LAND TRANSPORT AUTHORITY TECHNICAL REQUIREMENTS FOR THE URA DEVELOPMENT SITE AT OUTRAM PARK (NORTH EAST LINE) MRT STATION AT NEW BRIDGE ROAD/EU TONG STREET/OUTRAM ROAD/CANTONMENT ROAD/BUKIT PASOH ROAD
LAND TRANSPORT AUTHORITY'S TECHNICAL REQUIREMENTS FOR THE URA DEVELOPMENT SITE AT OUTRAM PARK (NORTH EAST LINE) MRT STATIONS AT NEW BRIDGE ROAD/EU TONG STREET/OUTRAM ROAD/CANTONMENT ROAD/BUKIT PASOH ROAD

Foreword

This document is prepared to provide guidance in the design and construction of future developments adjacent to and above the Rapid Transit Systems (RTS) structures. It contains the technical requirements to be complied with by the Developer and comprises the following sections:

Section One: Requirements for development over and adjacent to MRT Station.

Section Two: Technical requirements for the URA sale site at Outram Park (North East Line) MRT stations at New Bridge Road/Eu Tong Street/Outram Road/Cantonment Road/Bukit Pasoh Road.

Section One gives the general conditions to meet. Section Two contains specific requirements for the URA sale site at Outram Park (North East Line) MRT Stations at New Bridge Road/Eu Tong Street/Outram Road/Cantonment Road/Bukit Pasoh Road. It outlines details of the provision made in the station and specific technical requirements. The Developer and his agents should strictly comply with the conditions in both sections.

The application and interpretation of this document in designing the permanent and temporary works of the future development should be entrusted to the appropriate qualified persons and the construction should be carried out under the direction of the respective qualified persons in line with the statutory requirements.

It is highlighted that effective from November 1996, LTA no longer require Developer of any site which falls within the railway protection zone to provide an indemnity against any loss, damage of any kind to any property arising out of or in conjunction with carrying out of this work. Further LTA does not require Developer to furnish evidence of third party insurance policy or banker's guarantee for the above indemnity.
# SECTION ONE
## REQUIREMENTS FOR DEVELOPMENT AT MRT STATION

1. **GENERAL**
   1.1 Scope
   1.2 Definition
   1.3 Rapid Transit Systems Act
   1.4 Rapid Transit Systems (Railway Protection, Restricted Activities) Regulations
   1.5 Rapid Transit Systems (Development and Building Works in Railway Corridor and Railway Protection Zone) Regulations
   1.6 Additions and Alterations to RTS Station
   1.7 Operator's Rules & Requirements
   1.8 Damage to Persons and Property
   1.9 Security
   1.10 Access through railway premises
   1.11 Terms & Conditions
   1.12 Creation of Rights under the Street Works Act

2. **ARCHITECTURAL**
   2.1 General
   2.2 Station Concourse
   2.3 Station Entrances
   2.4 Finishes
   2.5 Pedestrian Access Connections
   2.6 Design for Fire Protection and Prevention
   2.7 Ventilation Shafts
   2.8 Firemen Access and Emergency Stairs
   2.9 Graphic & Sign
   2.10 Relocation of Cooling Towers, Sprinkler Water Tanks, etc.
   2.11 Commuter Facilities

3. **CIVIL AND STRUCTURAL**
   3.1 General
   3.2 Site Survey
   3.3 Loading on MRT Structures
   3.4 Foundation for the Development
   3.5 Flood Protection
   3.6 Waterproofing of Station Roof Slab
   3.7 Construction below ground
   3.8 Demolition
   3.9 Drainage (Storm and Foul)
   3.10 Instrumentation and Monitoring

4. **ELECTRICAL AND MECHANICAL**
4.1 General
4.2 Ventilation Shafts
4.3 Lighting and Ventilation at Access Connection
4.4 Fire Compartmentation
4.5 Lighting for Station Entrance and Concourse
4.6 General Purpose Power for Station Entrance and Concourse
4.7 Air-conditioning
4.8 Fire Protection for Station Entrances
4.9 External and Landscape Lighting
4.10 High Point Antenna
4.11 Fire Protection Systems
4.12 Lightning Protection
4.13 Electromagnetic Compatibility / Interference
4.14 MRT Station Control and Communication Systems
4.15 Low Smoke, Halogen-Free, Fire Retardant/Fire Resistant Cables

5 OPERATION RELATED MATTERS
5.1 General
5.2 Facilities in Future Development
5.3 Access Connection
5.4 Entrance Grilles/Shutters at Access Connections
5.5 Operational Constraints
5.6 Restricted Working Hours and Permit to Work
5.7 Details of Future Occupancy Load
5.8 Disturbance and Noise
5.9 Advertising
5.10 Temporary Access to Station
5.11 Access to Existing Facilities after land is sold

SECTION TWO
TECHNICAL REQUIREMENTS FOR THE URA DEVELOPMENT SITE AT OUTRAM PARK (NORTH EAST LINE) MRT STATIONS AT NEW BRIDGE ROAD/EU TONG STREET/OUTRAM ROAD/CANTONMENT ROAD/BUKIT PASOH ROAD

1 GENERAL
1.1 Scope
1.2 Future Development
1.3 Certified Plan of NEL Outram Park Station

2 ARCHITECTURE
2.1 General
2.2 Knock-out Panels Station Entrance
2.3 Integration of Entrance 4
2.4 Flood Protection
2.5 Equipment Removal Routes
2.6 Entrance Structures - Dismantle and Removal
2.7 Graphic & Signage
2.8 Integration of other entrance’s facilities
2.9 Integration of entrance finishes with future development finishes

3 CIVIL & STRUCTURAL
3.1 General
3.2 Ground Condition
3.3 Design Considerations for Future Development at Entrance 4
3.4 Knock-Out Panels for Future Connections
3.5 Limitations on Excavation and others by Future Developer
3.6 Limitations on Excavation for future basement and Water Table Draw-Down by Future Developer
3.7 Statutory Requirements for the Future Developer’s QP
3.8 Piling Location

4 CONSTRUCTION OF FUTURE DEVELOPMENT
4.1 Limits on excavation on Future development
4.2 Monitoring Plan
4.3 Knock-Out Panels for Future Connections
4.4 Waterproofing Detail for Column Stump

5 ELECTRICAL AND MECHANICAL
5.1 General
5.2 Design Considerations
5.3 Future Development Interface Report on Drainage, Water Supply & Sanitary Plumbing Systems
SECTION ONE
REQUIREMENTS FOR DEVELOPMENT AT MRT STATION

1 General

1.1 Scope

1.1.1 Provisions were made in the design and construction of the Rapid Transit Systems (RTS), to integrated RTS stations or railway with future developments on adjacent land into multi-dependent development units. The concept envisaged was that these future developments will be built over and/or abutting the RTS structures. This will enhance the attractiveness of these developments as they will be provided with convenient public transport access. The RTS stations or railway involved were therefore designed and constructed to accommodate these developments. Certain railway related facilities such as environmental control and communication equipment will be affected by the development. These will be required to be relocated and incorporated into these developments without affecting the RTS.

1.1.2 The Rapid Transit System is an important component of the public transportation system in Singapore. The fundamental concerns of the Authority are the operational safety, fire safety and flood protection and structural integrity of the rapid transit systems. Developments proposed above and/or adjacent to the station therefore have to be designed and constructed such that they do not endanger the RTS structures and the railway operation. The safety and convenience of the traveling public shall be protected at all times in the design and construction of the development; and there shall be no service disruption.

1.1.3 This section covers the general requirements to be complied with in the design and construction of future developments adjacent to and above RTS structures.

Chapters 2, 3, and 4 cover the general principle for the design of the future development. Chapter 5 outlines the operational requirements of the rapid transit systems.

1.1.4 Section One of this document must be read in conjunction with Section Two which describes the specific requirements that shall be considered for the particular station/structure.

1.1.5 The Developer shall include for the costs of all materials and works including any services in relation to the proposed development which may or may not be expressly specified or implied but which may be necessary for the satisfactorily completion of the works to satisfy the requirements of Land Transport Authority.
1.1.6 The conditions, requirements, information given in these documents are based on data available at the time of compiling the document and are given without prejudice to any changes which may take place subsequently.

1.1.7 The Authority disclaims any liability for any damage or loss that may be caused to any person or property directly or indirectly as a result of the conditions imposed herein.

1.2 Definition

1.2.1 For the purposes of this document the following definitions shall apply:

Developer  The successful tenderer for the land sale and his agents engaged to design and engaged to carry out all works related to the development.

LTA  The Land Transport Authority; herein referred to as the Authority or LTA.

Operator  An organisation licensed to operate the railway under the RTS Act.

Standard for Fire Safety in Rapid Transit Systems  This standard is issued by FSSD, SCDF and it stipulates the minimum fire safety requirements for the Rapid Transit Systems.

Qualified Person  A qualified person is in accordance with the Building Control Act (Cap 29).

Code or CPRP  The Code of Practice for Railway Protection issued under the Rapid Transit Systems (Development and Building Works In Railway Corridor and Railway Protection Zone) Regulations.

1.3 Rapid Transit Systems Act

1.3.1 The Developer shall comply with the Rapid Transit Systems Act and all regulations made thereunder. The Developer shall note the powers conferred to LTA by the Rapid Transit Systems Act in particular Sections 6, 9, 22, 23 and 24 which read as follows:-

1.3.2 Section 6

(1) From the date of publication in the Gazette of a notice of creation of a right under this section, the Authority or any person authorised
by the Authority may, at any reasonable time and for the purpose of and incidental to the operation of a railway specified therein, enter upon such land within the railway area as described in the notice, not being State land or land belonging to or acquired by the Authority, and exercise such permanent rights in, under or over such land or such rights of temporary occupation of the land as may be specified in the notice.

(2) A notice of creation of a right under this section shall:-

(a) be made by the Authority;
(b) describe the right in, under or over land or the right of temporary occupation and the area of land subject to such right; and
(c) state particulars of the places and times at which a copy of a plan of the area of land subject to such right may be inspected.

(3) Any right referred to in a notice of creation of a right under this section shall be limited to a right conferring such rights and powers as are necessary or convenient for the operation of any railway and for all purposes connected with or incidental to such operation.

1.3.3  Section 9

(1) The Authority, or any person acting under its authority, may enter any land or building situate wholly or partly within the railway area or wholly or partly within 150 metres thereof in order to carry out -

(a) any inspection or survey which is reasonably necessary to ascertain the condition of such land or building prior to or during the construction of the railway and to carry out all reasonably necessary work of a preventive or remedial nature; and

(b) any inspection or maintenance of the railway which has been laid by the Authority on, under or over the land or building and to carry out any work and do all things necessary for the purpose of maintaining the railway causing as little damage as possible and paying compensation to any person affected for any damage that may be caused.

(2) No person shall, for the purposes of subsection (1) enter any land or building which is occupied without giving to the owner and the occupier at least 7 days' notice of his intention to do so unless: -
(a) the Authority is of the opinion that an emergency exists which necessitates immediate entry; or

(b) the entry is required only for the purpose of an inspection or survey.

(3) A notice of entry referred to in subsection (2) shall:

(a) describe the purpose of the entry and the nature of any work to be carried out; and

(b) be deemed to be given to and received by an owner or occupier if a written notice is affixed to a conspicuous part of the land or building to be entered.

(4) In subsection (1), "work of a preventive or remedial nature" means the underpinning or strengthening of any land or building and other work thereon intended to render it reasonably safe or to repair or detect damage caused in the course of the construction or operation of the railway.

(5) The decision of the Authority that any work is of a preventive or remedial nature or that such work or any inspection or survey is reasonably necessary shall be final.

(6) The Authority, or any person acting under its authority may as the occasion requires enter and re-inspect and re-survey any land or building in respect of which any of the powers contained in subsection (1) have been exercised and may in relation to that land or building exercise such powers as often as the occasion may require.

(7) Any person authorised under this section to enter upon any land or building shall, if so required by the owner or occupier, produce evidence of his authority before so entering it.

(8) Any person who unlawfully obstructs an agent or employee of the Authority at any time in the exercise of his authority shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $1,000.

1.3.4 Section 22

Any person who willfully does or omits to do anything in relation to the railway as a result of which the safety of any person traveling or being upon the railway is endangered, or is likely to be so endangered, shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $10,000 or to imprisonment for a term not exceeding 5 years or to both.
1.3.5  Section 23

Any person who willfully removes, destroys or damages any railway or railway premises or any part thereof shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $200,000 or to imprisonment for a term not exceeding one year or to both.

1.3.6  Section 24

(1) Any person who removes, destroys or damages, whether willfully or otherwise, the railway or railway premises or any part thereof shall, in addition to any penalty for which he is liable for an offence under this Act, be liable to pay compensation for the damage he has done and the compensation shall be recoverable by civil action or suit before any court of competent jurisdiction.

(2) Subject to subsection (1), any court before which a person is charged with an offence under this Act may assess the compensation payable under this section and may make an order for the payment of the same.

(3) Any order made under subsection (2) may be enforced as if it were a judgment in a civil action or suit.

1.3.7  The lot No. of NEL Outram Park Station is TS 22 - 80001P. LTA will create rights under the Rapid Transit Systems Act for Entrance 4 of the station and rapid transit systems facilities in the land parcel.

1.3.8  LTA exercises Statutory easement rights for the RTS stations entrances, ventilation shafts and other substructures or facilities at ground level necessary for the operation of the railway. These are protected under Section 6 of the Rapid Transit Systems Act. When the state land on which these facilities are sold, LTA would create rights to these facilities. If these facilities are altered or modified, LTA will exercise power under the Rapid Transit Systems Act on these new facilities. The layout of the future development around these areas shall be designed for convenient commuter access from the major roads or commercial centres and access required for maintenance purposes by the Authority’s and/or Operator’s staff and agent authorised by the Authority or Operator. In addition to these, access to the station by other agencies, such as the Singapore Civil Defence Force to the firemen staircase and other related fire fighting facilities are also reserved.

1.4  Rapid Transit Systems (Railway Protection, Restricted Activities) Regulations
1.4.1 Approval shall be obtained from the Authority to carry out restricted activities in accordance with the requirements of the Rapid Transit Systems (Railway Protection, Restricted Activities) Regulations.

1.5 Rapid Transit Systems (Development and Building Works in Railway Corridor and Railway Protection Zone) Regulations

1.5.1 Approval from the Authority shall be obtained for development and building works in railway protection zone in accordance with the requirements of the Rapid Transit Systems (Development and Building Works in Railway Corridor and Railway Protection Zone) Regulations. Application for permit to commence works is also required.

1.5.2 The design and construction of the development and building works shall comply with the requirements of the Code of Practice for Railway Protection

1.5.3 Prior to execution of URA development works, permanent or temporary, the contractor must be required to submit a Method Statement & carry out risk assessment on how they are going to carry out their works particularly the impact on railway operation and safety. It must contain the details of work to be carried out, the sequence and program, the procedure, identify the equipment and materials to be used, the tests and monitoring works to be carried out, including addressing all the possible hazards that might occur and how to prevent it. This Method Statement must be checked and approved by LTA and URA and/or other relevant Statutory Authority prior to commencement of any work, to ensure that quality of work and safety of personnel, public and existing structures, utilities and operation is not compromised.

1.6 Additions and Alterations to RTS Station

1.6.1 Should the Developer's proposal affect either existing permanent or temporary facilities, structures, architectural finishes and fixings and electrical and mechanical equipment and systems in the station requiring them to be modified, altered, relocated, demolished, rebuilt, upgraded or replaced, all works involved shall be carried out by the Developer at his expense. This includes the supply and installation of any new facilities including associated and consequential works that are required as a result. Should the works require the involvement of the Authority or the Operator, all cost incurred by the Authority or the Operator, shall be reimbursed to the Authority by the Developer.

1.6.2 The Developer shall be responsible for the design of the additions and alterations works including the checks on the adequacy of the existing structures and systems and assess the effects these works would have on the existing structures and services. He shall engaged qualified persons to submit and obtain clearances for development and building plans from all
technical departments. For additions and alterations works to the RTS structures, in addition to submissions to Development & Building Control Division of LTA, submissions to Building and Construction Authority and Fire Safety Shelter Department in accordance with the Building Control Act and Fire Safety Act respectively for approval of the proposals are required.

1.6.3 The Authority reserves the right to charge the Developer for any works which have to be carried out by the Authority with respect of the development or the development site. This will include all administrative and financial costs incurred by the Authority. If the modification and alteration works result in change to the gazetted railway area, LTA would be required to submit and obtain approval from the Competent Authority to amend the railway area. The Developer shall assist and provide drawings prepared by Qualified Person, survey drawings prepared by Registered Surveyor, etc to facilitate LTA to gazette the railway area and create rights.

1.6.4 The design and specifications of any addition, alteration, modification, upgrading, supply and installation of plant and equipment for civil, structure, architecture, electrical and mechanical services and any other systems of the station and rapid transit facilities shall comply with LTA design criteria and specifications.

1.6.5 All material, equipment and plant, etc shall comply with LTA’s standards and specification.

1.6.6 The Developer is responsible for the design, modification, installation including testing and commissioning and handing over to the Authority any of the reinstated works such as the electrical and mechanical system, station control, monitoring and communication systems or architectural and structural works related to the operation of the railway which are not specified or foreseen in this document. Details of these works shall be submitted to the Authority for acceptance. There will be a defect liability period of twelve months for any alteration works carried out by the Developer commencing from the handover date of the works which include civil & structural works, architectural works, electrical and mechanical services and systems.

1.6.7 The Developer shall be responsible for the design, modification, installation including testing and commissioning, updating of "as-built" drawings, operating manual etc. and hand over to LTA any of the reinstated works. A minimum warranty period of 12 months shall be provided for new and reinstated works, facilities and equipment after commissioning and handing over upon obtaining Temporary Occupation Permit for the works.
1.6.8 The proposed development must be designed and constructed such that the safe operation of the MRT station including its entrance, handicap facilities is not affected both during construction and upon completion of development. The construction works must also not cause nuisance or inconvenience to the public.

1.6.9 The development proposal shall be planned such that it does not impact on the station commercial areas. If it does, the developer shall resolve the commercial issues directly with the station operator and forward a copy of the operator’s concurrent to support his development proposals.

1.7 Operator’s Rules & Requirements

1.7.1 The Developer shall comply with the prevailing Operator’s rules and operation procedures when working in the railway system. It may be necessary for supervisors and workers employed to carry out the works to attend training courses, etc. conducted by the Operator before they are allowed to work in the railway premises. Application for permit to work, etc. is also required.

1.7.2 It is highlighted that the railway Operator will require their officers to be in charge for access to track and station areas and premises when working, monitoring inside these area, etc. They will charge for their services and attendances rendered and the successful tenderer shall be responsible for all these cost and associated costs.

1.7.3 The equipment and facilities in the MRT station may be sensitive to vibration. The successful tenderer shall not cause vibration which may affect the equipment, facilities including finishes in the MRT station. This may include facilities such as Automated Teller Machines, and other vending machines, etc.

1.7.4 The Developer shall ensure his work in the station premises is safe and supervised by a competent person providing standing supervision and the safe operation of station is not compromised at any time.

1.8 Damage To Persons and Property

1.8.1 The Authority had since November 1996, did not require Developer to provide a Deed of Indemnity against any loss, damage of any kind to any property arising out of or in conjunction with carrying out of this work. Further LTA does not require the Developer to furnish evidence of third party insurance policy or banker's guarantee for the above indemnity. However, the Developer shall be liable for or in respect of any damages to railway system and infrastructure or compensation payable under common law or under any stature in respect of or in consequence of any accident, illness or injury to any workman or any other person in the employment of
the Developer, save and except an accident, illness or injury resulting solely from any act or default of the Authority.

1.9  Security

1.9.1  The Developer shall ensure that there is no unauthorised access to the RTS station from the development site during construction. All openings into the station from the development site must be barricaded with 2-hour fire rated barriers during construction.

1.9.2  Where works to be carried out is exposed to public, the area must be enclosed with hoarding to cover-up any unsightly works, prevent the public from unauthorized access or provide security. Where necessary, adequate safety barriers, directional and warning signs must be installed prior to work operation being a safety precaution.

1.10  Access Through Railway Premises

1.10.1  When alteration works are to be carried out in the railway premises, the Developer shall ensure that construction debris is cleared immediately from the railway premises after demolition/removal of existing facilities/services. The Developer shall ensure that no construction material is brought in through the station entrances during the operation hours of the railway.

1.11  Terms & Conditions

1.11.1  The Developer acknowledges that the LTA Lot has been or may be developed by LTA or such other Government Agency as the Government may direct and/or such other person as LTA may direct, together with all guideways, foundations, columns, slabs, beams, supports, walls, lobbies, corridors, crossings, earth and water retaining walls and other structures on, under or above the floor and ceiling of the Site for use as the Stratum.

1.11.2  The Developer covenants with LTA to perform the obligations stated in this Clause 1.1 and further agrees to grant the following easements and rights over the Site in favour of LTA or its successors, assigns and all the owners and occupiers for the time being of the LTA Lot and persons authorised by them as appurtenant to the LTA Lot for the Lease Term –

(a) the right at all times by day or night to pass and repass on foot and by vehicle across and along such portion of the Site without any charge, payment, hindrance or restriction as would be necessary for reasonable access to and from any part of the LTA Lot including the escalators, lifts, stairs, stairways and lift lobbies to and from –
(i) any public road by –

(I) LTA, persons authorised by LTA and commuters using the Station;

(II) LTA, persons authorised by LTA and members of the public;

(III) LTA, owners, lessees, sub-lessees and occupiers of the LTA Lot, persons authorised by LTA, owners, lessees, sub-lessees and/or occupiers of the LTA Lot and employees and agents of persons authorised by LTA, owners, lessees, sub-lessees and/or occupiers of the LTA Lot; and

(ii) any refuse disposal facility and loading/unloading bay by LTA, owners, lessees, sub-lessees and occupiers of the LTA Lot, persons authorised by LTA, owners, lessees, sub-lessees and/or occupiers of the LTA Lot and employees and agents of persons authorised by LTA, owners, lessees, sub-lessees and/or occupiers of the LTA Lot; and

(b) the right to maintain and use any cables, pipes, ducts, cooling towers and channels in, on and under the Site for free and uninterrupted passage or provision of air, drainage, gas, garbage, artificially heated or cooled air, water, electricity, telecommunications, data and other utilities and services (including telephone, radio and television services) to and from the Site Provided Always that nothing in this covenant shall place or be deemed to place on LTA or the owner for the time being of the LTA Lot any obligation to carry out any repair and maintenance of any of the Developer’s cables, pipes, ducts, cooling towers and channels; and

(c) the right at any time on giving not less than 7 days’ notice together with reasonable particulars of the proposed statement of works (except in the case of emergency when prior notice only shall be required to be given) to enter the Site with or without workmen, appliances, equipment and materials to inspect, clean, repair, maintain, renew, remove and replace LTA’s cables, pipes, ducts, cooling towers, wires, sewers and channels.

1.11.3 The Developer for himself and his successors and assigns with the intent and so that the rights and covenants hereinafter contained shall run with and be binding upon the Site sold into the hand of whomsoever the Site may come and shall ensure for the benefit of the whole of the LTA Lot
or any part or parts thereof and so that the covenants and conditions shall as far as practicable be enforceable by the Lessor, its successor or assigns, or the owners and occupiers for the time being of the LTA Lot or any part or parts thereof hereby covenants that the Developer shall –

(a) procure from the transferees or assignees of the Site or any part thereof a covenant for the benefit of the owners for the time being of the LTA Lot or any part thereof to observe and perform the covenants contained in this Lease, including the present covenant;

(b) permit the use of any refuse disposal facility and loading/unloading bay, in, on and under the Site by LTA, owners, lessees, sub-lessees and occupiers of the LTA Lot, persons authorised by LTA, owners, lessees, sub-lessees and/or occupiers of the LTA Lot and employees and agents of persons authorised by LTA, owners, lessees, sub-lessees and/or occupiers of the LTA Lot for any purpose whatsoever, including, but notwithstanding the generality of the foregoing, for the purpose of the storage and disposal of garbage and the delivery of any objects, including, but notwithstanding the generality of the foregoing, goods; and

(c) notwithstanding any other provision, not touch, move or destroy any structure within the Site constructed by or on behalf of LTA except with the prior written approval of LTA.

1.11.4 LTA may exercise powers under section 6 of the Rapid Transit Systems Act and/or section 10 of the Street Works Act in respect of any part of the Site in, under or over which there is a structure(s) constructed by, on behalf of or for LTA or pursuant to a request by LTA at any time before, during or after the sale of the Site by the State.

1.11.5 If required by LTA or the owners for the time being of the LTA Lot, the Developer shall, at the cost and expense of LTA or the owners for the time being of the LTA Lot, execute in favour of LTA and the owners for the time being of the LTA Lot, an assurance containing the above easements and upon the agreement of the Developer, other rights and restrictive and other covenants in such form as LTA or the owners for the time being of the LTA Lot may require.

1.11.6 No failure or delay on the part of LTA to exercise any rights powers or remedies under this Clause 1.11 or its authority conferred under general law and no indulgence or forbearance or extension of time allowed to the Developer shall prejudice or operate as a waiver of LTA’s rights contained in this Clause 1.11 or under general law in respect of the subsequent exercise by LTA in respect of the same.
1.11.7 For the avoidance of doubt, unless expressly otherwise provided for in this Clause 1.11, the Developer shall be responsible for and bear all the costs incurred or that may be incurred in performing its obligations stipulated in this Clause 1.11.

1.11.8 For purposes of this Clause 1.11, unless otherwise expressed:

(a) "LTA Lot" refers to the strata space known as Lot of Mukim;

(b) "LTA" refers to the Land Transport Authority of Singapore, a body corporate established under the Land Transport Authority of Singapore Act (Cap. 158A);

(c) "Station" refers to the rapid transit system station; and

(d) "Stratum" means such facility, building or development (including a Station) as may exist or may be built or developed on or within the LTA Lot.

1.12 Creation of Rights under the Street Works Act

1.12.1 For the purposes of the construction and maintenance of streets, road structures and road related facilities, LTA wishes to highlight the rights of LTA under Part II of the Street Works Act. Pursuant to section 10 of the Street Works Act, LTA will in due course be creating rights for the purposes of and incidental to the maintenance of any street, or the operation or maintenance of any road structure or road related facility.

2 ARCHITECTURAL

2.1 General

2.1.1 The architectural layout and overall architectural design of the future development above and/or adjacent to the MRT station is the responsibility of the Developer. The Developer shall take into consideration the constraints placed on his architectural layout and design due to the presence of the MRT station. The essential criteria in the station layout is to provide adequate space for the movement of commuters from the station entrances to the platform level in the most direct way and this free access should not be interfered with. The positions of the existing entrances, firemen stairs, ventilation shafts and other facilities of the station both at ground level and also below ground will dictate to a large extent the overall design of the development.

2.1.2 Provisions have been made in some MRT stations to support a future building above the station box, direct underground pedestrian connection
to the future development and the integration or extension of ventilation shafts within the development. The Developer shall therefore include in his architectural design provisions for incorporating these into his development taking into consideration the technical and operational requirements that have to be met.

2.2 Station Concourse

2.2.1 Proposed connection to the station concourse from the adjacent development shall be designed to ensure smooth circulation of commuters. Connection can only be made into the free area in the station. Free area is a public circulation space in which information and ticket machines are located to which there is no charge for access. The layout of the development adjacent to the station concourse level shall be submitted to the Authority for review and acceptance.

2.3 Station Entrances

2.3.1 The entrances to the station at ground level are positioned such that they are easily recognisable and accessible in relation to the roads and commercial premises in the vicinity and the flow of pedestrian and passenger traffic. Beacon signs are strategically placed at ground level next to the entrances. These entrances at the ground level lead directly to the station concourse or via an intermediate level of a shopping mall in the station. The materials used for the finishes in and around the entrances are similar to those used within the station in order to project the overall image of the MRT system. Station sign with the Transit Logo are prominently displayed at the entrance so that commuter could see these signs from a distance and identify the station entrance easily. The developer must comply with this and provide signs meeting this within the development if the station entrances are affected.

2.3.2 The width of the station entrances are evaluated by considering the projected passenger flow during peak period together with the necessity for rapid evacuation of passenger from the station in an emergency. These have been designed based on the guidelines given in the Standard for Fire Safety in Rapid Transit Systems (SFSRTS) and also any other mandatory requirements of the Fire Safety & Shelter Department (FSSD), SCDF. The design of the station entrances into the future development shall take these into consideration.

2.3.3 All entrances are provided with canopies or roof to adequately protect them from the weather. Canopies and roof are constructed with adequate projection and fascia or parapets to cover the structural elements of the roof and provide sufficient upstand against rainwater spillage. The rainwater should be collected and discharged to the surface drainage network.
2.3.4 The threshold level of any opening into any development connected directly to the concourse or atrium level shall not be lower than the threshold level of the station for the flood protection of the MRT system. Threshold level at different locations at site would be different. This is subject to meeting the requirements of Drainage Department, Public Utilities Board whose clearance shall be obtained.

2.3.5 The entrances to certain stations may form part of an integral development and special consideration shall be given in the design solution or layout around it. The layout of the future development at ground level shall be designed such that access to the station entrances from the roads and other premises in the vicinity are not adversely affected. Free and easy access to the station entrances shall be maintained for the benefit of the traveling public. The entry/exit points to the station shall be separated from or independent of the entry/exit points to the development to avoid congestion. The Authority will exercise permanent right under Section 6 the Rapid Transit Systems Act for station entrances located in the development.

2.3.6 The entrances to the station shall have a fire separation of at least 2 hours from the future development in accordance with the Code of Practice for Railway Protection if they are integrated into the development. Besides this the Developer must meet the criteria and requirements set by FSSD.

2.3.7 A protected passageway for commuters access to the station entrances shall be provided at all times during the construction of the future development. Construction works at the area including demolition and removal of the existing entrance canopy and services, construction of the building over the entrance, etc., shall be planned and scheduled so that access to the station via the entrances are maintained operational and safe. The Developer shall submit proposals to the Authority for review and acceptance before commencement of works.

2.4 Finishes

2.4.1 The material selected for the finishes in the station are of a high quality in order to project the prestigious and highly visible nature of the MRT system. The materials used are also generally robust, durable and hard wearing, maintenance free and non-combustible. The floors in the public area in the station are generally finished in granite. The walls are cladded with durable hard wearing material generally comprising of granite slab, vitreous enameled steel panels or glass-fibre reinforced concrete panels. Ceilings are suspended from the soffit of floor slabs and are generally made of aluminum egg-crate panels, glass-fibre reinforced concrete panels, etc.

2.4.2 The Developer shall adopt the architectural finishes for the future development that is best suited to his needs. However, due consideration
should be given such that the finishes in the development are compatible with and complement the architectural treatment of the MRT station. Interface details of finishes at the subway or at the connections with the station shall be submitted to the Authority for comment.

2.5 Pedestrian Access Connections

2.5.1 Facilities for the convenience of commuters to access the MRT station shall be provided at grade as well as via underground pedestrian walkways from the developments. Pedestrian access connections shall be provided either by covered walkways to the MRT station entrances at grade or underground pedestrian walkways which are seamlessly connected to the underground MRT station. Details of the layout of these facilities for the convenience of the public shall be submitted to the Authority for review.

2.5.2 The layout of the pedestrian passageway within the development from the entrances of the development to the access connections or links with the station shall be direct and whenever possible with line of sight and unhindered to allow free and convenient flow of passenger to and from the development in line with the design concept of the station.

2.5.3 Where the underground pedestrian walkway or access connection connects directly to the station concourse, adequate space taking into consideration of the projected population should be provided for passenger circulation and direct flow lines between any future ticket machines and/or automatic fare collection gates to be provided in the station shall be made available. Unnecessary obstruction shall be avoided so as not to impede passenger movement.

2.5.4 The architectural finishes and electrical and mechanical services within the station affected by the construction of the pedestrian linkway are to be removed by the Developer. All materials removed shall be returned to the Transit Operator, unless otherwise directed by the Authority. The architectural finishes within the station affected by the construction of the access connection are to be rebuilt or reinstated by the Developer at his expense. The materials used shall be compatible with those of the finishes within the station. Fixing details for all architectural finishes and the interface details of the finishes with that of the station are to be submitted to the Authority for review and acceptance.

2.5.5 The underground pedestrian walkway to the station where provided from the future development shall not be used as part of the escape route for occupants in the development in order to comply with the requirements of the Fire Safety & Shelter Department (FSSD). Suitable illuminated signs indicating this shall be installed in the linkway.

Fire protection and prevention requirements outlined in this document have also to be complied with.
2.5.6 Barrier free access to station lift for the physically handicap with the associated ramp shall be incorporated within the development. The route to the lift shall remain accessible, direct and visually obvious to the public. Fire compartmentation of minimum 2 hours shall be provided between the development and the lift. The Developer shall provide barrier free route from this lift to the nearest development drop-off point.

2.5.7 The Developer shall ensure the following in their design of the access routes:

- tactile routes installed in accordance with the Guide to the layout of the Tactile Guidance System in MRT Station.
- accessible to people with disabilities in accordance with the prevailing Code on Barrier Free Accessibility in Buildings.

2.5.8 The developer shall refer to the Architecture Design Criteria of LTA for technical design criteria regarding Emergency Access, Handrails and Railings, Slipping and trip hazards, Avoidance of obstructions/Hazards, Public Health, Weather Protection, Visual Contrast, etc.

2.6 Design for Fire Protection and Prevention

2.6.1 The fire protection standards within the station and means of escape from the station are designed to comply with the requirements of the FSSD and the Standard for Fire Safety in Rapid Transit Systems (SFSRTS) which covers the fire protection requirements for all aspect of fixed guideway transit system and for life safety from fire in the transit system. The design of any development linked to the station shall meet with the similar level of fire protection and prevention adopted in the station.

2.6.2 All materials used in the structural elements of the stations are non-combustible and able to sustain a fire rating of up to 4 hrs for underground station. Similarly, all finishing materials within the stations are non-combustible (satisfying BS 476:Part 4). Where the materials cannot be regarded as fully non-combustible, they are fire resistant or fire retardant and shall not support fire or emit toxic gases. Cables used in station are either fire resistant (complying with SS CP 299) or fire retardant. In addition, cables used for underground station are also of low smoke and halogen-free type. Material used within the RTS facilities integrated with the development shall be of similar specification.

2.6.3 The stations are protected with automatic fire detection system and provided with smoke extract ventilation system designed to allow extraction of smoke to the exterior. The stations are also provided with sprinkler system, hose reels and extinguishers for fire fighting purposes. For critical plant rooms, gas protection is provided.
2.6.4 The Developer shall design his building to conform to the requirements of the FSSD. Furthermore, all interfaces with the MRT system and all rail commuters’ access routes, fire escapes in stations, etc. shall conform to the requirements of the Code of Practice for Railway Protection and the Standard for Fire Safety in Rapid Transit Systems.

2.6.5 A 2 hours fire separation shall be provided at all underground links and any openings between the station and the future development. For links which are left open during train operating hours, a fire door (hinged or sliding)/roller shutter/folding shutter which will automatically close in the event of a fire and offer protection to these openings from spread of fire for a minimum period of 2 hours shall be installed.

2.6.6 The existing entrances and exits from the firemen access stairs and emergency stairs of the station shall discharge directly to exterior. They shall not be enclosed within the future development. Prominently located sign shall be provided to indicate the location of these stairs if the entrance/exit to these stairs is relocated to the external walls of the development.

2.6.7 Circulation space at the interface connecting the development and the station shall be provided with minimum 2 hours automatic fire-rated shutters in compliance with Fire Code and Code of Practice for Railway Protection for activation and monitoring the status of the shutters at the integrated supervisor control system of the rapid transit system. As the fire separation along the boundary of the development and station is located in underground space, the developer shall engage Fire Safety Engineers to carry out fire safety design at the interface to ensure life safety for station and development in the event of fire emergency. This may involve using performance-based fire safety engineering approach. The Fire Safety Engineers shall submit the fire safety design to Fire Safety & Shelter Bureau (FSSD), SCDF for approval. The Fire Safety Engineer shall seek consultation with FSSD to agree on the design objectives, performance criteria and design fire scenarios. The design fire scenarios shall include fire scenarios in the development and station. The fire safety design in the interface boundary between the station and development shall be further enhanced when the proposed mitigation measures are approved by FSSD.

2.6.8 Should it become necessary to temporarily divert any of the station’s fire safety measures including fire fighting facilities, the Developer shall forward the proposal prepared and endorsed by the relevant Qualified Person to the Authority for review and acceptance. The design and construction of all temporary fire safety facilities shall comply with the Standard for Fire Safety in Rapid Transit Systems. Diversion works shall not proceed unless the Developer has obtained clearance from the Authority. Upon completion of the temporary diversion works, Qualified
Person shall submit a copy of his letter to the Authority to confirm that the works have been carried out in accordance with the Fire Safety Act.

2.7 Ventilation Shafts

2.7.1 The station ventilation shafts including the tunnel ventilation shafts shall be designed and positioned such that mutual recirculation will not occur if they are extended within the development. Openings of the ventilation shafts shall be arranged in such a manner that no smoke from the exhaust ventilation shaft and tunnel ventilation shaft can re-enter the station via the intake ventilation shaft and station's entrances (including the exit points of the firemen's stair and emergency stairs). Any gratings, grilles or lourves shall be designed to prevent unauthorised entry to the shafts.

Consideration shall be given to ensure that exhaust air discharge of the development is not close to the station's intake openings and entrances. Likewise, intake points including windows of the development shall be designed to prevent smoke due to a fire in the station or tunnel from entering and endangering the development by the station exhaust and tunnel ventilation shafts’ outlets. In the event of fire in the station, replacement air for the station smoke purging system and trainway emergency ventilation system will be supplied from station entrances. The design of the development shall take this into consideration to ensure life safety of passengers in the event of fire emergency in station.

2.7.2 A minimum separation distance shall be kept between the building line of the future development and the discharge for the exhaust and intake shafts to prevent entry of smoke which will be generated when the station or tunnel smoke extract system is in operation during a fire into the development. A Computational Fluid Dynamics (CFD) simulation shall be carried out during the design stage by a suitably qualified Professional Engineer (PE) for the development to determine the safe distance required.

2.7.3 A 2-hour fire rated partition shall be maintained at all times between the individual ventilation shafts and there shall be a 2-hour fire separation between the ventilation shafts and development. The use of dry wall partitions will not be permitted. In order to limit the risk of unauthorised amendments or alteration to the fire partition, reinforced concrete construction for the wall shall be used.

2.8 Firemen Access and Emergency Stairs

2.8.1 The architectural layout of the future development shall be designed to ensure that the entrance/exit to the station firemen stairs and/or emergency stairs is not obstructed. Where they are incorporated into the future development, a 2 hours fire separated passageway of not less than the width of the existing stair shall be provided leading to the exterior. Entry
point to firemen's staircase shall be visible and located within 18 m from
the fire engine accessway. Entrance/exit points to the stair are to be
provided with suitable signs so that they are easily recognisable by the
SCDF. The Authority will exercise permanent right under Section 6 the
Rapid Transit Systems Act for these facilities integrated with the
development.

2.9  Graphic & Signs

2.9.1  All developments linked to MRT stations shall put up MRT-related signs
within and at the commencement of the link to the station and station
entrances for the information and direction of the public. Station beacon
signs or totem poles which are illuminated are provided to indicate the
location of all entrances to the station at ground level. This also includes
RATIS signs giving information of train arrival times, and other related
information on LED or Plasma display panels. Sign design guideline will
be provided by the Authority.

2.9.2  Directional signs guiding commuters to the MRT station are to be
displayed clearly at prominent locations within the development and at the
commencement of the link to the station. The locations of these signs are
to be proposed by the Developer.

Additional information and signs advising the public on the location of the
link to the MRT station are to be displayed within the private development
where appropriate and at locations to be proposed by the Developer.

2.9.3  All MRT related signs are to be designed according to the Authority
guidelines (LTA Sign Design Guidelines Manual). The design of these
signs and their proposed locations are to be submitted to the Authority for
review and acceptance.

2.9.4  Any existing signs, station beacon signs, RATIS signs and advertising
panels, etc., that are required to be relocated shall be carried out by the
Developer at his expense. This shall also include transportation charges
for returning the signs to the Authority for storage etc. Proposals for the
relocation of these signs and advertising panels and arrangement for the
termination and reconnection of power supply shall be submitted to the
Authority.

2.9.5  Sign on No Smoking/No Eating/No Drinking

"No Smoking/No Eating/No Drinking" signs shall be affixed at the
proposed underground Pedestrian Mall before the entrance to the MRT
station by the Developer.

2.10  Relocation of Cooling Towers, Sprinkler Water Tanks, etc.
2.10.1 The cooling towers for certain MRT stations are located on the station roof or at ground level near to the station. The existing cooling towers and water tanks may be relocated to the roof or podium of the future development. The new location of the cooling towers on the development and any other installations affected shall be submitted to the Authority for review and acceptance.

2.10.2 The Developer shall ensure that the operations of the existing cooling towers, sprinkler system, etc. of the station are not affected at any time during the construction of the future development. Construction activities shall be planned taking into consideration this requirement. All necessary measures required shall be at the Developer’s cost.

2.10.3 Pipe and cable shafts shall also be incorporated in the future development for connecting the pipework and cabling to the relocated cooling towers, water tanks, etc. These pipe and cable shafts shall have a fire separation of at least 2 hours from the future development. Maintenance access via fire doors to the pipe and cable shafts shall be provided at every floor in the future development. These shall be located at easily accessible location such as a lobby or corridor. The Authority will exercise permanent right under Section 6 the Rapid Transit Systems Act for these facilities integrated with the development.

2.11 Commuter Facilities

2.11.1 If existing covered linkway from the entrance of MRT station was to be demolished, it shall be reinstated and integrated with the development to provide proper connectivity to the existing station.

2.11.2 The Developer shall provide temporary covered linkway between the commuter facilities such as taxi shelter and the MRT station before the existing covered linkway is demolished.

2.11.3 The commuter facilities affected by the proposed development are to be reinstated and make good.

3 CIVIL AND STRUCTURAL REQUIREMENTS

3.1 General

3.1.1 The site of the future development above and/or adjacent to the MRT station and tunnels fall within the MRT Railway Protection Zone. A future underground infrastructure is located in the vicinity of the MRT station entrance. The design and construction of the proposed future development shall be carried out in accordance with the requirements of the Code unless otherwise stated herein. The Developer shall comply with the technical requirements as stated in the Code of Practice for Railway
Protection in carrying out design and construction of development works and Guides to the Carrying Out Restricted Activities within the Railway Protection and Safety Zone.

3.2 Site Survey

3.2.1 The setting out of the stations and other MRT structures is based on the MRT Survey Grid system adopted for the whole Mass Rapid Transit System. This survey coordinate system is different from the Singapore Government Cadastral Survey Grid system.

3.2.2 The responsibility of determining the exact locations of the stations and other MRT structures affected by the future developments rests solely with the Developer.

A survey of the section of the MRT structures affected by the proposed works have to be carried out by a registered land surveyor in order to determine in plan and level the relative position of these structures with respect to the proposed development. Survey plan showing the location of the station, tunnels and the limits of the reserve lines of the protection zone as defined in the Code in plan and sections from the proposed development endorsed by a Registered Surveyor shall be prepared. This survey plan must contain information such as the survey system used.

3.3 Loading On MRT Structures

3.3.1 Where provision were made for MRT structures, particularly, the station box for additional loading, this will be stated in Section 2 of the technical conditions. All superimposed dead and live loads on MRT structures shall not exceed those that have been designed for. Generally, station columns have been designed to support axial loading with limited allowance for eccentricity due to construction tolerance. Loading shall only be transferred to the station structure at the columns only.

3.3.2 The MRT structures have been designed to support the future column loads on the assumption that ground condition remain substantially unaltered since the construction of the MRT works. If significant disturbance to the ground condition occurs, both as a result of the works for the development or nature, these loads may no longer be applicable and should be re-assessed by the Developer. Any re-assessment required shall be prepared, endorsed by a qualified person and submitted to the Authority for review and acceptance.

3.3.3 Reinforcement couplers and starter bars where provided have been arranged to suit column size as shown in the detailed reinforcement plans. The actual column for the development may be of a different shape if required to suit the building design with appropriate modifications made to
the notional reinforcement provided. The Developer shall check the permissible loading on the station column taking into considerations the actual column dimensions, location, grade of concrete and reinforcement provided. Details shall be submitted to the Authority for review and acceptance.

3.4 Foundation for the Development

3.4.1 The future development shall be designed with foundation having compatible settlement characteristics with the MRT structure to ensure that loads greater than those that have been designed by the Authority are not transferred to the MRT structure as a result of differential settlement, etc. A geotechnical assessment shall be submitted to the Authority for review and acceptance.

3.4.2 The future development may be affected by changes in ground conditions, vibration, noises as a result of the construction of a future underground infrastructure. The design of the future development particularly the foundation, building structure, finishes and fittings shall take these effects into consideration.

3.5 Flood Protection

3.5.1 As a guide, all entrances/exits of the station at ground level are located at 1m above the adjacent road/ground level or 1 m above the highest recorded flood level, if any, as advised by the Director, Drainage Department or other level as may be specified by the Director, Drainage Department whichever is the higher to prevent ingress of flood water into the station. The requirement of Drainage Department (PUB) for flood protection of the rapid transit system shall be complied with and their clearance obtained.

3.5.2 The entrances/exits of any development connected to the station shall be located at the same level or higher than the threshold level of the station. The Developer shall ensure that the proposed connections to the station from the future development do not constitute a route for floodwater into the station.

3.5.3 Where connection is made underground to link to MRT station, the threshold level of any opening within the development shall not be lower than the threshold level of the station for flood protection of the rapid transit system and approval from Drainage Department of Public Utilities Board shall be obtained. The level must comply with the level required in line with Code of Practice for Surface Drainage for Flood Protection of the underground rapid transit system. Breakthrough of connection to the MRT station shall only be made when the development has reached the flood threshold level.
3.5.4 Proposals for flood protection and prevention of the station during the construction stages for the development shall be submitted by the Developer to the Authority for review and acceptance. The construction works shall be planned and programmed such that there is no possibility of floodwater ingress into the station at any stages of the work.

3.6 Waterproofing of Station Roof Slab

3.6.1 All stations roof slabs are waterproofed with waterproofing membrane overlaid with a protective layer of concrete. The waterproofing membrane generally extends for a distance of about 1.0m down the external face of the station wall. Care should be exercised while carrying out works above the station roof to ensure that the station waterproofing systems are not damaged.

3.6.2 If it is necessary to remove the waterproofing system for the construction of columns, etc., the works shall be planned and carried out such that no water can seep into the station. The waterproofing system that are removed or damaged shall be reinstated to the satisfaction of the Authority. Details of the remedial works shall be submitted to the Authority for review and acceptance prior to commencement of works. The Developer shall reinstate or provide a new warranty of the waterproofing system upon completion of the construction works. The period of warranty shall be ten years.

3.7 Construction Below Ground

3.7.1 The Developer shall design both his temporary and permanent works to ensure that ground movements in the vicinity of the MRT structures are kept to a minimum. These works shall be designed such that no overloading or excessive deflection is caused at any stage of the construction to the MRT structures. The construction sequence and the method of construction adopted for any excavation works shall be so planned and executed to minimise ground movement, disturb the subgrade beneath the MRT structures and avoid endangering the strength and stability of the structures. In addition, he must recognise that the use of proven techniques and good workmanship are essential in restricting ground loss.

The basement shall be constructed with every effort made to quickly and adequately support the exposed ground, and to minimise the inflow of water into the excavation. In compressible ground, provisions shall be made to ensure that over-excavation and heaving do not take place.

3.7.2 The method of construction for any proposed basement shall take into account the following:-
a) The geology along the length and depth of the basement and the MRT structures.

b) The foundation of the MRT structures.

c) The hydrogeology and strata permeabilities.

d) The degree of settlement which would be expected. In this context the location of the works in relation to existing MRT structures shall be considered.

e) The depth of construction required.

f) Control over heave and instability of the base of the excavation.

g) The method for waterproofing the completed structure as no dewatering is permitted.

3.8 Demolition

3.8.1 The Developer shall take all reasonable care and precaution when demolishing or cutting away existing work in the MRT structures to ensure that no adjacent structure is damaged. Should there be any damage it shall be made good at the expense of the Developer to the satisfaction of the Authority.

3.8.2 The Developer shall inform and obtain permission from the Authority before any demolition works affecting MRT structures including the landscaped areas at ground level above the station is carried out. The Developer shall ensure that the following are observed during the demolition work: -

a) The Developer shall protect MRT finishes and services during the demolition work. Permanent finishes and services at least 2m away from the demolition should be removed and carefully stored by the Developer for reinstatement. The Developer shall repair, and reinstate the finishes in accordance to the Authority requirements. Any damage shall be repaired or replaced by the Developer at his own cost.

b) A temporary full height dust tight partition is to be erected not more than 2m inside railway premises with a minimum 1.2m wide clear passage for maintenance and access. The partition is to be durable to resist the abuse expected and is to be well made and maintained throughout the works by the Developer.

c) Adequate provision must be provided to prevent water seepage into railway premises.
d) All floors and walls affected by the construction are to be protected by suitable means.

e) All materials used within the station shall be non-combustible.

3.8.3 The Developer shall programme his work and plan his method of construction such that there is no possibility of flooding to the MRT structures at any time during the construction. Any demolition work on the knock-out panels in the station can only commence after the completion of the substructure of the development above the threshold level of the MRT station including all entrances to the development and the sealing of any openings below that of the station threshold level.

3.9 Drainage (Storm and Foul)

3.9.1 The Developer shall not break, divert or utilise either temporarily or permanently the station storm or foul water drainage system without the prior written consent of the Authority. Should the Developer wishes to alter the station drainage system, the design, construction and maintenance of the affected works including all manhole connection, making all necessary submissions to the relevant authority for approval, etc., shall be undertaken by the Developer at his cost. The Developer shall also ensure that there are no disruptions to the existing drainage system while the alteration works are being carried out. Details are to be submitted to the Authority for review and acceptance.

3.9.2 The drainage system of the future development shall not be allowed to discharge into the station drainage system. A separate system for the drainage of storm and foul water from the development shall be provided.

3.10 Instrumentation and Monitoring

3.10.1 The effect of the construction work on the MRT structures shall be monitored throughout the construction period. Careful consideration should be given to monitoring the movements of the MRT structures and the ground by establishing a system of measurements before, during and after construction to give assurance that design assumptions are realistic. Monitoring instruments shall be installed at least two weeks before the commencement of construction for initial readings to be obtained. The frequency of monitoring will depend on the nature of the construction activity and as agreed with the Authority. The Developer must ensure that the frequency of monitoring is such that all possible effects on RTS structures are recorded during the construction period. The monitoring are to be carried out until it is deemed that there is no more possibility of any further movement and agreed to by the Authority.
ELECTRICAL AND MECHANICAL

4.1 General

4.1.1 The Developer shall be responsible for and implement at his own cost any modification to the existing electrical or mechanical system on the operating railway which may have to be relocated or modified to suit his development proposal. This shall include the supply of new equipment to replace the existing equipment as necessary. All new material and equipment proposed shall meet with the requirements and specifications of the Authority. All equipment and accessories removed shall be returned to Operator.

Special arrangements shall have to be made by the Developer for carrying out work within the station, taking into consideration the restricted hours of working, safety and other requirements.

4.1.2 There should be no interruption to the existing services in the station during construction. If the plant and equipment serving the station or tunnel are relocated, the Developer shall make modifications to the equipment, pipework, cabling, etc. where necessary to ensure the proper, safe and efficient operation of the system. The Developer may consider providing new plants rather than relocating the existing ones if it is found to be more practical and feasible to do so. The Developer shall submit his proposal for approval. All modification works and replacement of existing plants shall be at the Developer's expense.

4.1.3 The Developer shall install, test and commission all new installations to the satisfaction of the Authority before connecting them to the existing station facilities. The Developer shall also be responsible for the maintenance of the new facilities for a period of 12 months from the date of hand-over to the Authority.

4.1.4 The installation programme of the replacement services must be agreed with the LTA noting that interruptions to the station and tunnel systems will be kept to a minimum and passenger services must not be disrupted in any way.

4.1.5 The Developer shall be responsible for all costs associated with any modifications to the existing electrical and mechanical systems in the station which have been relocated or modified to suit his Development proposal whether such a modification is implemented by him or LTA. This shall include the supply of new equipment to replace the existing and any temporary installed equipment as necessary.

4.1.6 Where existing warranty of the as-built station E&M equipment and installation is affected due to the Developer's proposed works, all costs to provide the necessary warranty to LTA and the Operator for that
duration of warranty period, which has been forfeited as a result of the Developer's proposed works, shall be included.

4.1.7 The Developer shall also provide the necessary drawings, operation and maintenance manuals, warranty, licensed software, etc. for any new equipment, supplied and installed by them as a result of the proposed modifications, diversions, extensions and alteration works etc. The materials and equipment used in any modifications, diversions, extensions, replacement and/or additions to the E&M systems shall meet LTA's specifications and are subjected to the approval of LTA and the Operator. Tunnel ventilation fans, underplatform exhaust fans, station smoke extraction fans and the associated equipment and accessories shall be rated to operate with air temperature of 250°C for minimum of 2 hours.

4.1.8 The Developer shall permit LTA, its Representatives and the Representatives of the railway Operator to enter the Development without charge and every part thereof with or without workmen, materials, specialist services or vehicles for the purpose of constructing, operating and maintaining rapid transit systems. The Developer shall undertake to ensure that access is available to officers of the LTA, its agents, Operator and their nominated contractors into the premises of the Development at all time for the purpose of gaining access to carry out installation, maintenance or repair works necessary on all equipment and services associated with the station.

4.1.9 Where new equipment is supplied by the Developer, remote monitoring and control facilities shall be provided to interface with the existing monitoring and control system in the station and Operation Control Centre (OCC).

4.1.10 The Developer shall coordinate closely with relevant personnel from the Authority and railway Operator on all aspects relating to the installation of the E&M systems and associated equipment.

4.1.11 Should it become necessary to temporarily divert any of the station's fire protection works including fire fighting facilities, the Developer shall forward the proposal prepared and endorsed by the relevant Qualified Person to the Authority for review and acceptance. The design and construction of all temporary fire safety facilities shall comply with the Standard for Fire Safety in Rapid Transit Systems. Diversion works shall not proceed unless the Developer has obtained clearance from the Authority. Upon completion of the temporary diversion works, Qualified Person shall submit a copy of his letter to the Authority to confirm that the works have been carried out in accordance with the Fire Safety Act.
4.1.12 The Developer shall ensure that the equipment can be easily accessible for maintenance. Access for future replacement of the equipment shall be provided.

4.1.13 The Developer shall warrant all plants, materials and equipment supplied and all workmanship performed by him to be free from defects of whatever nature and he shall replace, repair or make good, at no cost whatever to the Authority, and all plant, materials and equipment which are found to be defective during the 12 months period following the date of certified completion of the works.

4.1.13 The Developer shall not providing jointing to cables and shall provide new cables and cable containments for the modified works. If providing of new cables and cable containments are not feasible, the Developer shall justify to the Authority on the constraint at site.

4.1.14 If there is an increase of electrical loading for the station due the modification and A&A works and the existing spare capacities of the existing transformers and LV Main Switchboards are insufficient, the Developer shall provide additional/upsize the transformers and LV Main Switchboards to cater for the changes. The Developer shall also provide local and remote (ISCS) control and monitoring to these equipment as per the Authority requirements. The Developer shall submit to the Authority for review and acceptance on the justification of the electrical loading and the detailed design of the changes required.

4.2 Ventilation Shafts

4.2.1 Arrangement and Separation

Fresh air for ventilation of the station is taken from the intake vent shafts while air is exhausted through the exhaust vent shafts. The tunnel vent shafts are for ventilation of the tunnels. The overpressure or underpressure brought about by train movements through the tunnels are relieved through the tunnel vent shafts. These shafts also act as exhaust shafts for the purging of hot gases and smoke from the tunnels.

4.2.2 If the Developer wishes to relocate, extend or modify any of the ventilation shafts, he shall make modifications to the existing equipment, cables, pipes, ducts, etc. where necessary to ensure the safe, efficient and proper operation of the station and tunnel ventilation systems. The Developer shall also ensure that the ventilation shafts opening locations comply with the following requirements:

a) There is no short-circuiting of air between the different ventilation shafts.
b) No smoke and/or hot gases emitted from exhaust systems enter the station.

c) Exhaust air or smoke discharged from the Development's exhaust outlets and cooling towers shall not enter the station and tunnels via the intake vent shaft, tunnel vent shafts, firemen's stairs, emergency stairs or station entrances of the station.

d) Intake openings of the Development shall be located such that exhaust or smoke and hot gases emitted from the station’s exhaust vent shafts and tunnel ventilation shaft openings, are not drawn into the Development.

e) The ventilation shaft openings shall not be closer than 5 meters from each other and any other openings and where possible, they are not located on the same plane.

f) Louvers and screen shall be fitted to the vent shaft openings to prevent ingress of rain water, birds and entry of unauthorised persons.

4.2.3 A Computational Fluid Dynamics (CFD) simulation shall be carried out during the design stage by a suitably qualified Professional Engineer (PE) for the development to determine the safe distance required.

4.2.4 Where vent shafts are incorporated in the development, the location of openings shall comply with the requirements in the Code. The vent shafts shall be designed for side discharge where possible, and equipped with louvres to prevent the ingress of rainwater. Where vertical discharge is proposed for the vent shafts, the Developer shall provide the drainage system, including pumping system where necessary, to prevent accumulation of water. Louvres shall have a weather resistance of 95% and provided with bird screens of not larger than 10mm mesh and shall be designed such that there is minimal pressure drop through them. Frames shall be robust and protected against corrosion. Details or the louvres shall be submitted to the Authority for review and acceptance.

4.2.5 Design

In the design of the MRT ventilation shafts, pressure drop calculations shall be prepared by the Developer and submitted to the Authority for review and acceptance. If it is necessary to modify the vent shaft, the Developer shall undertake to review its impact on the station ventilation fans. The Authority will exercise permanent right under Section 6 of the Rapid Transit Systems Act for these facilities integrated with the development.
4.2.6 The Developer shall ensure that the sound level emitted from the operating of outdoor E&M equipment, and from the ventilation shafts when the indoor equipment is operating shall comply with the noise criterion stipulated by the authorities.

4.2.7 Modification Works

Care should be taken to ensure that the operation of the ventilation shafts will not be affected at all times during and after construction of the development and any modification works to the shaft. There should be no restriction to free flow of air around the vent shafts and no ingress of rainwater into the stations through the vent shafts during and after construction. The 2-hour minimum fire compartmentation between individual vent shafts and minimum separation between vent shaft outlets to prevent short-circuiting of air shall be observed at all times. The Developer shall submit for review his proposal for the design and construction of the vent shafts.

4.2.8 Dust and Environmental Pollution

Construction activities in the vicinity of the ventilation shaft will generate dust pollution, smoke and exhaust fumes and other environmental pollution which will affect the performance of the environmental control equipment as well as the fire and smoke detection system of the station. Effective measures to minimise dust pollution, etc. shall be implemented.

4.3 Lighting and Ventilation at Access Connection

4.3.1 Adequate lighting and ventilation to the access connections including the staircases shall be provided by the Developer. The Developer shall make provision for the power supply from the development to the access connection for all the necessary services. The ventilation system for the access connections shall not adversely affect the performance of the station air-conditioning system. It shall not cause draught at the interface of the connection to the station thus affecting the station air-conditioning system.

4.5.2 Fumes from food preparation and cooking facilities within the development could permeate into the station premise. This may cause discomfort to traveling public and station operation personnel. The design of the ventilation within the development must be designed to extract the fumes from these and similar activities so that they would not reach the station.

4.4 Fire Compartmentation
4.4.1 A 2 hours fire separation shall be provided at all underground links and any other openings between the station and the future development unless otherwise stated. For links, which are left open during normal time, fire-rated shutter shall be installed which will automatically close in the event of a fire and offer protection to these openings from spread of fire for a minimum period of 2 hours. The closing mechanism shall be activated by smoke detectors installed at either side of the fire-rated shutter. In addition the fire shutters shall also close when the local fire alarm of the development at the zone in the immediate vicinity of the shutters or the fire alarm zones in the station public area are activated. The fire-rated shutter after closing by the activation of the smoke detectors shall remain closed and be rendered inoperative until the control system which the smoke detectors are connected are manually reset.

4.4.2 The Developer shall make provision to transmit and link the signal indicating the open/close status of the fire shutter to the station integrated supervisory control system (ISCS). The status of the fire-rated shutters provided at the underground linkway and any other openings between the station and the future development shall be monitored at the ISCS at the station's Passenger Service Centre. Upon receiving the alarm signal, an audible and visual alarm shall be activated at the Passenger Service Center and Operation Control Centre. A silencing switch shall be provided to silence the audible alarm but is shall not cancel the visual alarm. Signal cables with appropriate spare capacity (50%) which are screened, fire retardant, low smoke and halogen free placed in hot dipped galvanised metal conduits or trunking and junction boxes shall be supplied and installed by the Developer to transmit the signal to the ISCS control unit in the station.

4.4.3 The Developer shall design, provide and install all necessary equipments and accessories, cable, conduits and their supports, update of existing hardware and software in the station and other works required for the fire separation works including those required for updating the ISCS.

4.4.4 The Developer shall carry out regular maintenance of the fire shutter and engage a qualified person (mechanical discipline) to carry out annual testing of the fire shutter to be witnessed by the Authority. The qualified person shall submit a letter certifying that the fire shutter and monitoring system are in good working condition.

4.5 Lighting for Station Entrance and Concourse

4.5.1 Temporary and permanent lighting, including emergency lighting, for the station entrances and station concourse shall be provided by the Developer where these are integrated into the development. The level of lighting to be provided when the station entrance are integrated into the development and where linkways are proposed to connect to the station shall be consistent to the existing level provided within the station. The type and
quality of fittings and their illuminous intensity are subject to approval by the Authority. Lighting levels shall be designed to be uniformly distributed and such that glare, dark recesses and areas of poor lighting are avoided. Details of this design shall be submitted to the Authority for review and acceptance.

4.5.2 Lighting at the station entranceway which is integrated into the development shall be provided and maintained by the Developer. The minimum lighting level at the station entrances is 450 lux. The Developer shall provide the power supply to lighting at station entrance integrated into the development. The switching mechanism of these lighting is to be controlled separately. The Operator determines the operation hours of the station entrance and linkway.

4.5.2 The lighting control for the lightings from Concourse to subway leading to entrances shall be controlled and monitored by the lighting control panels in the station. The grouping of the lightings for control shall be consistent to the different lighting levels required to be achieved within the existing station.

4.5.3 Where the lighting levels are affected by the construction of the development, particularly at the station entrances, vent shafts and proposed linkway, additional light fittings including emergency lights shall be provided to ensure that the level of illumination is maintained throughout the train operation hours. The cost of such provision, operation and maintenance shall be borne by the Developer.

4.5.4 Existing station light fittings, cables, etc. which are required to be removed shall be carried out by the Developer at his expense. All light fittings (including their associated control gears) removed shall be cleaned, individually packed and returned to the Authority. Arrangement for the termination of power supply shall be made with the Authority. The existing light fittings shall not be removed until alternative arrangements are provided to ensure that the lighting level is not affected.

4.6 General Purpose Power for Station Entrance and Concourse

4.6.1 13A switched socket outlets shall be provided generally every 30m for the cleaning and maintenance purpose.

4.7 Air Conditioning

4.7.1 Areas within the station are either air-conditioned or mechanically ventilated. Where the proposed development is connected to the part of the station which is air-conditioned, the area at the access connection shall provided with air-conditioning or other approved alternative to prevent leakage of cooled station air. The air-conditioning of the area just adjacent to the station shall be designed such that a slightly positive pressure is
provided over that of the station. Details of this design shall be submitted to the Authority for review and acceptance.

4.8 Fire Protection for Station Entrances

4.8.1 If the entrance canopies are removed, the existing fire protection shall be removed and terminated by the Developer. New fire protection shall be installed to provide coverage over the station entranceways.

4.9 External and Landscape Lighting

4.9.1 The external and landscape lighting and the associated cabling and OG boxes are to be disconnected and removed by the Developer if it encroaches into the development. All lighting fixtures are to be returned to the Operator or the party responsible for its maintenance.

4.9.2 If the station beacon signs are to be relocated, the cables connecting to the signs are to be properly terminated and extended. The power supplies to these beacon signs are from the station supply. Arrangement for the termination and reconnection of the power supply to these signs shall be made with the Authority if it is necessary to relocate the signs. This works shall be carried out entirely by the Developer.

4.10 High Point Antennae

4.10.1 If the development affects the radio communication through the high point antennae, the antennae shall be relocated by the Developer to the unobstructed part of the building to the acceptance of the Authority. Radio communication throughout the railway system should not be affected both during construction and on completion of the development. This includes radio communications around the station and between existing area where equipments such as cooling towers, etc are located. Interim measures may be necessary to relocate the antennae to ensure that the radio communication system is not affected. The design and installation of these radio communication facilities including link budget calculations, etc must be submitted. The works shall be carried out to the satisfaction of the Authority.

4.10.2 In addition to the railway radio communication system, high point antennae are provided for the Singapore Civil Defence Force’s and Singapore Police Force’s radio communication network. In Civil Defence station, radio communication antennae are also provided. These antennae may also be affected by the proposed development and the details of the relocation shall be submitted to the SCDF through the Authority for approval.
4.10.3 Equipments of telecommunication providers such as Singtel, Starhub and M1 in the station could also be affected. The Developer should liaise with the service providers on their equipments.

4.11 Fire Protection Systems

4.11.1 Breeching Inlets, fire control panel and firemen intercom shall not be obstructed at any time during and after the construction of the future development. Fire engine accessway is provided within 18 m from the breeching inlets, firemen intercom. Adequate and ready fire engine accessway for SCDF shall be safeguarded during construction and maintained at all times.

4.12 Lightning Protection

4.12.1 The above ground structures of the station such as the entrance canopies, ventilation shafts, etc. are protected with lightning conductors connected to earthing pits located near to these structures at ground level. These may have to be re-sited at the expense of the Developer if the existing installation is affected by the development.

4.12.2 The requirements and specifications for the relocation of the lightning conductor earthing pit are as follows:-

a) The earth electrode shall be installed in accordance with CP 33 or its latest revision and the individual earth resistance shall be less than 10 ohms.

b) The earthing inspection chamber and cover shall be of heavy-duty type. The dimensions shall be similar to the existing ones.

c) Test clamp shall be located at 150mm above Finished Floor Level.

d) Copper tape shall be protected by pipe sleeve and properly secured to the structure.

e) All materials used for the lightning protection system shall be similar to the existing materials used in the station.

f) Details of the proposed location of the earthing pit and the method of construction shall be submitted to the Authority for review and acceptance before commencement of works. Care should be taken to ensure that the existing structure is not affected.

g) Test results are to be submitted to the Authority on completion of works. Test record must be in proper form endorsed by a Qualified Person in Electrical discipline.
h) A site inspection shall be arranged on completion with the Authority.

4.13 Electromagnetic Compatibility / Electromagnetic Interference

4.13.1 The Developer shall ensure that electrical systems installed by him within the development have no detrimental effect on the operation of systems within the station and railway. In addition, he is advised to consider the effects on his own equipment of the systems operating as part of the station and railway. The Developer shall submit details of the measures for the equipment, the testing and inspection proposals to the Authority for approval.

4.14 MRT Station Control and Communication Systems

The Developer shall comply with the following requirements:-

4.14.1 Integrated Supervisory Control System (ISCS) Technical Requirements

a) Cable relocation and diversion including its cable infrastructure, if affected by the works;

b) ISCS to monitor and control any new equipment that is introduced within station boundary, entrances and MRT related facilities as a result of the new works. (For example, fire and security shutters, etc);

c) All new monitoring points shall include the necessary cabling and its infrastructure following the existing system architecture;

d) Programming and configuration of the system at Passenger Service Centre and Operation Control Centre such as RTU, servers, database and graphics for any equipment added, removed or relocated are to be updated. Input/Output hardware cards shall be supplied if the existing system spare is not available;

e) All changes made shall comply with LTA specifications and requirements;

f) To conduct testing and commissioning of the system;

g) Update existing as built drawings and documents.

4.14.2 Travel Information System (TIS) Technical Requirements

The Developer shall provide display panels and associated infrastructure meeting the following at the connection to the development within the subway. This shall meet the following:
a) Cable relocation and diversion including its cable infrastructure, if affected by the works;

b) Supply and install new LED displace panels with brackets and its mounting accessories facing the new station entrance that is created as a result of the new works;

c) New LED shall include the necessary cabling and its infrastructure following the existing system architecture;

d) Programming and configuration of the system servers including updating its database at the station and Operation control centres;

e) ISCS graphics and its interface are to be updated;

f) All changes made shall comply with LTA specifications and requirements;

g) To conduct testing and commissioning of the system;

h) Update existing as built drawings and documents.

4.14.3 Closed Circuit Television Cameras (video cameras), Public Address System and Radio Coverage

The Developer shall provide the closed circuit television camera (video camera), public address system in the station entrances and subway connection to the station meeting the following:

a) All one-way and two-way emergency voice communication requirements as specified in the SFSRTS shall be complied with;

b) Depending on the extent of the A&A works, equipment/services may have to be relocated/diverted, cable relocation and diversion including its cable infrastructure, if affected by the works;

c) Cameras to monitor the interface boundary with the new development will be required. The number of cameras needed would be determined based on the site situation;

d) ISCS to monitor and control any new equipment that is introduced within MRT Station boundary or relocated as a result of the new works. For example, closed circuit television cameras, public address speakers, etc;
e) All new monitoring points shall include the necessary cabling and its infrastructure following the existing system architecture;

f) Testing and commissioning of all new installations and systems shall be conducted;

g) Update existing as built drawings and documents.

4.14.4 Access Management System Requirements

The Developer shall carry out cable relocation and diversion including cable infrastructure, if affected by the works.

4.14.5 Maintenance Management System Requirements

The Developer shall update Maintenance the Management System (MMS) following any equipment change (new or removed) within the station as a result of the new works and/or alteration works.

4.15 Low Smoke, Halogen-Free, Fire Retardant/Fire Resistant Cables

4.15.1 All cables installed within the station shall be of low smoke, halogen-free, fire retardant/fire resistant cables. The details are to be submitted to the Authority for approval.

5 OPERATION RELATED MATTERS

5.1 General

5.1.1 The Developer shall make provision in the development for complying with the operational requirements of the Operator. This will include the right to use facilities in the future development by Operator and its tenants in the shopping or commercial centres in the station. The Developer or owner of the development shall also be responsible for security to be provided by him. Besides this, the Developer shall also observe the restrictions and constraint imposed by the Operator during the construction period so that the railway operation is not disrupted in any way.

5.2 Facilities in Future Development

5.2.1 Use of Service Lift, Service Bay and bin centre within development.

The Developer shall allow the Operator and its tenants in the station to utilise the service/goods lifts and service bays and loading and unloading facilities within the development serving the levels at which the future development connects to the station. These are required for the loading and unloading of goods and equipment by the Operator or its tenants for
maintenance purposes and for conducting their business activities. There shall be no charge levied for the use of these facilities.

5.2.2 Similarly, the Operator and its tenants shall be permitted to use the bin centre located within the development for the disposal of refuge without charge if the existing station bin centre is removed. Future operational arrangements shall be worked out with Operator.

5.3 Access Connection

5.3.1 Access connection

Access from the future development to the MRT station shall be kept open during the operational hours of the railway.

Where the existing entrance is to be incorporated into the future development, the entrance must remain open 24 hours if it is considered as entrance to an underpass.

5.3.2 Maintenance

5.3.2.1 The Developer shall be fully responsible for the maintenance of the access connection which includes all sliding grilles, fire door/shutter, electrical and mechanical equipment therein within his property. The structure, finishes and all services in the access connection within his property shall be maintained to a standard comparable to that carried out within the station. The Developer shall ensure that the linkway does not deteriorate to such a stage that it may have negative effect on the image of the station.

5.3.2.2 Maintenance of the access connection shall include regular cleaning, comprehensive preventive maintenance, corrective maintenance i.e. repair of breakdown and defects and replacement of equipment.

5.3.2.3 The Authority reserves the right to enter and carry out periodic checks on the maintenance of the access connection to ensure that a reasonable standard is achieved.

5.3.2.4 The Authority reserves the right to request for any cleaning, repair and replacement by the Developer if so required.

5.3.2.5 The Authority reserves the right to enter and carry out minor works and repairs on an urgent basis and to claim from the Developer the cost of such works and repairs.

5.3.3 Closure of Access Connection

5.3.3.1 The Authority reserves the right to require the permanent closure of the access connection upon default by the Developer or subsequent owners,
lessees and management corporation to comply with any operational and maintenance requirement. The Developer shall be responsible for all costs of closing off the access connection to the satisfaction of the Authority.

5.3.4 The Authority reserves the right to place signs relating to the operation of the MRT within the access connection as and when necessary.

5.4 Entrance Grilles/Shutters at Access Connections

5.4.1 Motorized Security Grille

5.4.1 The developer shall also provide motorized security grilles or shutters in the station boundary where there is any connection between the station and the development. This motorized grilles shall also be provided at the station entrances. This is to allow the station to be closed after operation hours and for security reasons. The design of the security grilles shall meet LTA specifications. The motorized security grille shall be linked to the station integrated supervisory control system. It shall also be designed such that it can be remotely operated at the passenger service centre in the station. The shutter shall be located within the MRT station boundary and handed over to the LTA and railway Operator upon completion for their control and maintenance. The Developer shall design, provide and install all necessary equipments and accessories, cable, conduits and their supports, update of existing hardware and software in the station and other associated works required.

5.4.2 Lockset of all doors, grilles and shutters which are to be handed to the Operator shall be provided with key cylinder compatible to those used in the station.

5.4.3 Access keys to the grilles/shutters provided at all connections/links to the station shall be handed over to and kept by the Authority before the opening of the access connection to the public.

5.4.4 The shutter shall be kept shut during non-operational hours of the access connection.

5.4.5 The Authority reserves the right to keep the shutter closed as and when necessary.

5.4.6 The access connection and its connection to the street shall be made available to all commuters at all times within the operational hours of the railway.

5.5 Operational Constraints

5.5.1 The Developer shall provide, maintain and clean both during the construction and on completion of the works, all railway operational
facilities within the development site to ensure the smooth and safe operation of the MRT system.

5.6 Restricted Working Hours and Permit to Work

5.6.1 The Developer shall note that any work that affect the railway operation can only be carried out during the time where the railway is not in operation. This is generally from 0100 hrs to 0500 hrs but may be subject to change from time to time. The Developer shall obtain permit from the Operator to carry out works within the railway premises.

5.7 Details of Future Occupancy Load

5.7.1 The Developer shall provide the projected future occupancy load of the proposed developments so as to facilitate the Authority to provide for operational facilities in future, should the need arise.

5.8 Disturbance and Noise

5.8.1 The Developer shall ensure that construction activities carried in the vicinity of the station do not cause undue inconvenience and discomfort to train passenger or tenants within the station. All reasonable effort shall be made to ensure that these activities do not affect the business of the tenants within the station. Where activities which will generate noise and vibration are required to be carried near the station, these shall be carried out during those periods of the day which will not adversely affect the business activities within the station.

5.8.2 The Developer shall inform the Authority at least four (4) weeks in advance before commencement of any works within the railway premises.

5.9 Advertising

5.9.1 Content and display of advertisements or posters in the access connection shall not detract from the primary function of access connections, i.e. to provide a convenient, smooth and efficient access for commuters from the MRT station to the development and vice versa.

5.9.2 The Authority reserves the right to require the removal of any advertisement/posters of any kind placed in the access connections which the Authority deems undesirable to the primary function of the access connection.

5.10 Temporary Access to Station

5.10.1 If the existing entrance to the station is affected by the construction of the development, the Developer must provide alternative entrance/exit to the
station. The proposal must be submitted to the Authority and the railway Operator for acceptance

5.10.2 The design must meet the following:

a) Approval for these facilities shall be submitted to the building authority, SCDF and other relevant departments for their approval.

b) The new facilities must comply with the requirements of the Standard of Fire Safety in Rapid Transit Systems.

c) The width of the entrance and exits shall not be less than that of the existing entrance.

d) The numbers of escalators, lifts and stairs shall be the same as those provided at the entrance.

e) Lighting (normal and emergency), ventilation, etc meeting the technical requirements shall be provided.

f) Signs to direct members of the public and commuters shall be provided in the station and at prominent location around and near the new alternative entrance/exit.

g) If the entrance/exit is located within the construction site, a protected passage way providing a minimum 2 hour fire separation from the construction shall be provided from the entrance to the exterior.

h) The Developer must obtain TOP and TFP from the relevant authority before the new facilities can be opened for use.

5.11 Access to Existing Facilities after land is sold

5.11.1 The Developer shall permit the railway Operator and their tenants unhindered access to existing facilities in or on the site at all times after they take possession of the land and during construction. These facilities include cooling towers, bin centre, loading and unloading facilities, mechanical and electrical facilities, etc.

5.11.2 The Developer must also ensure that unhindered access for SCDF to the fire fighting and fire safety provisions for the station are provided at all times.
SECTION TWO: TECHNICAL REQUIREMENTS FOR THE URA SALE SITE AT OUTRAM PARK (NORTH EAST LINE) MRT STATIONS AT NEW BRIDGE ROAD/EU TONG STREET/OUTRAM ROAD/CANTONMENT ROAD/BUKIT PASOH ROAD.

1 GENERAL

1.1 Scope

1.1.1 This part of the document covers the specific requirements and constraints that shall be considered in the design and construction of the development on the plot of land bounded by New Bridge Road, Cantonment Road and Bukit Pasoh Road adjacent to Northeast Line Outram Park Station and shall be read in conjunction with General Requirements (Section One).

The conditions, requirements and information given in this Section are based on data available at the time of compiling the document and are given without prejudice to any changes that may subsequently occur.

1.1.2 The NEL Outram Park Station is located underneath New Bridge Road and Eu Tong Sen Street. The station is on the Northeast Line (NEL) route of the MRT system. It is linked by bored tunnels to Harbourfront Station and Chinatown Station.

1.1.3 Entrance 4 of the MRT station is located in the development site. Provisions at Entrance 4 were made during construction of the MRT station for future development at the site.

1.1.4 As the site falls within the railway protection and safety zones of both Northeast Line and East-West Line rapid transit systems, the development and building works must meet the requirements in the Code of Practice for Railway Protection and the relevant codes. The construction of the future development above and/or adjacent to the rapid transit systems must not adversely affect the structural integrity of the structures and compromise the safe operation of the railway. The safety and convenience of the traveling public shall be protected at all times in the design and construction of the development without any service disruption and affect the quality of service level. The developer shall bear all works and provisions that are needed to be carried out in conjunction with the development and for interfacing with the rapid transit system as well as cost of services rendered by the Operator.
1.1.5 The developer shall liaise with LTA and seek LTA’s approval to install proposed deep foundation in the vicinity of the East-West Line rapid transit system tunnels.

1.1.6 A future underground infrastructure will be constructed in the vicinity of the NEL MRT Station Entrance 4. This infrastructure is located within the shaded area shown on Sketch A1. The developer shall liaise with LTA and seek LTA’s approval to install additional deep foundation in the shaded area. The design of the future development shall take into consideration the effects of the construction and operation of the underground infrastructure. The building structure including foundation, finishes and any fixtures and equipments of the proposed development shall be designed and constructed taking into account the total and differential settlements that could be caused by the construction of the underground infrastructure.

1.1.7 The Developer shall carry out his own investigation and land survey to ascertain the accuracy of the information relating to the station, as the LTA cannot warrant the accuracy of the information provided. The Developer is advised to consult LTA if he finds any discrepancy or require any clarifications. In this document, the word "Authority" refers to LTA.

1.2 Future Development

1.2.1 Provisions have been made during the design and construction of NEL Outram Park Station Entrance 4 to support a future development and for direct underground connection to future development adjoining the station in order to maximise land use above and adjacent to the station. The station walls are designed and constructed with knock out panel as required by the URA during the planning of the station.

1.2.2 A series of knock-out panels have been provided in the station for the future development to connect to the station. A wide commuter corridor has been created within the station structure to separate the station from the development construction site in order to ensure that construction works adjacent to the station do not affect the operation of the station. Nevertheless, permit to work has to be obtained from the Operator/LTA prior to knocking out of these panels. These works must be carried out from the development site, safe and must not disrupt activities in the station, lower the service standard and operation of the rapid transit system.

1.2.3 The required Provisions and Information for Future Development is
prepared based on the estimated end product of the base structure for future development. The base structures viz. the foundation system for the future development is analysed and designed for the column loads given by URA. The loading provisions at Entrance 4 however have been changed due to accommodate construction of a underground infrastructure. The main body of this document is divided into four parts viz. Architectural, M&E, Structural and Construction issues. Essentially this report was prepared on the guidelines provided at the beginning of the project for future development. All the relevant drawings developed for the future developer are included in this document.

1.2.4 The developer shall comply with the requirements drawn up by LTA, and the Code of Practice for Railway Protection, Rapid Transit Systems (Development and Building Works in Railway Corridor and Railway Protection Zone) Regulations and Guide to Carrying Out Restricted Activities within Railway Protection and Safety Zones to protect the integrity and safety of the rapid transit systems.

1.2.5 The developer shall comply with the rapid transit systems operators rules and regulations when working in, on or near the railway system. The developer shall comply with all current rules and regulations including application for modification or change request required for any alteration to the rapid transit systems.

1.2.6 Compliance with these LTA’s requirement does not preclude the developer from having to obtain full clearance from Development and Building Control Department (DBC), LTA for his proposal. Developer shall submit plans and the required documents for release of planning and building plan approval to DBC for clearance.

1.2.7 The developer shall prepare and submit plans of the proposed development to Development and Building Control Department (DBC), LTA for Building Plan approval under the Rapid Transit Systems (Development and Building Works In Railway Corridor and Railway Protection Zone) Regulations.

1.2.8 The developer shall prepare and submit building plans in accordance with the Building Control Act, Standard for Fire Safety in Rapid Transit Systems and all other relevant authorities such as Civil Defence Shelter Bureau, etc for additions and alterations works to the rapid transit systems arising from the development work.

1.3 Certified Plan of NEL Outram Park Station
1.3.1 The lot No. of the station is TS22-80001P. Certified plans (CP38314 and CP38315) showing the station subterranean boundary are enclosed for reference. LTA will create statutory rights under Section 6 Rapid Transit Systems Act for Entrance 4 of the station and other rapid transit systems facilities in the development site.

2 ARCHITECTURAL

2.1 General

2.1.1 This section is intended to highlight to the developer the primary purpose of the station as a facility for the movement of people and access route must not be compromised. The prime considerations of pedestrian movement in rapid transit system station design are the provision for both clarity and safety, with spaces organised for maximum efficiency and smooth passenger flow. These issues should be fully catered for in the design and configuration of spaces in the interface of their development.

2.1.2 The areas at the station Entrance 4 are provided with handicapped ramp, pedestrian walkway, external lighting and landscaped with turfing and plants. The area is dominated by the above ground entrance structures and ventilation ducts. These are shown in plan A/710/OTP/ALP/0140.

2.2 Knock-out Panel

2.2.1 A “knock-out” panel has been provided at the subway level of Entrance 4 of the station for the future development to connect to the station. The developer is required to connect the development to the station entrance at this knock-out panel. The overall size of the knock-out panel is 4m (width) by 3.4m (height), which is the maximum possible within the structural constraints. Internal wall panelling has been designed so that it is easily demountable at the knock-out panel opening. Trimming of the opening and making good the area will be necessary. The wall is cladded with VE Panels. Sketches on the details are enclosed in the document for easy reference.

2.2.2 The knock-out panel is designed to be removed if required or replaced by permanent boundary walls. The Developer shall liaise and work with LTA on modification of the station to accommodate the development. The Developer shall remove the knock-out panel, if necessary and interface the development with the station. Where permanent walls are required to be erected at the interface, fire separation meeting Fire Code shall be provided. This shall be carried out at Developer’s costs. The
Developer shall plan and design his development butting against the permanent boundary walls subject to approval from the LTA.

2.2.3 Circulation space at the interface connecting the development and the station shall be provided with minimum 2 hours automatic fire-rated shutters in compliance with Fire Code and Code of Practice for Railway Protection for activation and monitoring the status of the shutters at the integrated supervisor control system of the rapid transit system. The Developer shall engage Fire Safety Engineers to carry out fire safety design at the interface to ensure life safety for station and development in the event of fire emergency. This may involve using performance-based fire safety engineering approach. The Fire Safety Engineers shall submit the fire safety design to Fire Safety & Shelter Department (FSSD) for approval. The Fire Safety Engineer shall seek consultation with FSSD to agree on the design objectives, performance criteria and design fire scenarios. The design fire scenarios shall include fire scenarios in the development and station. The fire safety design in the interface boundary between the station and development shall be further enhanced when the proposed mitigation measures are approved by FSSD.

2.2.4 If the future connection is not air-conditioned, glass doors shall be provided to prevent leakage of the station’s conditioned air. Fresh air is also drawn into the station through the station entrance in the event of station and tunnel fire. Design of the doors which enclose the entrance must take this into account so that the doors can be automatically opened in fire mode. Foul air must also not be drawn into the station from the development. The Developer shall submit his proposals and design to LTA for acceptance and approval.

2.2.5 The developer shall provide barrier free access including lifts in the development for the physically handicapped to the knock-out panel located at Entrance 4. The route from this lift in the development to the station entrance shall be direct and visually obvious to the public both below and above ground. This area and route shall remain opened during train operation hours.

2.3 Integration of Entrance 4

2.3.1 There are future column loadings and piles provided in and around Entrance 4 of the station. These have been integrated into station architecture so that the future development can bear down on these load points without needing to disturb the station interiors. The above ground station entrance structures have been designed as light weight and demountable, for expediting and facilitating demounting with
2.3.2 This entrance serves as one of the escape routes out the station. There are time constraints to escape from platform level out to a point of safety through Entrance 4 which is defined in the requirements of the Standard for Fire Safety in Rapid Transit Systems (SFSRTS). This entrance including the staircases and escalators shall not be removed or relocated in planning the layout of the development.

2.3.3 During future construction, the entrance must be kept clear at all times as it serves as one of the escape routes out the station, and any temporary structures over the entrance must be 2-hours fire rated. Furthermore, there are time constraints to escape from platform level out to a point of safety through Entrance 4 which is defined in the requirements of the Standard for Fire Safety in Rapid Transit Systems (SFSRTS). Any future extensions of the roof covering from what is shown in the drawing ALP/140 may affect the escape times. This must be checked by Qualified Person so that it meets SFSRTS requirements. The design and layout of the future development shall also not compromise the escape route of the station.

2.3.4 Entrance 4 and the subway area are mechanically ventilated. Ventilation ducts for fresh air supply and exhaust run from the underground part of the entrance to duct shafts at ground level. These will be affected when the entrance is incorporated into the future development.

2.3.5 A minimum separation distance shall be kept between the building line of the future development and the discharge for the exhaust and intake duct shafts to prevent entry of smoke which will be generated when the station is in operation during a fire into the development. An engineering analysis shall be carried out by a suitably qualified Professional Engineer (PE) for the development to determine the safe distance required.

2.3.6 A handicapped ramp is provided for easy access to the station from the bus stop. This must not be removed unless an alternative is provided.

2.3.7 This entrance of the station has security grilles and is monitored with CCTV. As the traffic flow through this entrance is expected to be high, escalators and staircases are provided for convenience of commuters. Two escalators and a staircase are provided for direct access to the subway of the concourse level from the ground level.
2.3.8 The external and internal finishes of this entrance are of a quality compatible to the high public profile of the station. The floor of the station is paved with granite tiles, ceiling and wall are designed to LTA Design Criteria & Specifications. Where these are affected the Developer must replace them with materials of equivalent quality meeting LTA specification.

2.3.9 As the entrance to the station is fully enclosed by the roof, walls and security grilles, fire protection services and environmental control services are provided. If the entrance enclosure is removed, the incorporation of the entrance into the future development shall take into consideration this constraint and not compromise station security, safety, ventilation and environmental control system and fire protection systems. A fire separation of at least 2 hours shall be provided between the entrance area and the development.

2.3.10 In integrating the entrance into the development, lighting, public address system, CCTV coverage, security grills, fire protection and safety systems, ventilation, etc over the entrance and areas around it must be provided. All proposed finishes and the facilities shall be designed and installed to LTA specifications and other statutory requirements.

2.3.11 In removing the entrance, temporary services shall be provided in place of the permanent ones. Adequate protection around the entrances shall also be made. Temporary provision must also meet LTA criteria and specifications.

2.3.12 Where the Entrance 4 ground structure is removed, each member shall be disconnected and all the parts, panels, etc shall be labeled and properly packed in crates to be delivered to Railway Operator or disposed off by the Developer as directed.

2.3.13 All finishes, facilities and services installed by the Developer within the entrance enclosure shall be tested, commissioned and handed over to the Authority. The defects liability period shall be in accordance with the General Requirements (Section 1).

2.4 Flood Protection

2.4.1 As protection against flooding, the station entrances, vent shaft openings, utilities and services entries are placed at a level of 1.0m higher than the highest recorded flood level in the area subject to Drainage Department approval. The threshold level of any entrances and openings into any development with connection to the
underground station shall not be lower than the threshold level of the station for the flood protection of the rapid transit systems. The Developer shall obtain approval from Drainage Department on the flood protection to the Rapid Transit System.

2.4.2 The Developer shall ensure that the proposed connections to the station from the Development do not constitute a route for flood water into the station in the temporary situation during construction of the Development and its permanent state.

2.4.3 The Developer shall submit a proposal for flood protection and prevention of the station and rapid transit system during construction of the Development to LTA for review and acceptance. The construction works shall be planned and programmed such that there is no possibility of floodwater inundating the station and the rapid transit system at any stages of the work. The Developer shall ensure that the rapid transit system will not be subject to flooding when the knock-out panels at concourse level of the station are removed. A method statement and construction sequence for removal of the knock-out panels shall be submitted to DBC for approval.

2.5 Equipment Removal Routes

2.5.1 Delivery and positioning of equipment and future removal if found necessary have been clearly indicated on the plans, which show that the largest piece, the Generator Set, is deliverable and removable via the mid-station vent shaft. The plans also indicate other routes within the building that need to be negotiated and confirm that there are no inaccessible area.

2.6 Entrance Structures - Dismantle and Removal

2.6.1 The above ground structures at Entrance 4 consist of reinforced concrete structures and lightweight roof. The structural elements for the entrance are constructed of reinforced concrete. The lightweight roof covers the stairs, escalators and approach ramp. This roof is supported on steel columns and also attached to the adjacent concrete vent shafts. The steel columns and lightweight structure are easily dismantled and removed to allow for the construction of the future development. Refer to drawing nos ALP140, ALE/141, ADF/281 and ADF/286. There is also bus stop roof structure supported by steel column at Entrance 4 area. The following scope of works has to be considered during the removal of entrances’ canopies.
2.6.2 Dismantling and handing over of light fittings, CCTV cameras, public address system including speakers, signage and other services that are mounted on the ceiling of these canopies. These services will have to be replaced in accordance with the technical requirements and conditions and integrated into the future development. This could include provisions of additional equipments and associated amenities so that the performance of the system and security of the rapid transit systems are not compromised.

2.6.3 All surfaces defects due to removal and dismantling of the canopies has to be made good.

2.6.4 Relocate the bus stop with associated facilities prior to the commencement of the new development. Submission to all relevant authorities and obtaining their approval are deemed necessary.

2.6.5 A temporary roof with lighting shall be constructed around the Entrance to protect commuters and member of the public and maintain access to the station at all times, after which the lightweight roof and supporting steel structure can be dismantled and removed. The existing M&E equipments have to be protected.

2.6.6 Permanent lightings shall be provided and maintained by the developer over the station entrance where they are incorporated into the development.

2.7 Graphic & Signage

2.7.1 Adequate signage along the route to the rapid transit system station shall be provided and maintained at all times. Any affected existing signage to be relocated must satisfy LTA requirements.

2.7.2 Where the station entrance is to be modified, subject to the approval of LTA, easy recognition of the station entrance by the traveling public must be addressed. Signage such as station name, passenger information display (PID), directional signs, exit signs are to be provided.

2.7.3 Directional signs leading to the rapid transit system station are to be displayed at prominent locations within the development and at the commencement of the link to the station. The locations of these signs are to be proposed by the developer for LTA’s acceptance.
2.7.4 Additional information and signs advising the public on the location of the link to the rapid transit systems are to be displayed within the development where appropriate and at locations to be proposed by the developer.

2.7.5 All rapid transit systems related signs are to be tastefully designed, easily recognisable and legible to the general public. The design of these signs and their proposed locations are to be submitted to LTA for review and acceptance.

2.8 Integration of other entrance’s facilities

2.8.1 The following are the entrances’ facilities to be integrated into the design of the future development:
   a) Ramp
   b) Bus-stop facilities
   c) DB closet

2.9 Integration of entrance finishes with future development finishes

2.9.1 The following are the architectural finishes for all the entrances have to take into consideration in the design of the future development:
   a) Floor - White Star granite with Zimbabwe black border.
   b) Ceiling – Metal baffle ceiling with a 800mm wide Glass Reinforced Gypsum at both end of the baffle ceiling.
   c) Wall – Clad with Vitreous Enamel metal panel at both side of the wall.

3 CIVIL & STRUCTURAL

3.1 General

3.1.1 This chapter provides information the future developer must incorporate to design and construct the future development on and adjacent to the proposed OTP-NELP station structure.

Outram Park Station constructed as part of the North East Line Project (OTP-NELP) is designed to cater for the future development loadings as
described in this report and the accompanying drawings. Piles designed to carry future development loads have also been constructed as part of OTP-NELP.

OTP-NELP is a Civil Defence Shelter and has been designed and constructed to the requirements for such a structure.

Foundations and piles are generally within S2 (highly weathered mudstone) and S4 (completely weathered mudstone) materials.

3.2 Ground Condition

3.2.1 The Developer is to engage geotechnical engineer to verify and confirm the soil profile and parameters for the designs of the new development that may affect the station box during construction.

3.3 Design Considerations for Future Development at Entrance 4

3.3.1 Design Assumptions for Column Load and Foundations

The entrance structure is designed and constructed to support future load. In addition piles were installed near the entrance structure. The indicative location and load are shown in Sketch A1. The information in Sketch A1 supersedes the information on the load provision in the “Development Interface Reports” and drawings. The following assumptions have been made with regard to the design of foundations for future development loadings:

a. There are no horizontal, tension, shear, moment, or any forces other than vertical column load to be transferred to the station structure or pile foundations. To clarify, the station structure and pile foundations are only designed for concentric, vertical, compression loads. The columns are designed to BS8110 clause 3.8.2.4 for minimum eccentricity.

b. No additional load arising from future column eccentricity is taken into account for the design of foundation. Where above ground development load points are eccentric to provide foundation supports as on gridline Cc1/U9A, etc, the future developer must design and provide the load transfer system. This transfer shall be designed, detailed and constructed in such a manner that the resultant force on the provided foundation support is free of moment, shear, tension, and any forces beside concentric vertical load. Please refer to the Sketch A1 and drawing “Development Interface – Future Loading Plan” (W/710/OTP/INT/0801) to identify those load points that are
eccentric to their supports and the drawing “Development Interface Future Development Details and Requirements” (W/710/OTP/INT/0804M) to see the assumed load transfer system to be built by the future developer.

c. The load for piles in the area for a future underground infrastructure indicated in Sketch A1 is indicative only and calculated assuming friction along the pile shaft. The developer shall note that the existing piles and foundation provided on the Entrance 4 and around it will be affected by the construction of the future underground infrastructure. The developer must carried out a comprehensive detailed engineering analysis to check how the construction of the future underground infrastructure will impact on the carrying capacities, settlement, etc of all the piles installed and structures affected if the building is proposed to be supported on these foundations. The developer shall design the development to account for all these effects. Similarly the developer shall design and construct any new foundations and structures to taking into consideration construction of the future underground infrastructure.

d. Where two or more column loads are supported by the station structure with a transfer system of beams, walls, etc. the station structure is analysed and designed with full loadings applied simultaneously. There’s no provision to cater for patterned or unbalanced loadings.

e. For piled foundations, the future developer must provide the pile cap and column above pile cut-off. The total column load given is also assumed to have included the dead weight of these structures. The design of future piles must have a minimum center to center spacing of 3 times the average diameter to the as-built piles so that the designed capacity of piles are not affected.

f. The design assumes the future basements having the location and slab soffit level (details given by URA) of those shown in the Development Interface-Basement and Development Boundary Plan (D/710/OTP/INT/0805D).

g. The cut-off level for piles outside the future development basement boundaries is generally 1900mm below the existing ground level (developer to verify at site). The geotechnical capacity is derived from frictional skin resistance and end bearing resistance. Frictional skin resistance is calculated beginning at the design level. Pile design level is the level from which the pile does not have to be debonded. For piles located within the zone of influence of the existing MRT
structure, the piles are partially debonded using permanent steel casings to the requirements of relevant code. Top of pile is located 1400mm above the cut-off level. Full strength concrete is provided to the top of pile. The 1400mm over-cast is provided for lapping by future developers.

h. Piles located under the basements level indicated by URA are cut-off 1500mm below the basement slab soffit level shown in the Development Interface Basement and Development Boundary Plan (D/710/OTP/INT/0805D). The top of pile is 1400mm above the slab soffit level. Full strength concrete is provided to the top of pile. The 1400mm over-cast is provided for lapping by future developers.

i. Column stumps located outside the basement boundary (details given by URA) are cut-off 1900mm below ground level. The top of the column stump is located 500mm below ground level. The 1400mm over-cast is low strength concrete. The 1400mm over-cast is provided for lapping by future developer. Couplers shall be provided for future reinforcement connection.

j. Future development basements shall be built around transfer beams as per the figures shown on Development Interface Future Development Details and Requirements (D/710/OTP/INT/0805D).

k. Where possible, column stumps are designed assuming grade 45 concrete, short column design, and a low steel percentage. The column stump shapes and sizes are standardized where practical.

l. Some piles adjacent to the station are constructed with close spacing with the existing soldier piles used for station excavation. While these piles have been designed to account for the close proximity, the part of soldier piles or secant walls within three times pile diameter area shall not be extracted, removed or disturbed after the piles have been installed. These existing piles are identified in attached temporary piles layout plan.

m. Ground level in the vicinity of Entrance No. 4 is assumed at RL = 103.20.

n. Development load points along the Road Reserve Line are offset 600mm from the reserve line. This offset assumes a future rectangular column with a 2:1 aspect ratio having the long axis parallel to the reserve line. The future developer may select any size column he wishes, although he is responsible for properly lapping to the stump. The road reserve line may be changed from the time of construction.
The developer must verify the road reserve line and design his structure accordingly. The developer shall note the road reserve line could be revised and must check confirm with LTA.

o. Column stumps located along the road reserve line are set back from the reserve line so that the edge of the future finish aligns with the reserve line. The stumps assume the future column finished dimension perpendicular to the reserve line is 1200mm (100mm of finishes on both sides). Development load points are centered on their respective column stumps. Piles located along the road reserve line are off-set an additional 300mm from the reserve to cater for future pile caps or ground beams built by the developer.

p. The estimated settlement and total settlement for the pile and stumps, where applicable, is tabulated in drawing W/710/OTP/INT/0806. This settlement is only an estimate and done at the level indicated, basically just at the roof of the station structure or top of transfer beam. The future developer shall independently carry out his assessment of the existing station structures and make all provisions, if necessary, to cater for the implications and effect of the total and differential settlement on the future development and station structure.

3.4 Knock-Out Panels for Future Connections

3.4.1 Knock-out panel is provided at the semi-protected walls in Entrance 4. The dimensions of the knock-out panel are 4.0 m wide by 3.4m high. The limits of the panel are marked on the interior surface of the semi-protected structural wall behind the cavity wall so future contractors can properly locate and remove it.

3.4.2 The station structure is designed in such a manner that the removal of the knock-out panel does not affect the structural integrity of the station. Due to civil defence requirements, continuous steel reinforcing is provided throughout the knock-out panel. This reinforcement complies with those requirements established for semi-protected walls. Additional framing reinforcement is provided with sufficient concrete cover around the knock-out panel to provide support after removal of the panel concrete. The location of panels and structural details are shown in the drawings (W/710/OTP/CS/0560 to 0563) and the connection details with future development are shown in drawing W/710/OTP/INT/0804.

3.4.3 The future development connection at the knock-out panel must not transfer moment, shear, axial, or any other force to the station structure.
3.5 Limitations on Excavation and others by Future Developer

3.5.1 In order to prevent the possible damage to station structure and waterproofing system, the future developer must study the provided details in the structure details and waterproofing drawings, verified against the actual details of the as-built and prepare the necessary precautionary and contingency measures.

3.5.2 Future developer should limit the loading on the existing station, entrances and linkway structures to the values given in drawing “Outram Park Station, Entrances and Linkway Roof Loading Plan” (D/710/OTP/CS/7001D). The Developer shall refer to Section 3.3.1 above.

3.6 Limitations on Excavation for future basement and Water Table Draw-Down by Future Developer

3.6.1 The future developer must also limit the extent of water table draw-down on the excavation side so as to not adversely impact short term differential settlement of the station structure.

3.7 Statutory Requirements for the Future Developer’s QP

3.7.1 The interface between the station structure and future development structures shall be designed and constructed in compliance with the Civil Defence requirements issued by Civil Defence Shelter Bureau (CDSB). The Qualified Persons (QPs) shall consult CDSB on the details of the requirements.

a. Submission to be submitted to CDSB shall in general include but not limited to the following:

b. Construction sequence and method of construction.

c. Where connection leads to semi-protected areas, technical requirements would relate mainly to the layout of connection and design and detailing of reinforced concrete members.

d. Where connection leads to the main shelter area directly, additional requirements relating to the provision of suitable protective doors would have to be satisfied.

e. The Qualified Persons (QPs) shall make the necessary submissions to CDSB for their written clearances.

3.8 Piling Location
3.8.1 Piling location (northing & Easting) and etc. are followed according to LTA grid system, where the LTA grid system is different from cadastral survey grid system. The developer must independently carry out a survey and verify their locations.

4 CONSTRUCTION OF FUTURE DEVELOPMENT

4.1 Limits on excavation on Future development

4.1.1 If any excavation deeper than 1.5m is planned, the developer should conduct further structural analysis to confirm that their design and construction methods are appropriate. However, the Limits on the lateral movements of the temporary earth retaining structural system due to future development excavations shall depend on the assumptions of the analysis of the OTP-NEL station and linkway structure.

4.1.2 Generally struts butting against both faces of retaining walls should support the earth retaining structural system. The magnitude of Strut Loads depends upon the allowed lateral movements of the earth retaining structures for the future development. It is necessary to study and determine the method of earth retaining/supporting system at the onset of earth works and temporary works for the maximum depths of excavation that are allowed. The retaining wall system should be sufficiently rigid to take lateral pressure, so that the excavation works could be done with minimal movement to the rapid transit structure. Also, the retaining wall system should be sufficiently toe-in to the ground to prevent reduction of ground water level, toe failure and base heave.

4.1.3 It is the onus of the future developer to do a detailed study and analysis to keep the stability and integrity of the existing structures intact, by considering all the limitations and restrictions on various items of the temporary supporting structural system.

4.1.4 It is suggested that the future developer should consider using pre-compression for the struts supporting the earth retaining structures to nearly balance the anticipated ground forces. Considering this method may reduce wall deflection and therefore reduce the problems of settlement of existing structures.

4.1.5 Drawings D/710/OTP/DCS/9032 showing the left-in place temporary secant pile retaining wall system for the proposed station have been provided for future developer’s reference. The developer should note that this is indicative only and do not include other temporary works.
which are not removed. These could obstruct his construction activities.

4.2 Monitoring Plan

4.2.1 Since there are basements for future development it necessitates the development of monitoring plan for the existing MRT structures. Hence the monitoring plan with certain minimum number of instruments required to monitor and diagnose any unexpected behaviour of the surrounding existing structures, earth retaining structure and the surrounding ground.

4.2.2 In the monitoring plan, following items shall be carefully studied so that the cause-and-effect is clearly recognised

1) Monitoring items
2) Locations
3) The number of monitored points
4) Frequency of monitoring and the timing of measurements

4.2.3 A suitable number of the monitoring points shall be selected. When selecting instruments, it is necessary to consider the scope of monitoring, the precision, and the response time. Preliminary studies must be done prior to actual monitoring with regard to timing of measuring initial values, a method for checking monitored values, and pre-existing impacts. It is recommended that multiple monitoring methods should be adopted so that the reliability of the measured data is easily evaluated.

4.2.4 Vibration and noise levels vary during construction depending on the type of construction machines used and method of construction applied. Therefore, the future developer shall follow the requirements of relevant codes and the rules and regulations of NEA department.

4.2.5 The instrumentation and monitoring regime required for future excavation and construction works is primarily depended upon the future adopted construction methodology. Such activities and associated station/tunnel and ground movements along with water table fluctuation must be strictly monitored and compliance ensured with requirement of relevant code.

4.2.6 Instrument clusters, comprising of settlement markers, inclinometer, water stand pipes, piezometers, prisms, tilt plates, vibration sensors, etc should be installed at close spacing. Frequency of monitoring should be higher during critical activities. In addition, movement and vibration in MRT structures should be monitored with tunnel monitoring system.
4.3 Knock-Out Panels for Future Connections

4.3.1 The removal of knock-out panel affects the existing water proof membrane. Therefore, it is recommended that the future developer's contractor should provide approved water proof membrane according to relevant specification. The existing water proof membrane, details of fixing and specifications are given in the drawing W/710/OTP/INT/0804M for future developer's reference.

4.3.2 The Developer shall also take all necessary precaution to prevent flooding and to ensure that no water is allowed to seep or flow into the station from the construction site at all times during the construction work. The flood protection of the station must not be compromised during construction. In this regard, the developer should only remove the knock-out panel after all the structures of the development are above the required flood protection level.

4.3.3 At the interface, the station structure and the future development structure shall be designed to be able to move vertically independently of each other but at the same time be able to transmit horizontal loads. Suitable bearings or other approved materials shall be provided at the interface to ensure that both vertical movement and horizontal load transfer are achievable. No vertical load transfer is allowed at the joint between the station and the future development. Details of this and all relevant calculations such as estimate of the relative vertical deflection and/or displacement expected and the loading transmitted are to be submitted to the Authority for acceptance.

4.3.4 Along the perimeter of the interface between the station and the future development, an effective waterproofing system taking into account all hydrostatic pressure and relative movement between the structures shall be provided to prevent ingress of water into the station. Details of the waterproofing system shall be submitted to the Authority for acceptance. These shall in general include but not be limited to the following:

a) water bar around the perimeter of the interface.

b) expandable water seal around the perimeter of the interface.

c) waterproofing membrane around the external surface of the joint capable of accommodating any movement expected.

d) surface sealant where required at the joints.
e) surface drainage channel adjacent to the interface in the development to collect any seepage. The floor of the development adjacent to the interface shall be screeded to fall away from the station. The scupper drain along the side of station diaphragm wall at the interface must be protected, properly treated with finishes, etc to the requirements of LTA / Operator.

4.3.5 The Developer shall be responsible for the maintenance and replacement of the waterproofing system at the joint between the development and the station structure.

4.3.6 The Developer shall not carry out construction activities from the station side at the operation and public corridor areas for safety reasons.

The Developer shall take into consideration the following constraints imposed by an operating rapid transit system in developing his design and planning the construction of the Development.

a) Safeguarding the integrity of station structures to ensure safety of the operating railway;

b) Providing adequate and safe space for the movement of commuters at the affected station entrance subway;

4.3.7 The Developer shall ensure that all openings and doors in the protective walls are sealed to prevent unauthorised access to the station operational area during the construction of the development abutting the station. These shall comply with 2-hours fire separation.

4.3.8 Should the Developer proposes or plans to carry out any wet work in the vicinity of these walls, these walls have to be rendered waterproof and appropriately sealed to prevent water from seeping into the station.

4.3.9 The Developer shall ensure that no activities are carried out next to the station which would jeopardise the station operation or create nuisance to the station tenants and passenger such as noise and vibration.

4.4 Waterproofing Detail for Column Stump

4.4.1 The details of fixing and specification of waterproof membrane are given in the drawings W/710/OTP/INT/0804M.
5 ELECTRICAL AND MECHANICAL

5.1 General

5.1.1 NEL Outram Park Station is designed to function as both a Mass Rapid Transit System (MRT) Station and a Civil Defence (CD) Shelter. The areas having the most impact on the electrical and mechanical services and are considered in this report are at Entrance 4. These are notional on Drawing No: L/710/OTP/DC/0001.

5.1.2 The provision of electrical and mechanical equipment for the station and the layout of rooms have been undertaken without information of the proposed surrounding development. There are requirements associated with these provisions that the Developer should be aware of in progressing any development scheme and these are outlined below. As the station functions also as a Civil Defence (CD) Shelter, there are equipment/systems installed and requirements associated for that function. Any modification to these items is subjected to the approval of the Singapore Civil Defence Force (SCDF). In any case, when undertaking his design, the Developer should satisfy all current Statutory and Regulatory requirements and Code of Practices. The design shall be prepared and endorsed by relevant Qualified Persons and acceptance obtained from the Land Transport Authority (LTA).

5.1.3 It is not envisaged that there will be a need to move any of the plant or equipment from the current location however, should the Developer wish to propose such a relocation, this can be considered on receipt of a detailed proposal and justification for such a move. LTA will identify the implications and restrictions of the proposal on a case by case basis, as it is not practical to list out all the considerations of locating each and every element of the station equipment. The consideration of approval of the proposal will include potential disruption to passengers and the transit operation.

5.1.4 The Developer shall be responsible for all costs associated with any modification to the existing electrical or mechanical system on the station which have to be relocated or modified to suit his development proposal whether such a modification is implemented by him or by LTA. This shall include the supply of new equipment to replace or upgrade the existing and any temporary installed equipment as necessary. All new material and equipment proposed shall meet with the requirements and specifications of LTA. All equipment and accessories removed shall be returned to LTA. The Developer should note that material and equipment used in the railway systems are often specific to railways.
specifications and requirements can be more stringent or onerous than those for commercial buildings. For example, cable sheath are low smoke, halogen free, etc.

5.1.5 If the plant and equipment serving the station are relocated, the Developer shall be responsible for all modifications to the equipment, pipework, cabling, etc. where necessary to ensure the proper, safe and efficient operation of the system. The installation programme of replacement services must be agreed with LTA noting that interruptions to the station systems shall be kept to a minimum and passenger services must not be disrupted and inconvenienced in any way. The Developer may consider providing new plants rather than relocating the existing ones if it is found to be more practical and feasible to do so, in agreement with LTA. Should the Developer be allowed to provide and install new equipment or modify existing equipment, then the equipment shall be tested before commissioning to the acceptance of LTA. There is a minimum defect liability period of 12 month on handing over of the plant to LTA.

5.1.6 The Developer shall undertake to ensure that access is available to LTA officers, its agents, licensed Operators and their nominated contractors into the premises of the development at all times for the purpose of gaining access to carry out installation, maintenance or repair works necessary on all equipment and services associated with the Station. This applies during construction and after completion of the development.

5.1.7 The Station must be able to continue to operate throughout the construction and operation of the future development. The time during which services are to be operated are generally governed by the traffic hours. Currently these are defined as 0430 to 0030 but should be re-confirmed with LTA and the operator.

5.1.8 Construction activities in the vicinity of the ventilation shaft may generate dust pollution, smoke and exhaust fumes and other environmental pollution which will affect the performance of the environmental control equipment as well as the fire and smoke detection system of the station. The Developer shall consider the likely incidence of dust and fume production and prepare proposals for its avoidance, reduction and mitigation before commencement of works. This proposal shall be in the form of a written report that shall include details of all effective measures that will be implemented in order to minimise dust pollution, etc. to the station and shall be submitted for the approval of LTA.
5.2 Design Considerations

5.2.1 General
Design considerations are valid at the time of preparation of this document. These specifications are subject to changes as equipment could be upgraded and due to advances in technology and other factors.

5.2.2 Air Conditioning
The public areas of the station are air conditioned to a specification of 24 ±1°C at all times during traffic hours. If any access is provided through the development to the concourse public area, the design has assumed that all areas in the immediate vicinity of the station access to the development are maintained at the same temperature. The developer shall forward proposals to achieve this for LTA’s review and approval.

5.2.3 Ventilation System
The ventilation system provided for the station including entrance staircases and tunnels connect to the surface via ventilation shafts with louvre outlets. There are requirements regarding the pressure drop, noise and spacing of these louvres from other building openings, which shall be considered when planning the adjacent development. Care must also be taken to ensure that there is no short-circuiting of air paths. Smoke or hot gases emitted from an exhaust system must not be recirculated or enter the station and tunnel via the intake ventilation shafts, firemen stairs, emergency stairs and station entrances.

Any proposal to modify or extend a ventilation shaft shall be supported by design calculation that demonstrate the design does not exceed the pressure drop, air flow, noise levels, etc such that the performance of ventilation systems are not compromised.

As fresh air intakes are through the station entrances any future develop to entrance areas that prevents fresh air intake must be supported with a design that provides an alternative and equivalent air flow path.

The Developer shall submit an engineering analysis prepared by a suitably qualified Professional Engineer (PE) for the development to confirm that the above requirements have been fulfilled.

5.2.4 Fire Protection and Detection
The Developer shall liaise with LTA and establish the need to link the fire alarm systems of the station and development. Where a link is required the
Developer shall ensure the fire alarm system of the development is fully compatible with that of the Station.

Breeching inlets and fireman’s intercom shall not be obstructed at any time during and after the construction of the future development. Adequate and ready access for Singapore Civil Defence Force (SCDF) shall be provided and maintained at all times.

5.2.5 Escalators and Lift

At entrance 4 there are escalators and associated control panels mounted at accessible locations on the entrance structures. In the event that the Developer needs to modify the entrance structure, the escalator control panels must remain at their existing locations. The lift/escalators must remain in operation at all times when the Station is operational.

5.2.6 Electrical Distribution System

As part of the electrical distribution system for the Station, there are distribution boards (DB) in cabinets located at the Entrance and station. The Developer shall ensure that works are carried out without any disruption to the electrical system of the Station.

5.2.7 Smoke Extract System

Smoke detectors and smoke vent system are provided in the entrance. Alternative means of extracting the smoke shall be provided if the smoke vent system is obstructed during the construction of the development or if it is affected by the development. Details of the measures to be provided either temporary or permanent shall be submitted to the Authority for review and acceptance. In any case, the station operation, safety and comfort of commuters shall not be disrupted or compromised.

If the entrance is removed or extended vertically upwards or horizontally, the smoke detectors in the entrance shall be reinstated, if applicable, and a smoke control or smoke extract system shall be provided by the Developer to extract smoke and hot air from the station. The power supply for the smoke control or smoke extract system shall be taken from the station supply.

The smoke extract fan shall be rated to operate with air temperature of 250°C for 2 hours. The fan and duct shall have a minimum of 2 hours fire separation from the future development.
The Developer shall engage a Professional Engineer to carry out an engineering study to determine the extraction rate required in accordance with relevant code. However, the fan capacity should not be lower than 9 air-changes per hour.

The smoke extract fan shall be handed over to Operator and the Developer shall ensure that access to the smoke extract fan is provided to Operator maintenance staff at all times if it is installed within the future development.

5.2.8 Lighting

The minimum lighting level at the station entrance is 450 lux. The lighting circuits are connected to the station supply.

The lighting at entrance connections and future new access shall be consistent with the design of the station and not vary by more than 50 lux from LTA’s design criteria. Such lighting and its power supplies shall be provided and maintained by the Developer. All lighting shall be operational throughout traffic hours when access is provided through the development.

The minimum emergency lighting level is 10 lux. All exit and emergency lights shall be of the self-contained type rated at 2 hours minimum.

5.2.9 Lightning Protection

The building structures such as station entrances, ventilation shafts, etc are protected from lightning strikes. The Developer shall ensure that there is an effective lightning protection system in accordance with local regulations for these structures at all times. Earthing points and test points are also located at entrances and Ventilation shafts. The Developer shall ensure that these are not adversely affected by the Development. If it is necessary to re-locate the earthing pits and conductor tapes, etc, the work must be done in such a manner that will not leave the building exposed to lightning strikes and unprotected.

5.2.10 Electromagnetic Compatibility /Electromagnetic Interference

The Developer shall ensure that all electrical and mechanical systems installed by him within the development have no detrimental effect on
the operation of all LTA systems within the station and railway. If required, he shall carry out all necessary studies, tests and measurements to ascertain it to the satisfaction of LTA.

5.2.11 NEL Operational Radio System

Incorporated in the entrances and station are feeder cables, antenna and associated accessories for the transmission of mobile operational SCDF and public radio communication. The Developer shall ensure that care is taken not to interfere with this system. Radio communication must not be affected during construction and on completion of the development.

5.2.11 Commercial Communications System

Incorporated in the station are feeder cables, antenna and associated accessories for the transmission for mobile telecommunications (cellular system). The Developer shall ensure that care is taken not to interfere with this system. Mobile handphone communication must not be affected during construction and on completion of the development.

5.2.12 Closed Circuit Television (CCTV)

Incorporated within the ceiling are CCTV cameras to supervise the passenger flow at entrance and escalator. In the event that an entrance is altered or new access is added, the Developer shall ensure that the CCTV system is relocated to provide the same or better camera coverage on the supervision of passengers’ flow at these areas in meeting prevailing requirements, to the approval of LTA. The CCTV cameras must remain in operation at all times when the Station entrance is operational.

5.2.13 Passenger Information Display & Public Address System

At the entrance to the Station there are passenger information displays to give passengers early warning of major disruptions and station closure visually. In addition there are Public Address Speakers incorporated into the entrance ceilings. In the event that the entrances are altered or new access is added, the Developer shall ensure that the passenger information display and public address speakers are relocated or added to give similar visibility and acoustic characteristics, to the satisfaction of LTA.
The Developer shall ensure that all public address systems within the development do not interfere with public address systems within the station areas. Proposals for achieving this shall be submitted to LTA for approval.

5.2.14 Utilities Serving the Station

The PUB water main and water meter, incoming Telecom cables, ejector pipes, sewer manholes and inspection chambers are located at ground level near the station. These shall not be disrupted during the construction of the development.

5.2.15 Fire Compartmentation

The design of fire shutter control system (which shall have backup) together with the proposed location of the control panel which should be sited shall be submitted to the Authority for approval before commencement of work. If motor driven fire roller shutter is proposed, the motor shall be connected to the development’s standby generator to enhance its reliability to operate in the event of a fire. Accessible manual facility to lower the shutter upon total failure of power supply shall be provided. This requirement shall be in accordance with Standard for Fire Safety in Rapid Transit System and Code of Practice for Railway Protection.

In the event of a fire in the development, the station staff should be notified via transmission of fire signal to the VDU installed in the station passenger service centre (PSC) and the Integrated Supervisory Control System of the rapid transit system. The Developer shall provide one Fire Summary point, together with its associated cabling and Interface Terminal Board (ITB) to pick up fire signal from the development’s fire alarm system and transmit it through the station’s supervision control system for monitoring at the station's PSC. The Interface Terminal Board shall be located near the roller shutter. Fail-safe design shall be adopted. The Developer should note that this would involve updating of software and hardware for which he must bear the cost.

5.2.16 External and Landscape lighting

For open entrance the ceiling lights shall be maintained by the Developer, power supply for which shall be taken from the development. These light fittings shall be controlled separately to suit the train operation hours. For enclosed entrance (eg. integrated entrance separated from the development by 2 hours fire barrier), the lighting shall be
maintained by Operator with power supply connected to the station’s power distribution panel. Any landscape lightings in Developer’s area shall be powered from the development and maintain by Developer.

If the station beacon signs or totem pole are to be relocated, the cables connecting to the signs are to be properly terminated and new cabling from the distribution board shall be provided to the relocated beacon signs or totem poles.

5.2.17 Fire Protection for Station Entrance

If the entrance roof is removed, the existing sprinklers and associated pipeworks shall be removed and terminated by the Developer. Sprinklers shall be supplied and installed to provide coverage over the station entranceways. The sprinklers shall be connected to the existing sprinkler system within the station.

Sprinklers from the development’s sprinkler system shall be provided to protect the space above the open entrance and the adjacent area. However, for enclosed entrances, the existing sprinklers under the present roof canopies shall be reinstated. The new roof/ceiling should preferably be at the same level or lower than the existing level. If not the design of the station’s sprinkler system shall be checked to ensure that the new height will not affect the sprinkler performance.

5.3 Future Development Interface Report on Drainage, Water Supply & Sanitary Plumbing Systems

5.3.1 Drainage System

At all the Entrances (including the Vent Shaft/ Cooling Tower Enclosure and Tunnel Access Shafts), there are numerous discharge pipes that serve the Station and Tunnel Pump Sumps. They are routed above the escalators/staircases and through the ventilation shafts. In addition, there are surface drains that collect rainwater from the roof of the Entrances and the surrounding site.

All drainage pipes that exit the Station shall terminate in a ‘swan neck’ arrangement that is above the design flood level specified by Drainage Department, PUB for the Site. The Developer shall ensure that such a ‘swan neck’ is maintained for all drainage outlets from the Station and Tunnel. All alteration of the drainage system must take into account the
need for continuous discharge of water from the Station and Tunnel at ALL times.

If the Developer proposes any alteration to the Entrances, the Developer shall at his own expense, design and construct to the satisfaction of LTA, the Operator and ENV an integrated surface water drainage system for the Entrances and the Site. This drainage system shall accommodate all drainage pipes from the station and tunnel, and shall ensure ease of access to and maintenance of these pipes after the completion of the development. The Developer shall also demonstrate with calculations that such alterations will not affect the operation of the Station and Tunnel sump pumps. Any resulting changes necessary to the pumps and/or drainage pipes are to be made at the expense of the Developer to the approval of the Operator, LTA and PUB.

5.3.2 Water Supply

All water supply pipes enter the Station through the Bulk Water Meter Chamber. The sketch showing the 150mm diameter service pipe connecting the bulk meter to the 300m diameter water main located at Outram Road is enclosed. In addition, for Civil Defence Stations, there is an Emergency Water Infill Inlet (EWII) which will serve as an alternate supply source for the station shelter during CD operation. Any alteration due to the development shall safeguard both the continuous water supply to the Station at ALL times and the vehicular and pedestrian access to the EWII.

If the Developer proposes to relocate the bulk meter, the new location shall be to the approval of the Public Utilities Board (PUB), LTA and the Operator. Relocation shall be carried out by a Licensed Plumber at the expense of the Developer and in accordance with applicable PUB water supply regulations.

For CD Stations, changes to the location of the bulk meter and the emergency water infill inlet shall be in accordance with the CD Design Criteria and shall be approved by FSSD, PUB, LTA and the Operator. Any resulting changes necessary to the water supply pipes are to be made at the expense of the Developer.

5.3.3 Sanitary Plumbing System

All vent pipes and discharge pipes ejecting foul water/sewerage from the Station to ENV’s surface sewerage system exit the Station either through
the ventilation shafts or entrances. For CD Stations, these sanitary plumbing discharge pipes are connected to an emergency chamber before they are connected to ENV’s sewer manholes.

Any proposed relocation or alteration of the Sanitary Plumbing System must take into account the need for continuous discharge of foul water/sewerage from the Station at ALL times. The proposed sanitary system shall take account of all pipes from the station, and shall ensure ease of access to and maintenance of these pipes after the completion of the development. For CD stations, any changes to the location of the emergency chamber shall be in accordance with the CD Design Criteria and shall be approved by FSSD, ENV, LTA and the Operator. Any resulting changes necessary to the sanitary/sewerage pipes and chambers are to be made at the expense of the Developer. The Developer shall also demonstrate with calculations that such alterations will not affect the operation of the Station Ejector Pumps.

5.3.4 REFERENCE DRAWINGS

The location and details of the station drainage, water supply and sanitary plumbing systems are shown in the referenced drawings:

- W/710/OTP/PD/7110D – Outram Park Station Sanitary Drainage
- W/710/OTP/PD/7210C – Outram Park Station Drainage
- W/710/OTP/PD/7110C – Outram Park Station Water Supply

5.3.5 Station Earthing Mat System

The drawing D/710/OTP/ELL/7001 has been included in this report to facilitate the future developer to identify the routing of Earthing Mat at Station North end area for future development.