ROW affected by the NorthRail Project	▪ Advance notice to concerned utility companies who owns the electrical posts that have lease agreements with PNR	As per MOA of the utility companies with PNR, relocation of utilities will be at the cost of the lessees.	▪ PNR ▪ NLRC ▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ MOA between PNR and NLRC ▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and

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						CNMEG
Demolition of structures / relocation of PAFs	Abandonment and sealing of hand pumps within PNR ROW affected by the NorthRail Project	▪ Seal and abandon all hand pumps within PNR ROW ▪ Provision for installation of new hand pumps outside PNR ROW will be coordinated with concerned LGUs	Included in the Project Cost Estimate. Amount to be determined during the engineering surveys and preparation of the detailed design.	▪ PNR ▪ NLRC ▪ Project Contractor ▪ Other Contractors (if any)	▪	▪ MOA between PNR and NLRC ▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
	Abandonment and closure of some wells within PNR ROW affected by the NorthRail Project	▪ Close and abandon all wells located within PNR ROW ▪ Provision for replication of wells (only when absolutely necessary) outside PNR ROW will be coordinated with concerned LGUs	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and preparation of the detailed design.	▪ PNR ▪ NLRC ▪ Project Contractor ▪ Other Contractors (if any)	▪	▪ MOA between PNR and NLRC ▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
	Displacement of private lot owners where the width of PNR ROW is not adequate for double track requirements and for access roads for permanently closed road crossings	▪ Negotiations with private owners for lots that needs to be acquired by NLRC ▪ Existing access routes would be identified and presented to concerned LGUs to minimize the need to buy lots to private owners to be used as access roads	Nil	▪ PNR ▪ NLRC ▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ MOA between PNR and NLRC ▪ Project Contract ▪ Terms of Reference (TOR) ▪ Supply Contract between NLRC and CNMEG)
A.7. Health and Safety Concerns						
Demolition of squatter structures	During the actual transfer to relocation	▪ Ensure that all requirements	Included in the Relocation Program	▪ HUDCC/NHA ▪ Concerned LGUs	▪ 2001 – 2006	▪ Multi-partite MOA between the

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and health facilities	site, houses may not yet be ready for occupancy; basic utilities may not yet be installed at relocation site; and absence of health facilities in relocation site	necessary for relocation according to relocation plans are met prior to actual relocation and demolition	Cost	▪ LIAC members ▪ PNR ▪ NLRC ▪ PNP		Concerned LGUs, HUDCC, NHA, PAG-IBIG, PNR, NLRC and other concerned agencies ▪ MOA between PNR and NLRC
	Accidents could happen during actual demolition	▪ LGUs will supervise actual demolition process ▪ Guidelines and safety procedures for demolition process will be provided by LGUs and LIAC	Included in the Relocation Program Cost	▪ HUDCC/NHA ▪ Concerned LGUs ▪ LIAC members ▪ PNR ▪ NLRC ▪ DSWD (local) ▪ DOH ▪ PNP	▪ 2001 – 2006	▪ Multi-partite MOA between the Concerned LGUs, HUDCC, NHA, PAG-IBIG, PNR, NLRC and other concerned agencies ▪ MOA between PNR and NLRC
A.8. Waste Management Plan						
Demolition of squatter structures	Solid wastes include demolition debris and rubbish after the transfer of informal dwellers to relocation site. These solid wastes, if not removed, could hamper start of actual construction activities	▪ All solid wastes within the PNR ROW will be collected and the non-reusable materials will be brought to proper dumpsites ▪ Reusable materials from demolished squatter structures will be brought by informal dwellers to relocation sites	Clearing of post demolition debris and fencing is estimated to cost about Pesos 347M for the Caloocan – Malolos section.	▪ HUDCC/NHA ▪ Concerned LGUs ▪ LIAC members ▪ PNR ▪ NLRC	▪ 2001 – 2006	▪ Multi-partite MOA between the Concerned LGUs, HUDCC, NHA, PAG-IBIG, PNR, NLRC and other concerned agencies ▪ MOA between PNR and NLRC
A.9. Securing the Cleared ROW						
Securing the cleared ROW	Cleared ROW should be secured to prevent the return of previous informal settlers or arrival of new informal	▪ Fencing will be done to enclose the area prior to construction ▪ Security personnel will be strategically	Clearing of post demolition debris and fencing is estimated to cost about Pesos 65M for the Caloocan –	▪ PNR ▪ NLRC ▪ Project Contractor ▪ Other Contractors (if any)	▪ 2004 onwards	▪ MOA between PNR and NLRC ▪ Technical Document of Contract ▪ TOR

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	settlers to the area as this could hamper start of actual construction activities	installed within the cleared ROW	Malolos section.			▪ Supply Contract between NLRC and CNMEG
B. CONSTRUCTION STAGE						
B.1. Land Use and Pedology						
▪ **Land Use**						
Project activities such as the construction of the rail infrastructure within the cleared PNR ROW	The ROW will remain for use of the NorthRail Project. No change	None	None	▪ PNR ▪ NLRC	▪ 2006 – 2008	▪ Concession agreement between DOTC, PNR and NLRC
▪ **Soil and Geology**						
Excavation and filing of embankment	The project entails earth moving, both filling works and excavation works.	▪ Assess existing embankment for its suitability for the project ▪ Unsuitable materials from existing embankment will be removed and replaced. ▪ Where applicable, plants will be sown along the embankment in order to protect the slope of the embankment ▪ New embankment materials with be sourced from borrow pits. ▪ Separate ECC and permits will be obtained for these	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and preparation of the detailed design.	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG

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		borrow pits ▪ An agreement between the owner of the borrow pits and the contractor will define how the area will be restored.				
Soil scraping, filling for rail embankments	Strengthen the foundation of the railway structure	▪ Use soil of appropriate quality for embankment	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and preparation of the detailed design.	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
	erosion and siltation	▪ prepare and implement environmentally appropriate soil disposal plan ▪ use of siltation ponds ▪ proper construction of embankment ▪ existing embankment within the PNR ROW will be assessed as to its suitability for the new project. Areas where the existing embankments have deteriorated beyond use will be removed and replaced by suitable materials.	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and preparation of the detailed design.	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG

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		These materials will be sourced from borrow pits. Separate ECCs and permits will be obtained for these borrow pits. Mitigating measures for these pits will be formulated from their separate ECCs. ▪ Backfill materials from borrow pits will be transported appropriately in order to minimize dust during transport. The materials will be drenched in water and the trucks will be properly covered. ▪ In order to protect the slope of the embankment of the project, appropriate plants will be sown along the embankment where warranted.				
Construction of the rail infrastructure within the cleared PNR ROW	ground shaking hazard	▪ design parameter of peak ground acceleration not less than 0.5g ▪ all structures will be in-placed in solid	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG

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		and well-compacted foundation	preparation of the detailed design.			
	liquefaction hazard	▪ foundation will be set on more stable ground ▪ provide good water drainage in the foundation	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and preparation of the detailed design.	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
	ground rapture hazard	▪ proposed alignment will be located at site far from known active geologic structures	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and preparation of the detailed design.	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
▪ Drainage						
Construction of the drainage system to remove the runoff water from ROW to avoid ponding	Poorly located / constructed drainage system could cause erosion and weakening of the rail foundation	▪ All drainage will be replaced in most cases by a better system	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and preparation of the detailed design.	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
	Obstruction and clogging of waterways/drainage which causes flooding	▪ Leftover materials and debris should be hauled away from site	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and preparation of the detailed design.	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG

TABLE 7.1: ENVIRONMENTAL MANAGEMENT PLAN

PROJECT ACTIVITIES (PRE-CONSTRUCTION, CONSTRUCTION, OPERATIONS, ABANDONMENT)	IMPACT DESCRIPTION PER PARAMETER (PHYSICAL, BIOLOGICAL, VISUAL, SOCIO-ECONOMIC)	MITIGATION (IF NEGATIVE) OR ENHANCEMENT (IF POSITIVE)	COST OF MITIGATION OR ENHANCEMENT	INSTITUTIONAL PLAN	TARGET SCHEDULE	GUARANTEES (MOAs, ETC.) CONTRACTS
Construction of bridges	Flood water on the rivers could damage the bridges' structure	▪ Bridges, culverts and other similar structures will be designed in order to minimize the probability of damage due to flood waters and flood water borne debris ▪ NLRC commits that the Design will be such that flooding levels will not be aggravated; in most cases, due to the design and new construction, the general flooding in the locality may even be decreased. However, NorthRail does not commit to solve the flooding problems in the locality.	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and preparation of the detailed design.	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
▪ **Siting of Structures**						
Structures will be sited considering the probable impact of the project from noise and vibration	The stations will be located close to the track and therefore subject to the effect of noise and vibration	▪ Structures like the stations will be designed to reduce noise to acceptable level and vibration to prevent structural failure ▪ Baffle wall will be constructed to reduce noise level where practicable	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and preparation of the detailed design. Location and respective lengths of baffle walls subject also to engineering surveys	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG

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		▪ To reduce vibration effect, structures will be designed and suitable materials will be used to mitigate against the vibration impact	and design.			
Design and construction of the station building	The awning of the station platform will be made of steel structure in order to reduce the negative impact to the surrounding during construction, without pollution, less requires for construction site, benefit for environmental protection.	▪ Buildings in the station area will be arranged according to individual site conditions. All the buildings, mainly storied building, will be designed in accordance with the local general layout and optimization of land-take. Drainage system will be considered in the vertical location design, so that all sewages would be drained out smoothly. ▪ Virescence will be designed based on the principle of more greenbelt and less indurations. Trees and flowers will be planted along the road. Also some flowers and trees will be set among the buildings and the	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and preparation of the detailed design.	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG

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		place preserved for the future development.				
B.2. Water Quality						
Installation of bridge, viaduct and culvert	Positioning of bridges and culverts may result to obstructing channels of stream and surface runoff	▪ Piers of bridges over-crossing rivers and ditches of draining flood shall be constructed in rivers' natural direction and enough aperture dimensions shall be supplied to drain flood less than the level of designed flood frequency. ▪ Stream channels in the vicinity of the railway shall be paved with the tops of paved foundations shall be lower than channel beds. ▪ Upon reaching the site and prior to its installation, the ballast should be sprayed with water and covered with canvass. ▪ Waste soil for excavation foundations, construction waste materials and mud	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and preparation of the detailed design.	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG

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PROJECT ACTIVITIES (PRE-CONSTRUCTION, CONSTRUCTION, OPERATIONS, ABANDONMENT)	IMPACT DESCRIPTION PER PARAMETER (PHYSICAL, BIOLOGICAL, VISUAL, SOCIO-ECONOMIC)	MITIGATION (IF NEGATIVE) OR ENHANCEMENT (IF POSITIVE)	COST OF MITIGATION OR ENHANCEMENT	INSTITUTIONAL PLAN	TARGET SCHEDULE	GUARANTEES (MOAs, ETC.) CONTRACTS
		shall be properly disposed • Avoid obstruction of river channels by waste soil during construction. • Waste soil shall not be stored at random; contractor shall dispose waste soil for excavation foundations in time, all disturbed ground during the construction shall be adequately restored as soon as possible. • Drilling mud shall be stored and treated to reach the demand of related environmental standards before being discharged into river. • Barriers in river shall be removed as soon as possible • Soundproof board and absorption rubber bearings shall be used in bridges /viaducts near urbanized areas. Ballasted bridge / viaduct decks are adopted to reduce				

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		noise produced by operation. ▪ Aesthetics of overpass bridges / viaducts near city and town shall be paid more attention to blend in with city surroundings. Bridges / viaducts shall bring beautiful scene to cities. Rounded end wall-type piers and circular piers, which are light and graceful, are to be used for bridges.				
B.3. Air Quality						
Installation of ballast	Transportation and installation of the ballast may cause air pollution	▪ Trucks that will be used to transport the ballast will be securely covered by a canvass ▪ Upon reaching the site and prior to its installation, the ballast should be sprayed with water and covered with canvass.	Included in the Project Cost Estimate for civil works (US$72.26M). Amount to be determined during the engineering surveys and preparation of the detailed design. Location and respective lengths of baffle walls subject also to engineering surveys and design.	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG
Construction of the embankment facilities	Dust / particulate emissions	▪ Water spraying of unpaved grounds (roads, parking lots, etc.) ▪ Backfill materials from borrow pits will	Water spraying activity is part of construction, therefore cost of mitigation is part of US$72.26M.	▪ Project Contractor ▪ Other Contractors (if any)	▪ 2006 – 2008	▪ Technical Document of Contract ▪ TOR ▪ Supply Contract between NLRC and CNMEG