

Railway Protection Code of Practice for the Emirate of Dubai



Railway Protection Code of Practice for the Emirate of Dubai

Tenth Edition

June. 2023

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Director General's Message

The Railway Protection Code of Practice is in line with RTA's vision of safe and smooth transport for all and published by RTA to promote safe practice and ensure safety of railway infrastructure and operation. This document is part of the Roads and Transport Authority's (RTA) initiative to ensure safe, sustainable and reliable rail operation in Dubai.

This document is part of the legislation framework of Railway in the Emirate of Dubai. The Railway Protection Code of Practice applies to all Railways and Railway Infrastructure in the Emirate of Dubai under the jurisdiction of the RTA.

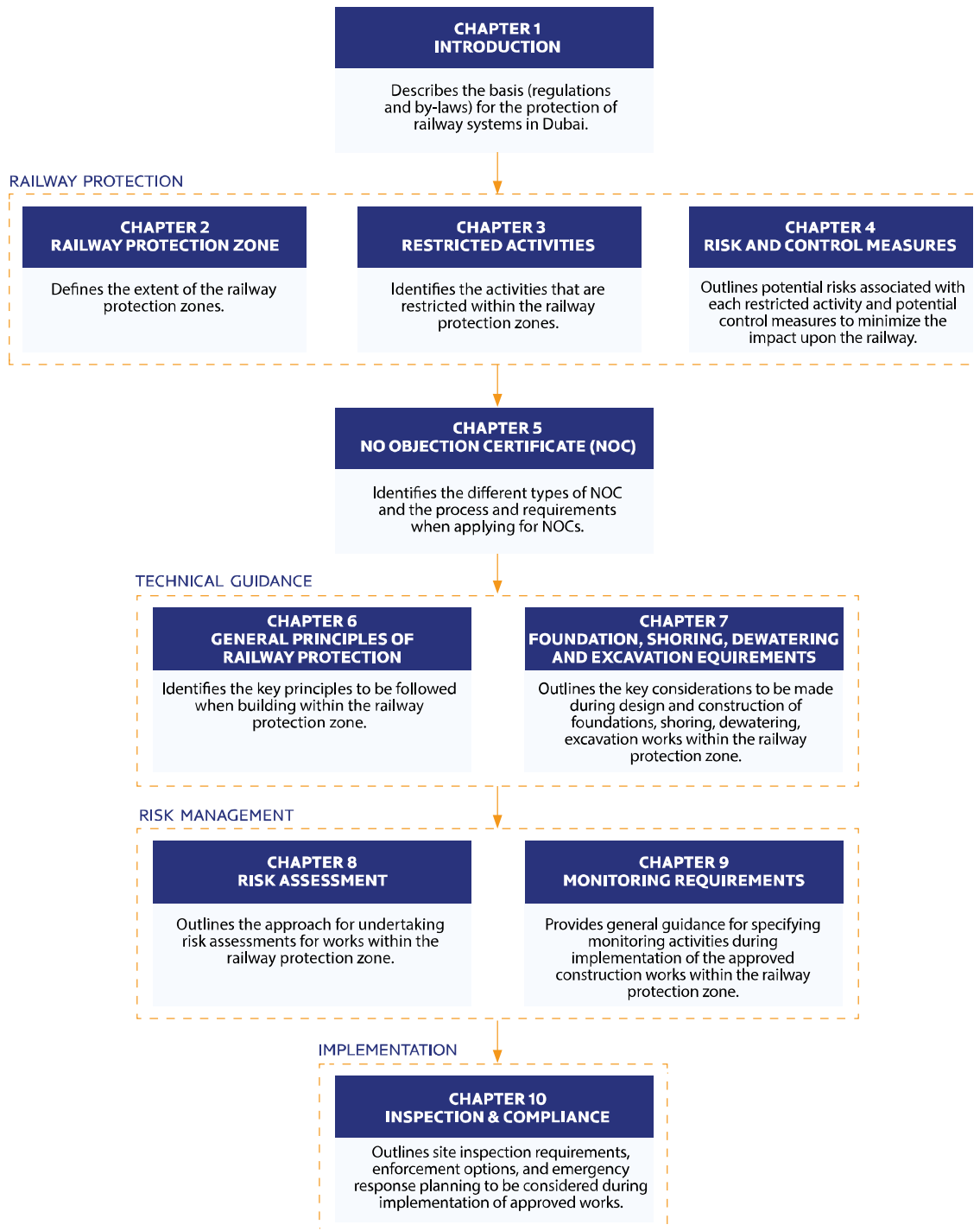
This code identifies the Railway Protection Zone (RPZ) and Restricted Activities within the RPZ. The procedures to be followed prior to carrying out any Restricted Activity or other construction related activities planned by any Government, Public or Private Entities in the vicinity of Railway Infrastructure is outlined in this document.

With the development of new Railway Infrastructure in Dubai, Railways have become the major mass transportation mode in Dubai, forming an integral part of the public transport system and attracting a significant number of passengers.

His Excellency
Mattar Al Tayer

Director General and Chairman of the
Board of Executive Directors.

Code of Practice Structure



Abbreviations

ALARP	As Low As Reasonably Practicable
BRE	Building Research Establishment
BS	British Standard
CCTV	Closed-Circuit Television
CIMP	Change Impact and Management Plan
CoP	Code of Practice
DANS	The Dubai Air Navigation Services Corporation
DCAA	The Dubai Civil Aviation Authority
DCD	Dubai Civil Defence
DEWA	Dubai Electricity and Water Authority
DM	Dubai Municipality
DTMFZ	Dubai Technology and Media Free Zone
EMC	Electromagnetic Compatibility
E-NOC	Electronic NOC
GIS	Geographic Information System
HSE	Health, Safety and Environment
IAC	Infrastructure Access Controller
JAFZA	Jebel Ali Free Zone Authority
LRSA	Low Risk Site Activity
MEP	Mechanical, Electrical and Plumbing
NDM	Non-Destructive Method
NDRC	Non-Destructive Road Crossing
NOC	No Objection Certificate
NFPA	National Fire Protection Association
PCFC	Ports, Customs and Free zone Corporation (Trakhees)
PIC	Person In Charge
PPE	Personal Protective Equipment
PPV	Peak Particle Velocity
PTE	Permit to Enter

PTW	Permit to Work
RA	Restricted Activity
RAMS	Reliability, Availability, Maintainability and Safety
REIS	Rail Engineering & Information Section
RFI	Request For Information
RPE	Responsible Project Engineer
RPZ	Railway Protection Zone
RROW	Rail Right Of Way
RTA	Roads and Transport Authority
SRRPD	Safety & Risk Regulation and Planning Department
TBM	Tunnel Boring Machine
TRA	Traffic and Roads Agency of the RTA
UAE	United Arab Emirates
UAV	Unmanned Aerial Vehicle
VCB	Vehicle Containment Barrier

Definitions

TERM	DEFINITION
ACCIDENT	The unexpected and undesirable occurrence directly associated with Railway operations and Railway Infrastructure, which results or may result in human casualties or damage to property.
AGENCY	Rail Agency of the body.
APPLICANT	Any party applying for a No Objection Certificate.
AUTHORITY	Roads and Transport Authority (RTA).
BATTERING	Sloping the exposed face of an excavation wall back either at a uniform angle, or stepping it back uniformly.
BENCHING	Method of preventing collapse of excavation walls by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.
BRANCH LINE	The area of Railway Infrastructure and the Railway Vehicles operating in it that is managed, owned or controlled by a Person other than the one who operates the Railway line connected to the Branch Line.
BUNDING	Embankment or wall which may form part or all of the perimeter of a compound within which sits a storage tank. The bund is designed to contain any spill resulting from a breach of the tank.
BY-LAW	The current Administrative Decision regarding Issuing, Implementation and Regulation of Order No. 1/2017 Regulating Railways in the Emirate of Dubai.
CHAIRMAN OF THE BOARD OF DIRECTORS	Chairman of the Board and CEO of RTA.
COMPETENT AUTHORITY	The Department of Economic Development or any other entity authorised to issue trade licences in the Emirate or in the UAE.
CONDITION SURVEY	Survey to assess the existing condition of Railway Infrastructure. Typically carried out before the Restricted Activity (pre-construction/baseline) and after completion of Restricted Activity (post-construction)
CONSTRUCTION	The erection of any new buildings or structures, or the variations to the Infrastructure facilities or Railway Vehicles.
CONSULTANT	A natural or legal person who is offering advice/consultation on engineering, technical, or any other matter related to Railways.
CONTRACTOR	An organization designated by the Owner or the Operator for the purpose of carrying out the works related to Railways, or execution of any work that requires obtaining of No Objection Certificates from the Agency.
CONTROL MEASURES	Provisions to reduce identified risks.
CRITICAL ZONE	A zone within the Railway Protection Zone, which requires more stringent Control Measures than the remainder of the Railway Protection Zone.
EMIRATE	Emirate of Dubai.

TERM	DEFINITION
E-NOC	The electronic NOC application that can be submitted via the online system (https:// noc.rta.ae/RTAeNOC/Webpages/common/login/login.aspx)
FORMWORK	Either temporary or permanent moulds into which concrete or similar materials are poured.
IMPROVEMENT NOTICE	A letter addressed by the Inspector to a Person who is in breach of the provisions of the Resolution or its current Implementing By-law requesting the Person to take the necessary action to remedy that breach within a specific time limit.
INCIDENT	An occurrence which affects or could affect the safety of people or the Railway Infrastructure.
INFRASTRUCTURE	See definition for 'Railway Infrastructure'.
INFORMATION NOC	A document issued by the Agency providing information about the Railway network and Infrastructure.
INSPECTOR	Staff authorized by the Authority to verify the safety of Railway Infrastructure and Railway Vehicles operation, carry out investigations and recommend actions to address situations that may affect the safety of the Railways.
INSTRUMENTATION	Devices installed to measure the impact of the proposed Restricted Activities upon the Railway Infrastructure.
LIFTING OPERATION	An operation concerned with the lifting and lowering of a load which has the potential to have an adverse effect upon the existing Railway system. A load is the item or items being lifted which could include a person or people. A lifting operation may be performed manually or using lifting equipment.
NO OBJECTION CERTIFICATE (NOC)	A document issued by the Agency, authorizing a Person to carry out a Restricted Activity within the RPZ.
OPERATIONS	The operation, movement or cause of movement of Railway Vehicles designed for transportation or for carrying out maintenance, modification works and development of Infrastructure or Railway Vehicles.
OPERATOR	The authorized party for the operation or maintenance of the Railway Infrastructure or Railway Vehicles, or both for the purposes of public transportation.
OWNER	Any public or private company or authority that owns the Infrastructure of the Railway or Railway Vehicles, or both, for the purposes of public transportation.
PERMIT	Written permission issued by the Agency for the construction of Railway Infrastructure, supply of Railway Vehicles and any other works related to the development and maintenance of Railway systems in the Emirates.
PERMIT TO ENTER (PTE)	A written approval granted by the Railway Operator that authorises a person or persons to carry out non-intrusive activities within a specified time frame within the Railway Infrastructure but outside of the Railway track area.
PERMIT TO WORK (PTW)	A written approval granted by the Railway Operator that authorises a person or persons to carry out specific work within a specified time frame within the Railway Infrastructure.
PERSON	A natural Person, or public or private legal Person.
PERSON IN CHARGE (PIC)	A person who is approved by the Operator and has the sufficient training and experience to manage the safety of a workgroup working within a worksite so that others are not unduly affected by the acts or omissions of this workgroup.

TERM	DEFINITION
PREQUALIFICATION NO OBJECTION CERTIFICATE	A document issued by the Agency authorising an organisation to apply to the Competent Authorities to obtain a trade licence to conduct business in relation to Railways.
POSSESSION	A specific area of track(s) under the absolute control of a Person-In-Charge (PIC) for local management and performance of works that may render the track unsafe for the passage of trains or where work requires protection from unauthorised vehicle movements.
PROHIBITION NOTICE	A letter addressed by the Inspector to the Owner, Operator, Contractor or Consultant demanding the suspension of works and implementation of the necessary measures to control potential risks according to the NOC conditions.
RAILWAY	Railway transportation systems designed to transport passengers and goods, guided by specific tracks, designed for the movement of the rails either a single or dual track system or any other direction system, including heavy and light rail, monorail services, tramways or Railways for maintenance or freight terminals.
RAILWAY INFRASTRUCTURE	All establishments, facilities, systems and software necessary to operate Railways and to enable them to work safely, including but not limited to, Railway tracks and associated track structures, service roads, signalling systems, communications systems, rail controlling systems, notices and signs, the electric power supply, electric traction systems and cable corridors, substations, the associated buildings, stations, warehouses, machinery, equipment, structures, utilities, corridors, pass ways, tunnels, bridges, sidewalks, barriers (iron gates), associated works, the work of sanitation, connecting pedestrian bridges, chilled water network and plants and any rail-related construction, assets or work.
RAILWAY PROTECTION CODE OF PRACTICE	The code issued by the Agency which specifies the sites, areas, standards, procedures and requirements for the protection of the Infrastructure in the Railway Protection Zone.
RAILWAY PROTECTION ZONE (RPZ)	The Railway Infrastructure sites and the surrounding areas designated as such by the Agency in the Railway Protection Code of Practice.
RAILWAY TECHNICAL STANDARDS	Technical documents issued, or adopted, by the Agency that can be applied as requirements for any Railway, planned, designed, developed or operated in the Emirate.
RAILWAY VEHICLE	Any vehicle that uses the Infrastructure of the Railway, including locomotives, engines, trains, trams, light inspection vehicles, self-propelled maintenance vehicles, freight wagons or monorail vehicles.
RESOLUTION	The current Resolution (No. 1/2017) Regulating Railways in the Emirate of Dubai.
RESPONSIBLE PROJECT ENGINEER (RPE)	A person appointed by the Applicant who holds responsibility for ensuring that the conditions of the NOC are implemented.
RESTRICTED ACTIVITY	Any activity considered by the Agency to (or have potential to) jeopardise or otherwise adversely affect any Railway, Railway Infrastructure and / or Railway Vehicles and / or pose a threat of risk or interference in any way with any Railway, Railway Infrastructure and / or Railway Vehicles as further described in the current By-laws and / or in the Railway Protection Code of Practice.

TERM	DEFINITION
RISK ASSESSMENT REPORT	A report prepared by the Applicant seeking Railway Protection NOCs identifying potential risks and mitigation measures involved in carrying out any Restricted Activity, development and building proposals within the Railway Protection Zone.
SAFETY	The absence of any risk of harm or damage to the Railway, Railway Vehicles and Infrastructure, that is deemed unacceptable to the Safety Regulation Authority.
SAFETY REGULATION AUTHORITY	Planning and Safety Regulation Department which the RTA established under the Rail Resolution to ensure the safety of all Railways, Railway Infrastructure and Railway Vehicles in the Emirate (as further set out in the Resolutions). Also known as the Safety & Risk Regulation and Planning Department (SRRPD).
SITE ACTIVITY	A Site Activity is a possible physical activity required to perform restricted activity. It is the applicant responsibility to provide detailed information on all site activities required to perform the proposed work/restricted activities specified in the application.
SHORING	A structure such as a metal hydraulic, mechanical, concrete, steel or timber shoring system that supports the sides of an excavation and which is designed to prevent soil movement and collapse.
STRUCTURE GAUGE	The boundary enclosing the clearances required outside the swept envelope to enable the Railway to be operated in safety. The structure gauge includes provision for staff safety, where staff are permitted on the Railway while Railway Vehicles are running.
TRA	Traffic and Roads Agency of the RTA.
TRAMWAY VEHICLE	Any vehicle that uses the Infrastructure of the tramway, including trams, light inspection vehicles and self-propelled maintenance vehicles.
TRIGGER LEVEL	Threshold level for data reading from monitoring instrument.
ZONE OF INFLUENCE	The area over which applied external loads are likely to affect a Railway structure below ground.

1. Introduction

1.1. General

- 1.1.1. This Railway Protection Code of Practice is issued by the Agency to set out the mandatory procedures, conditions and other requirements to comply with the latest Administrative Decision issued by the RTA with regard to the issuing, implementation and Regulation of Executive Council Resolution No. 1/2017 Regulating Railways in the Emirate of Dubai.
- 1.1.2. This Railway Protection Code of Practice provides mandatory requirements for any party who intends to carry out any Restricted Activity or other construction-related activities within the Railway Protection Zone. The Railway Protection Zones are defined in Section 2 and Restricted Activities are defined in Section 3.
- 1.1.3. Any party intending to carry out any Restricted Activities within the Railway Protection Zone is required to obtain permission from the Rail Agency before commencing any work at the site. Permission is provided through issuing a No Objection Certificate (NOC) by the Rail Agency. The NOC process is outlined in Section 5.
- 1.1.4. The Applicant shall take a risk-based approach to carrying out its duties to ensure a safe, sustainable and efficient Railway system in the Emirate.
- 1.1.5. The Railway Protection Code of Practice is published for guidance and does not absolve the Applicant from complying with other local or governmental laws issued for the Emirate of Dubai or the United Arab Emirates.
- 1.1.6. The Rail Agency will not be responsible for any damages, losses including without limitation direct, indirect, special or consequential damage or economic loss arising from any reliance on the information in these guidelines.



Figure 1.1: Dubai Rail Network

1.2. Scope

- 1.2.1. This Railway Protection Code of Practice is applicable only to all Railway lines owned and operated by Roads and Transport Authority Dubai (under planning, under construction or in the operation and maintenance phases) in the Emirate of Dubai unless specified by the Resolutions.
- 1.2.2. This document is applicable to the Dubai Rail Network as shown in Figure 1.1.
- 1.2.3. This Railway Protection Code of Practice outlines the submission procedures and requirements that must be followed to obtain No Objection Certificates (NOCs) for conducting Restricted Activities in any Railway Protection Zone.
- 1.2.4. The Applicant is encouraged to consult with the Agency, as required, to understand the requirements for Railway protection prior to making a formal application for a NOC.

1.3. Associated Documents

- 1.3.1. The associated documents include the current Executive Council Resolution No. (1) of 2017 Regulating Railways in the Emirate of Dubai and any other Resolution or Implementing By-laws associated with the Resolutions.
- 1.3.2. In addition to the Resolutions and requirements as stipulated in this Code, the Applicant is required to check the latest Resolutions issued by the RTA/ Dubai Municipality and other local authorities after the issuance date of this document, and to ensure full compliance with the same.



2. Railway Protection Zone

2.1. General

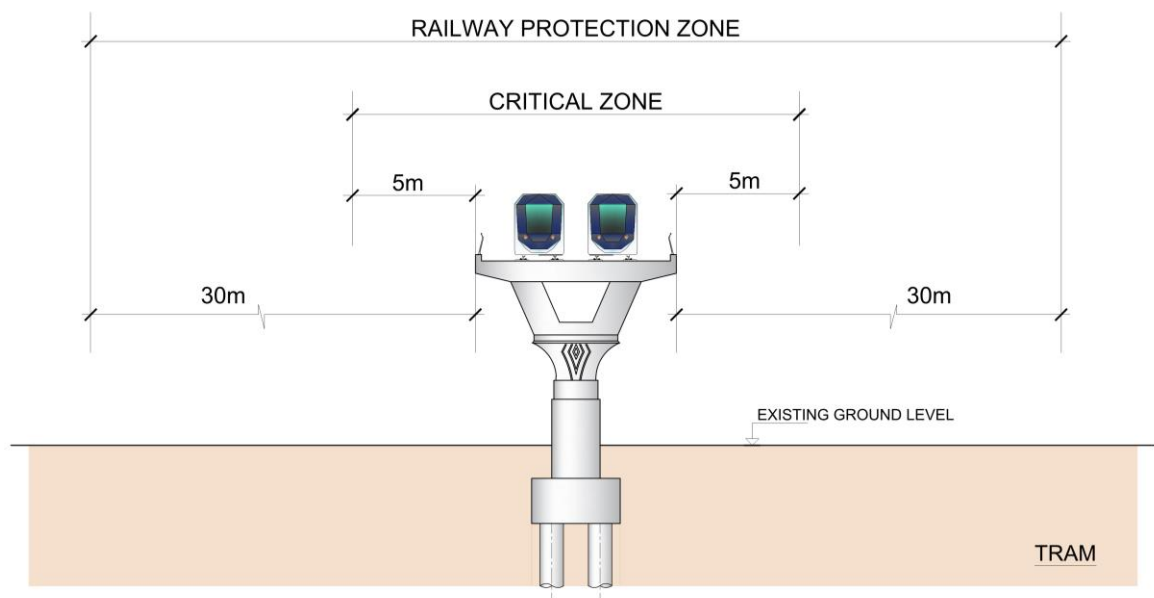
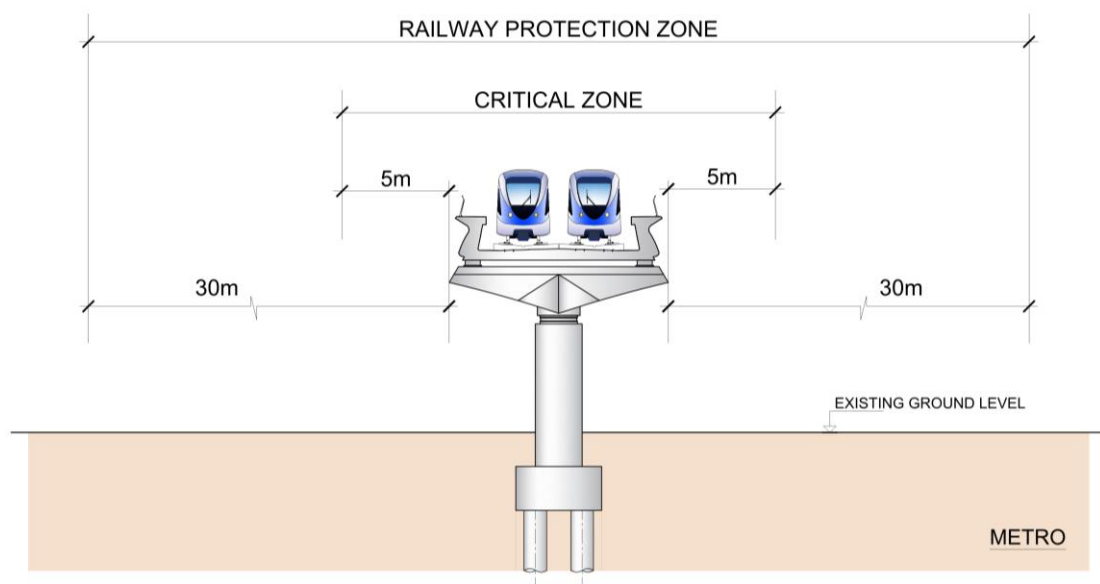
- 2.1.1. The term 'Railway Protection Zone' applies to the zones adjacent to the Railway Infrastructure as defined in Section 2.2 below.
- 2.1.2. In principle, the Railway Protection Zone (RPZ) shall be kept clear of any hazards, disturbances or activities that could give rise to an adverse impact upon the Railway Infrastructure to ensure the safe operation of the Railway and protection of the Railway Infrastructure.
- 2.1.3. All associated risks and mitigation measures arising from any Restricted Activity within the Railway Protection Zone shall be agreed with the Agency before carrying out such activities.
- 2.1.4. The classification of each Railway Protection Zone is based on the shape and function of the Railway Infrastructure and facility.
- 2.1.5. The Railway Protection Zone contains a Critical Zone, which requires more stringent Control Measures than the remainder of the Railway Protection Zone.
- 2.1.6. The Railway Protection Zone is applicable for any Restricted Activity no matter the height above (or depth below) the ground surface at which the Restricted Activity occurs.
- 2.1.7. Maintenance zones to permit maintenance of the Railway Infrastructure, access alongside the line, provision of future services or protection against errant vehicles may exist adjacent to the Railway Infrastructure. Activities in this zone will require additional safeguards.

2.2. The Railway Protection Zones Description and Definition

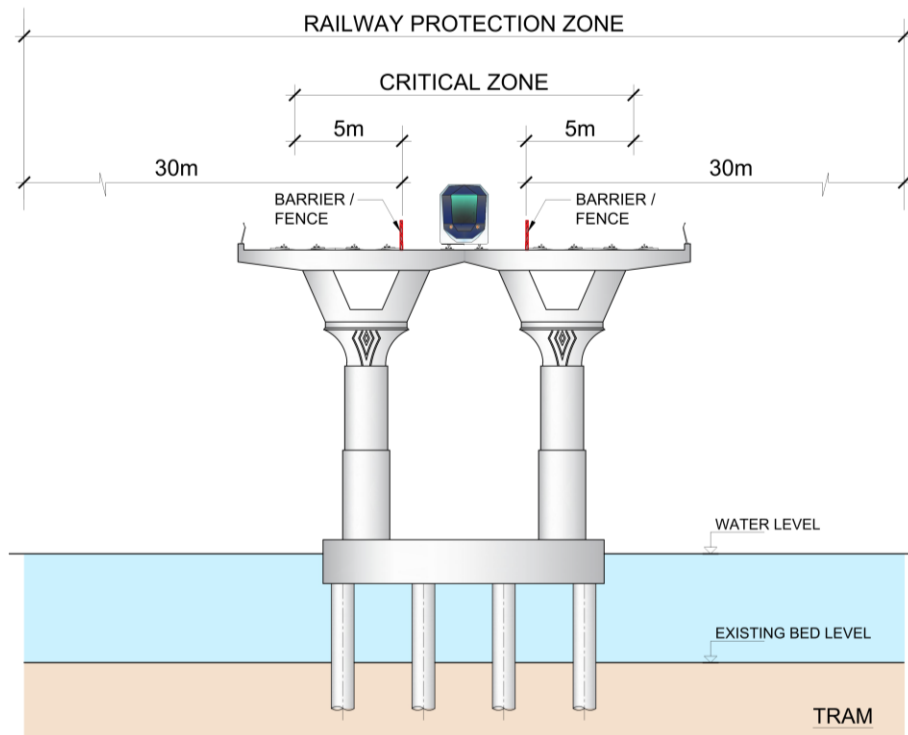
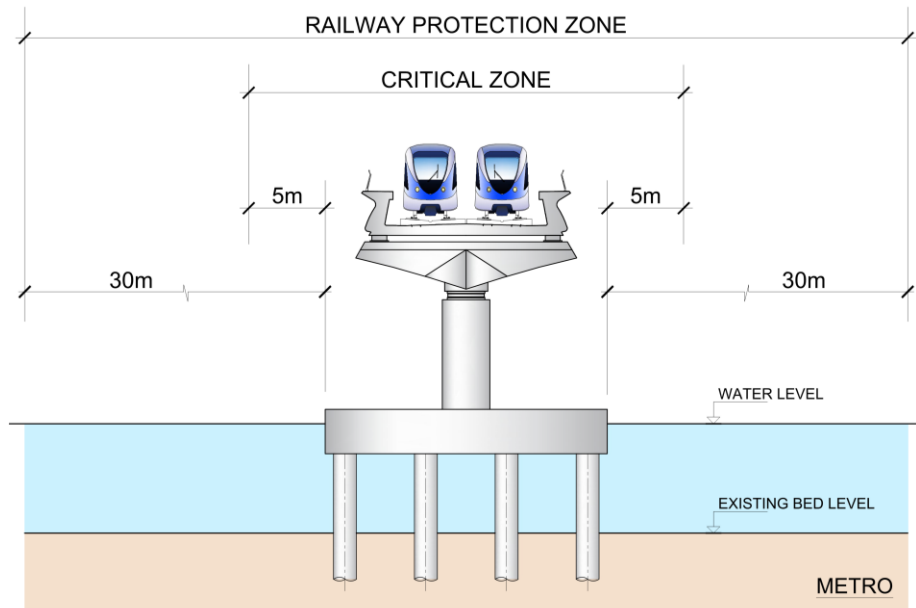
- 2.2.1. The Railway Protection Zones for the Dubai Rail Network are shown in Table 2.1 below.

Table 2.1: Railway Protection Zones Description and Definition

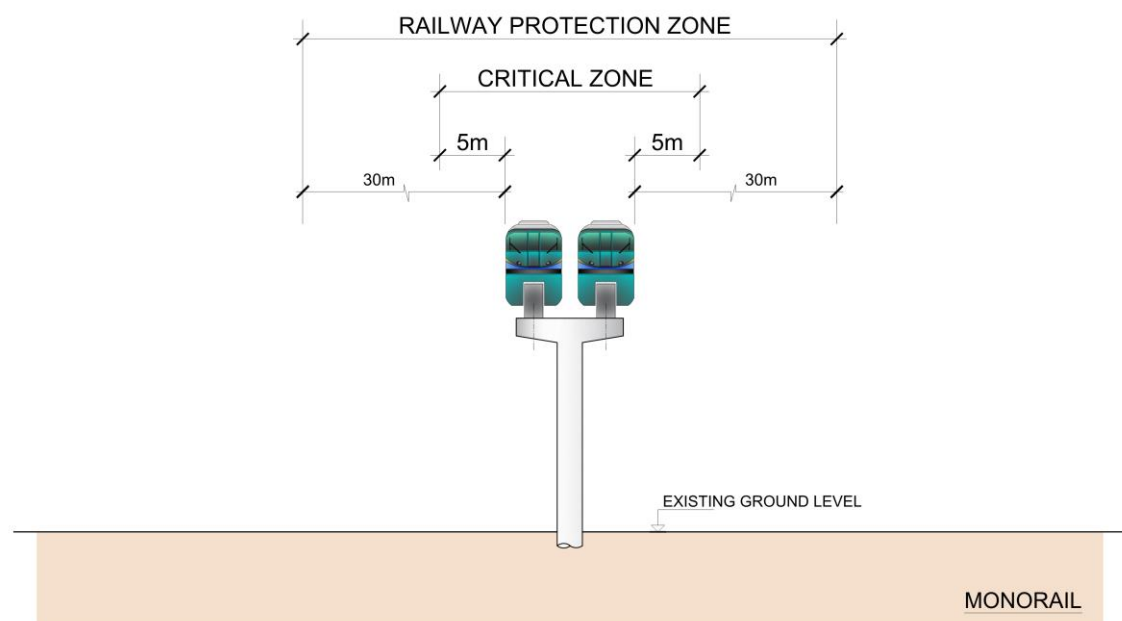
Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-1	Viaduct (Type A)	Zone-1A applies to Railway viaduct sections (Railway located on elevated structures) above ground level. The Railway Protection Zone is defined as 30m measured from the outermost edge of the superstructure, substructure or structure gauge whichever is greater.



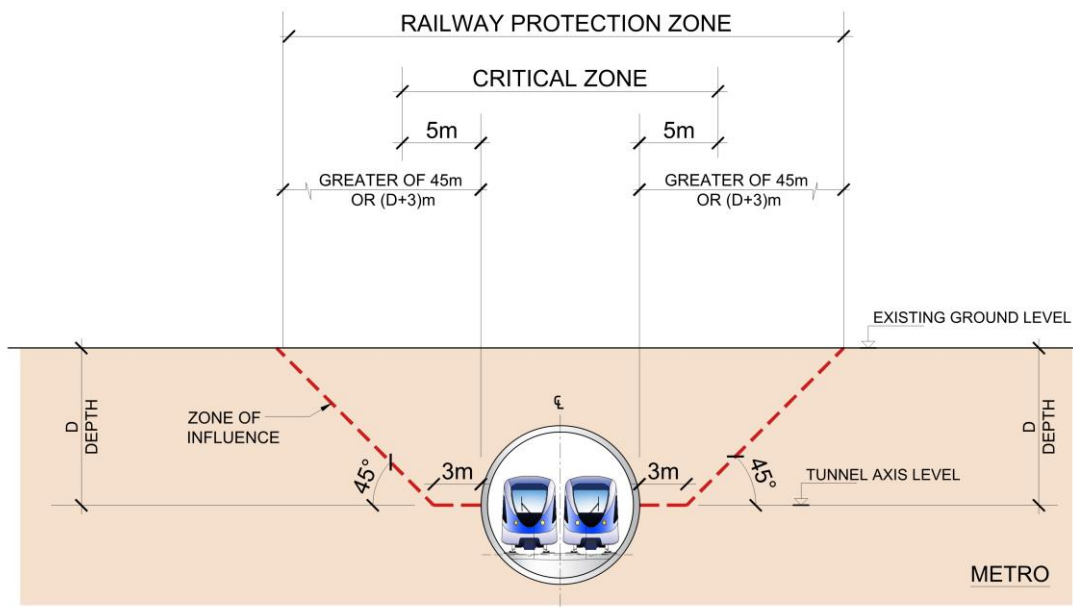
Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-1	Viaduct (Type B)	Zone-1B applies to Railway viaduct sections (Railway located on elevated structures) over water. The Railway Protection Zone is defined as 30m measured from the outermost edge of the superstructure, substructure or structure gauge whichever is greater.



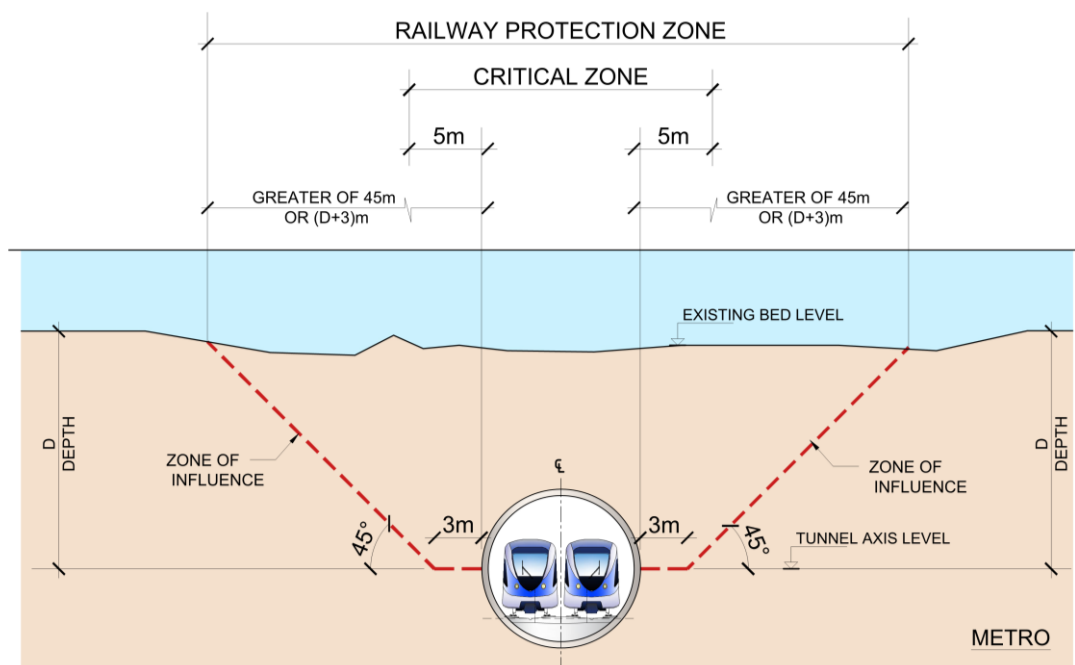
Zone no.	Railway structure sections	Railway Protection Zone
Railway Protection Zone-1	Viaduct (Type C)	Zone-1C applies to elevated monorail guide-ways. The Railway Protection Zone is defined as 30m measured from the outermost edge of the superstructure, substructure or structure gauge whichever is greater.



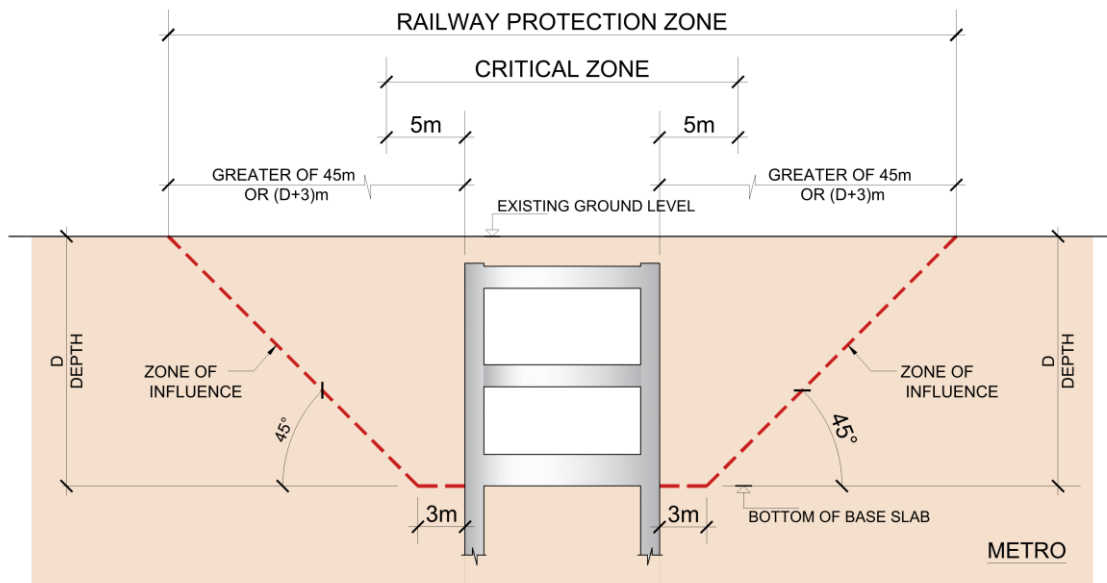
Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-2	Tunnel (Type A)	Zone-2A applies to Railway tunnel sections (Railway guideway located inside tunnel) below ground level. The Railway Protection Zone is defined as the boundary formed by the Zone of Influence or 45m measured from the outermost edge of the external tunnel construction whichever is greater.



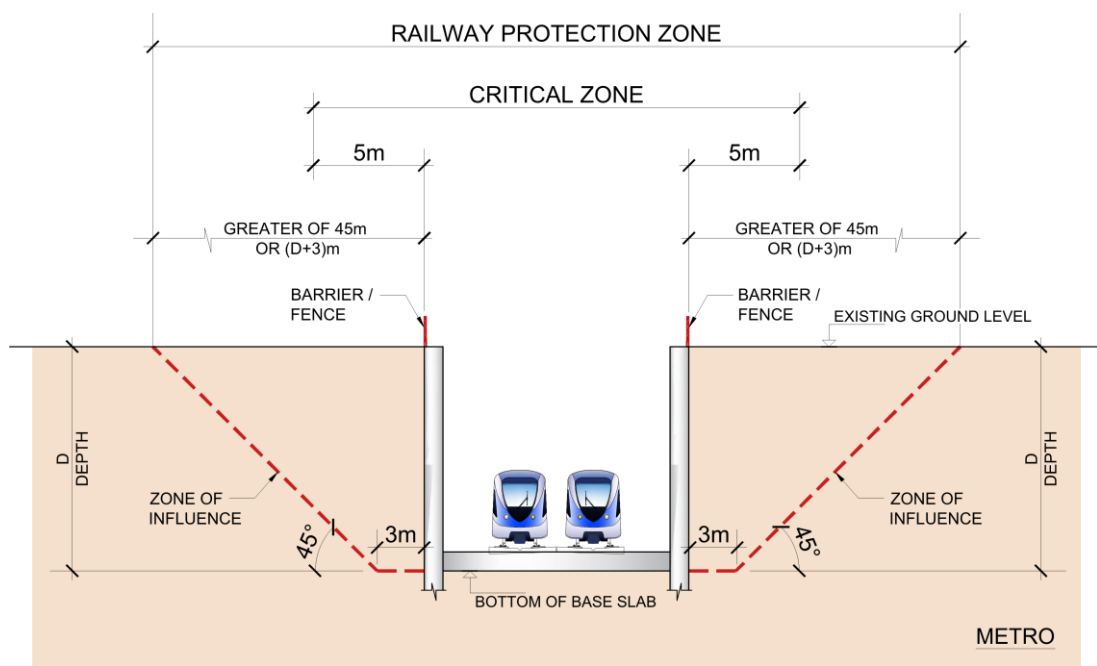
Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-2	Tunnel (Type B)	Zone-2B applies to Railway tunnel sections (Railway guideway located inside tunnel) located under water bodies. The Railway Protection Zone is defined as the boundary formed by the Zone of Influence or 45m measured from the outermost edge of the external tunnel construction whichever is greater.



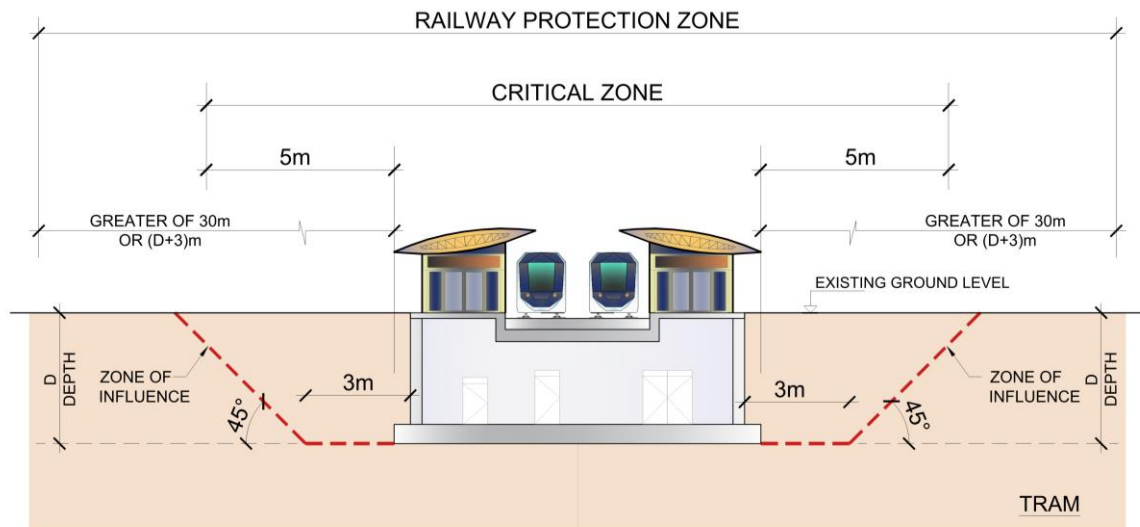
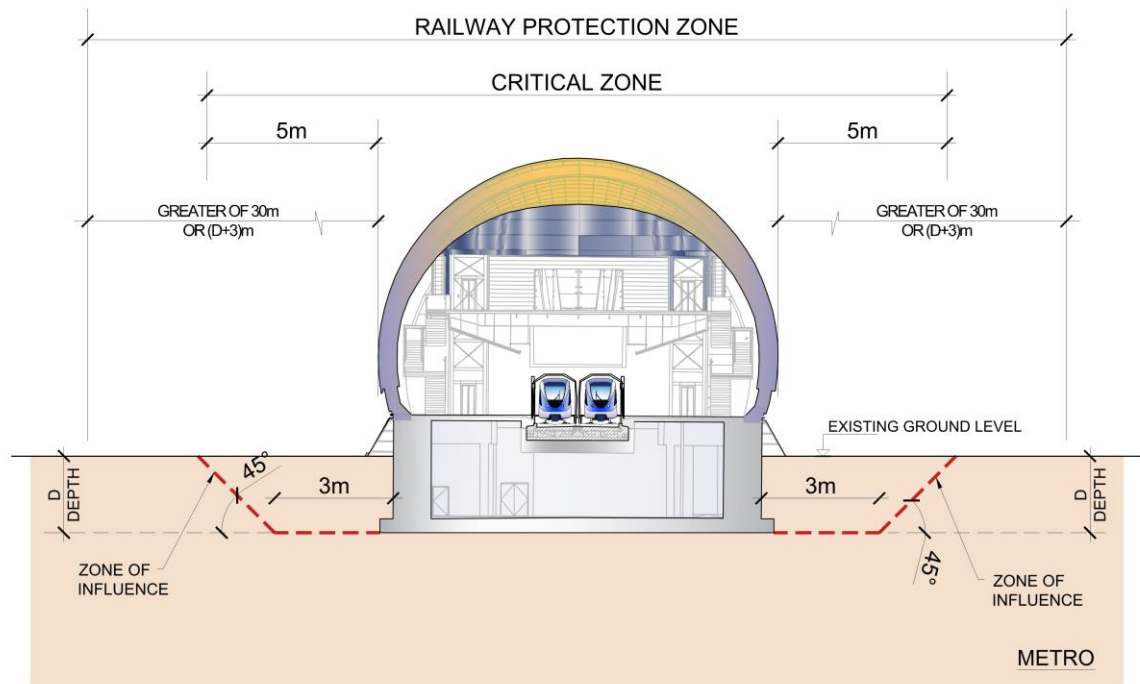
Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-3	Underground Stations (Type A)	Zone-3A applies to underground Railway stations below ground level. The Railway Protection Zone is defined as the boundary formed by the Zone of Influence or 45m measured from the outermost edge of the buried structure whichever is greater.



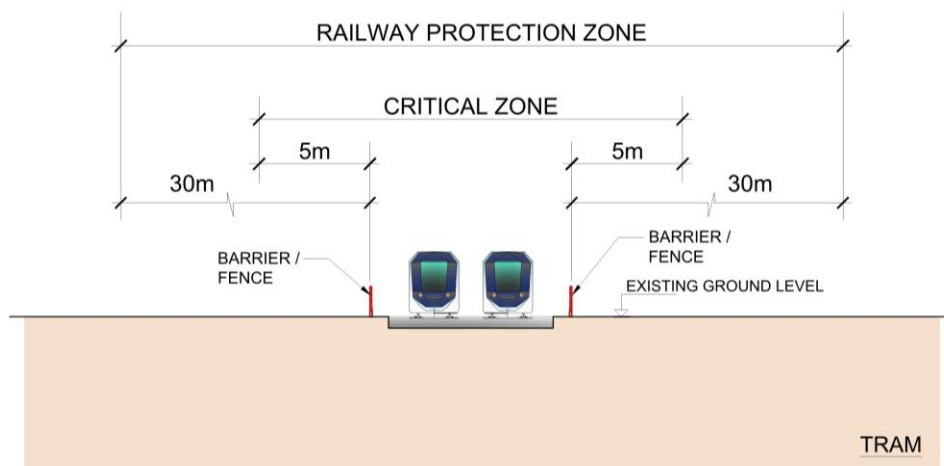
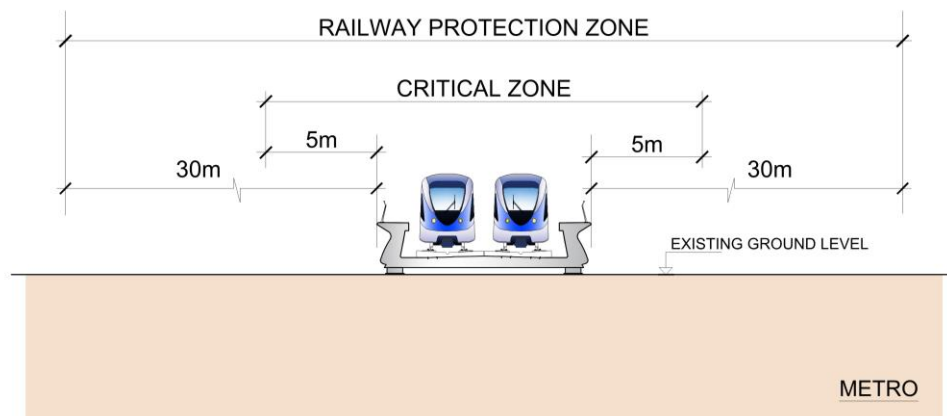
Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-3	Cut & Cover section (Type B)	Zone-3B applies to buried sections (including cut and cover) below ground level. The Railway Protection Zone is defined as the boundary formed by the Zone of Influence or 45m measured from the outermost edge of the buried structure whichever is greater.



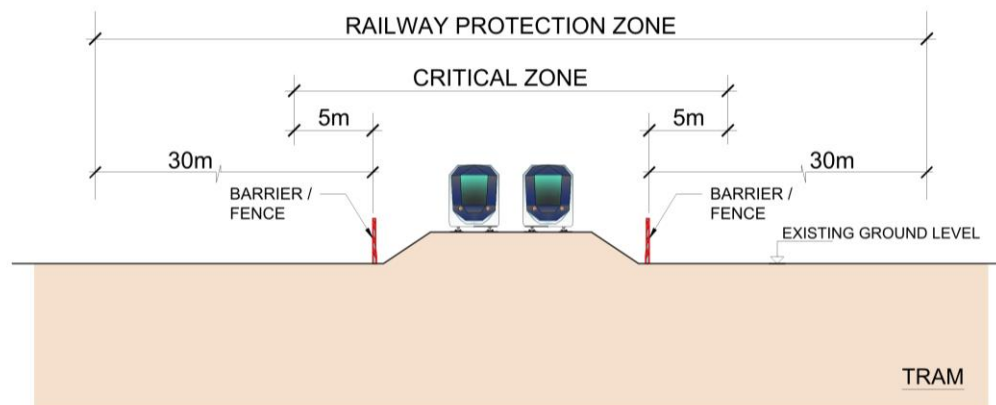
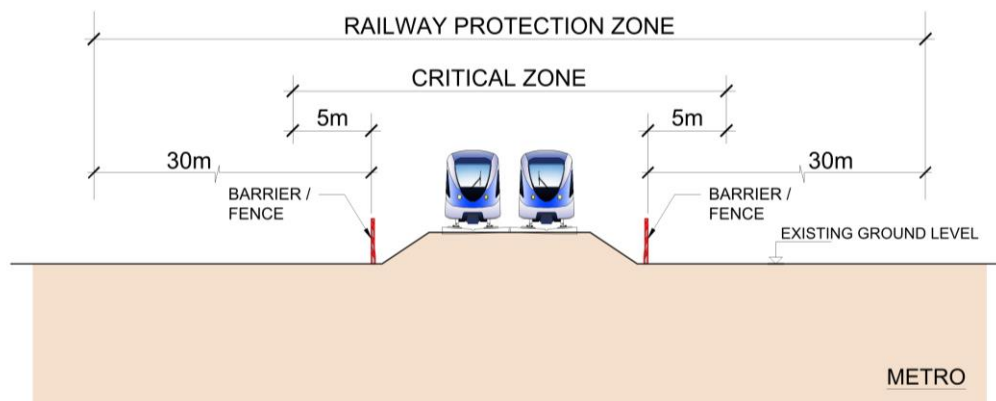
Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-4	At Grade stations	Zone-4 applies to at-grade Railway stations with basements. The Railway Protection Zone is defined as the boundary formed by the Zone of Influence or 30m measured from the outermost edge of the surface or buried structure whichever is greater.



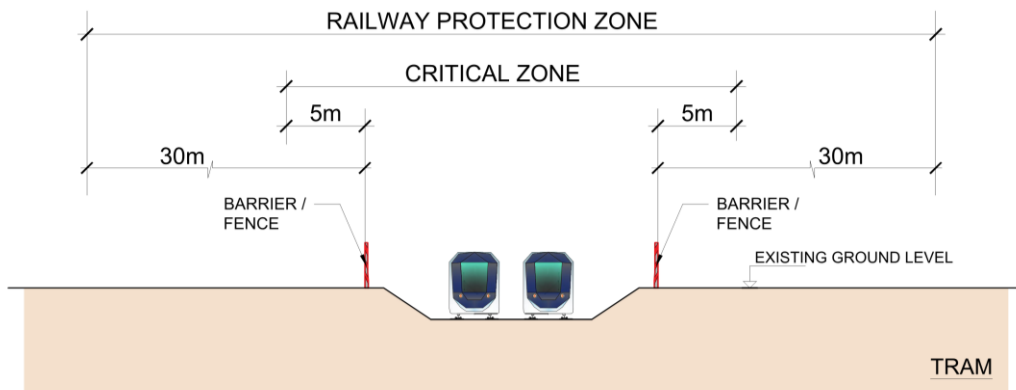
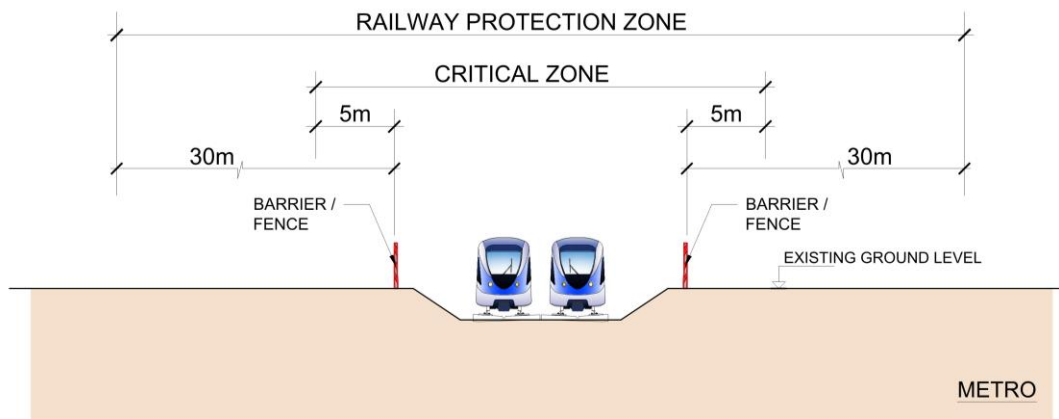
Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-5	At-Grade (Type A)	Zone-5A applies to at-grade Railway sections. The Railway Protection Zone is defined as 30m measured from the outermost edge of any superstructure, substructure or fenceline whichever is greater.



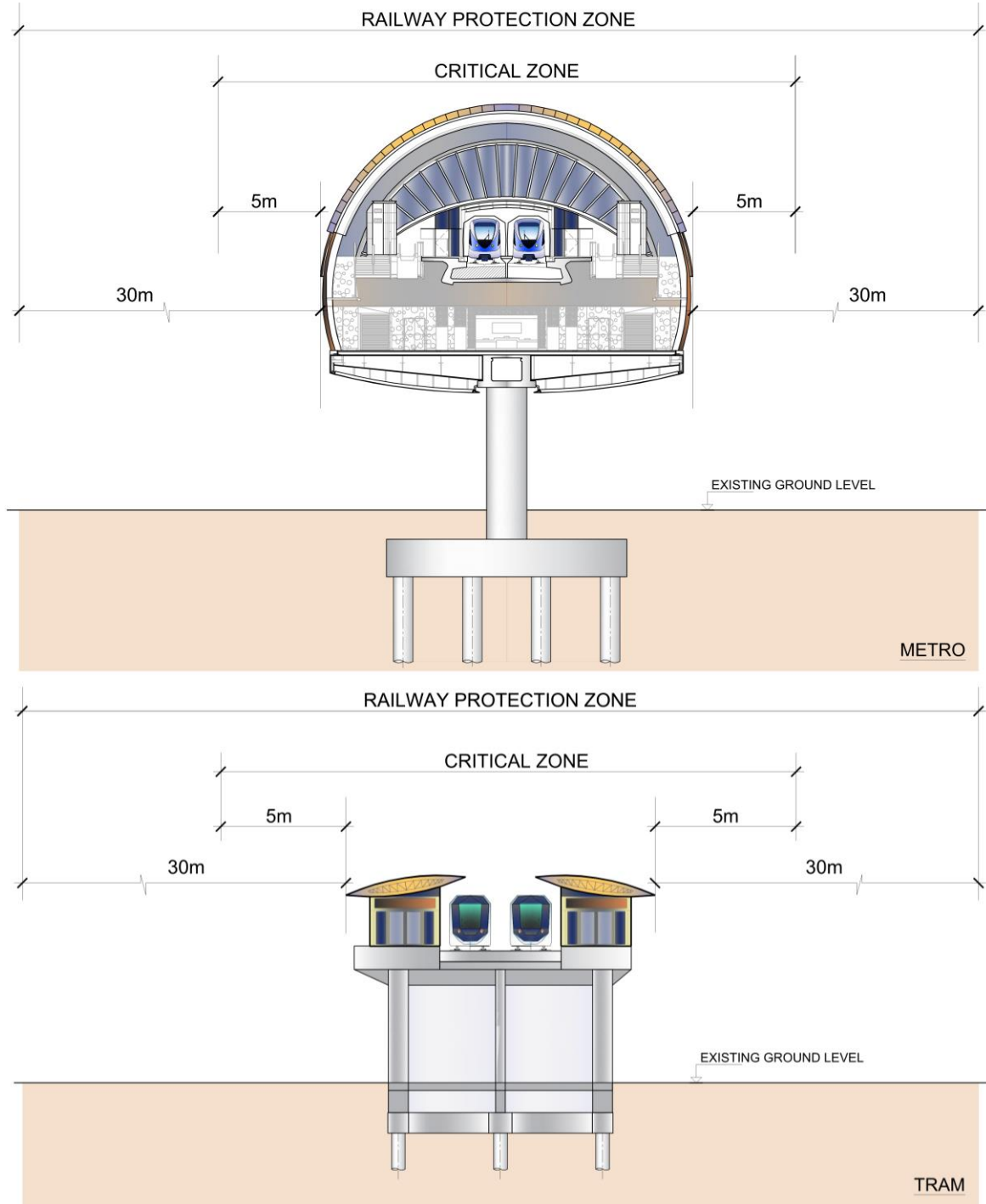
Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-5	Embankment (Type B)	Zone-5B applies to Railway upon engineered embankments. The Railway Protection Zone is defined as 30m measured from the outermost edge of any superstructure, substructure or fenceline whichever is greater.



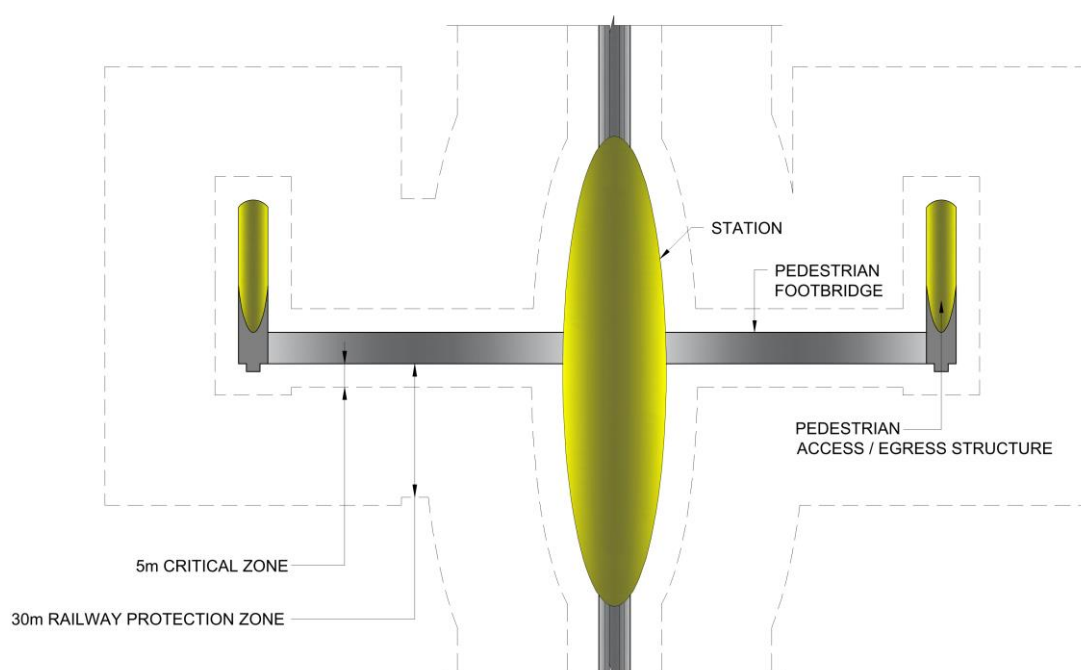
Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-5	Cutting (Type C)	Zone-5C applies to Railway within engineered cuttings. The Railway Protection Zone is defined as 30m measured from the outermost edge of any superstructure, substructure or fenceline whichever is greater.



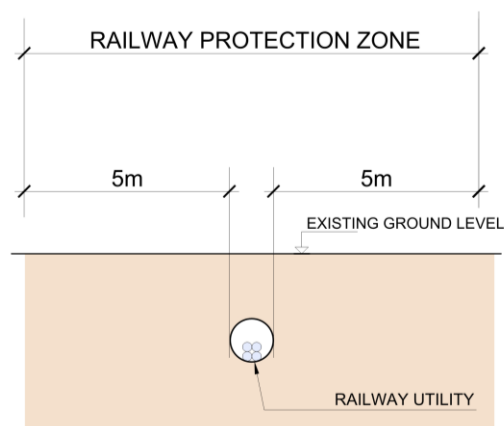
Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-6	Overground Stations (Type A)	Zone-6A applies to Overground stations. The Railway Protection Zone is defined as 30m measured from the outermost edge of the superstructure or substructure whichever is greater.



Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-6	Overground Infrastructure (Type B)	Zone-6B applies to other Railway Infrastructure (e.g. footbridge, entrance pod, car park building, annex building, emergency egress points, etc.). The Railway Protection Zone is defined as 30m measured from the outermost edge of the superstructure or substructure whichever is greater.



Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-7	Railway Utilities	Zone 7 applies to any utilities servicing the Railway Infrastructure (e.g., electricity, communications, water, gas, etc.). The Railway Protection Zone is defined as 5m measured from the outermost edge of the utility.



Zone No.	Railway Structure Sections	Railway Protection Zone
Railway Protection Zone-8	Depot	Zone-8 applies to Railway depots. The Railway Protection Zone is defined as 30m measured from the security or perimeter fence around the depot.



2.3. Railway Protection for Future Railway Lines

- 2.3.1. Where future Railway lines are planned, the frozen Rail corridors are shown on the local authority affection plans.
- 2.3.2. The Applicant shall liaise with the Agency to determine the Agency's requirements and ensure that the proposed development does not compromise the viability of the proposed Railway alignment.
- 2.3.3. For proposed underground developments that may conflict with future Railway structure foundations, the Agency may consider the following options in consultation with the Applicant;
 - › allowing the design of the future Railway structures to span across the proposed underground development.
 - › allowing the proposed underground structure to be designed to accommodate the future Railway and/or impact from construction of the future Railway.
- 2.3.4. For proposed developments above or adjacent to future underground Railway structures the Agency may consider the following options in consultation with the Applicant;
 - › restriction on area and number of levels or basements.
 - › restriction on the magnitude of the applied loads from the proposed structure.
 - › design of structures to bridge over future underground Railway corridors.
 - › provision of a space or corridor within the proposed development to allow for the future underground Railway structure to pass through or beneath the proposed development.
- 2.3.5. For proposed structures above or adjacent to Future underground Railway Structures, a soil structure interaction study shall be submitted by the designer to estimate the expected settlement from future Railway Structures and to be considered on the proposed Structure design.



3. Restricted Activities

3.1. General

3.1.1. A Restricted Activity is any activity considered by the Agency to (or have the potential to);

- › Jeopardize or otherwise adversely affect any Railway, Railway Infrastructure, Railway Operation and / or Railway Vehicle.
- › Pose a threat of interference in any way in each case with any Railway, Railway Infrastructure and/or Railway Vehicle or cause injuries and fatalities to passengers.

3.1.2. The Restricted Activities are identified in Table 3.1 below.

Table 3.1: List of Restricted Activities

ACTIVITY NO.	RESTRICTED ACTIVITY
RA1	Construction of tunnels, wells and boreholes
RA2	Excavation, earth movement, shoring, deep foundation and dewatering
RA3	Movement or operation of cranes, hoists, other lifting equipment and use of any machinery and heavy equipment
RA4	Dredging of sea-beds and canal-beds
RA5	Installation or replacement of conduits for any services & utilities
RA6	Erection or replacement of power towers and telecommunication towers
RA7	Construction and maintenance of roadworks and related infrastructure (bridges, underpasses, car parking, traffic signals, etc.)
RA8	Construction and maintenance of buildings
RA9	Erection of temporary structures, such as; scaffolding, storage of goods, tents, etc.
RA10	Horticulture and irrigation networks
RA11	Installation of advertisements and traffic and informative signboards
RA12	Demolition
RA13	Use of explosives, fireworks and the lighting of fires
RA14	Other activities to be controlled that may impose risk on railway systems or operations

3.2. Description of Restricted Activity

3.2.1. The description of Restricted Activities are listed in more detail in Table 3.2 below;

Table 3.2: Description of Restricted Activities

ACTIVITY NO.	RESTRICTED ACTIVITY	DESCRIPTION
RA1	Construction of tunnels, wells and boreholes	<ul style="list-style-type: none"> – The construction of tunnel or an underground passageway designed for use as a street or railway; to serve as a passageway, conduit for utilities, or to provide access for people, vehicles or equipment to an underground work site. – The installation of boreholes, wells, dewatering wells, piles, ground anchors and horizontal tie-backs.
RA2	Excavation, earth movement, shoring, deep foundation and dewatering	<ul style="list-style-type: none"> – The digging or excavation of trenches or pits, shoring of excavations, the carrying out of earthworks and backfilling, dewatering of ground water, or the shifting or pushing of earth or soil from one area to another, whether or not such activities are carried out manually or by mechanical means.
RA3	Movement or operation of cranes, hoists, other lifting equipment and use of any machinery and heavy equipment	<ul style="list-style-type: none"> – The movement or operation of any crane, machinery and heavy equipment, hoist, drilling or piling equipment, excavator or any other mechanical equipment or vehicle.
RA4	Dredging of sea-beds and canal-beds	<ul style="list-style-type: none"> – The dredging of sea beds or river beds carried out by any means and the anchoring of vessels.
RA5	Installation or replacement of conduits for any services & utilities	<ul style="list-style-type: none"> – The installation or replacement of conduits for any telecommunication, electrical and mechanical utilities.
RA6	Erection or replacement of power towers and telecommunication towers	<ul style="list-style-type: none"> – The erection or replacement or dismantling of power towers and telecommunication towers, including power transmission lines and associated structures.
RA7	Construction and maintenance of roadworks and related infrastructure (bridges, underpasses, car parking, traffic signals, etc.)	<ul style="list-style-type: none"> – The construction and maintenance of roadworks and related infrastructure such as; bridges, underpasses, car parking, traffic signals, etc.
RA8	Construction and maintenance of buildings	<ul style="list-style-type: none"> – The construction of buildings, including but not limited to, formwork, concreteing, safety net, protection screen, any other building activities for superstructure, and maintenance of buildings, including but not limited to, use of cradle, BMU and rope access for building maintenance and cleaning

ACTIVITY NO.	RESTRICTED ACTIVITY	DESCRIPTION
RA9	Erection of temporary structures, such as; scaffolding, storage of goods, tents, etc.	<ul style="list-style-type: none"> – The erection or dismantling of sheds, shelters, tents, scaffolding, temporary maintenance towers, ladders, hoardings, formwork, loading platforms, bridge gantries and other similar temporary structures for any purpose, including trade fairs, fun fairs, exhibitions, entertainment and commercial markets. – The erection and removal of temporary site fence, site offices or site signboard – The storing or placing, or causing or allowing the storage or placement of, any goods, power generator, fuel storage, material, any solid or liquid or gaseous matter or substance.
RA10	Horticulture and irrigation networks	<ul style="list-style-type: none"> – The activities related to horticulture and irrigation networks including but not limited to landscaping, trees planting, irrigation networks and maintenance work
RA11	Installation of advertisements and traffic and informative signboards	<ul style="list-style-type: none"> – The installation of advertisements, site signboard, traffic and informative signboards, temporary signboard, including but not limited to, erection, dismantling, associated temporary work, etc.
RA12	Demolition	<ul style="list-style-type: none"> – The tearing-down of buildings and other structures manually or using hydraulic equipment, a wrecking ball, or a blasting method.
RA13	Use of explosives and fireworks and the lighting of fires	<ul style="list-style-type: none"> – The use of explosive material, fireworks and lighting of fires for any purpose, including blasting, demolition, removal of rocks, or construction.
RA14	Other activities to be controlled that may impose risk on railway systems or operations	<ul style="list-style-type: none"> – Any activity to be performed within the Railway Protection Zone that has the potential to impose risk on safety of Railway Infrastructure, operation and passengers.

3.3. Site Activities required to Perform Restricted Activity

Normally, any restricted activity is a combination of one or group of site activities. This section outlines a general and indicative set of Site Activities required to perform Restricted Activity. It is the applicant responsibility to provide breakdown of site activities related to the proposed work. The associated site activities (SA) for any restricted activity (RA) are presented in the indicative table below.

Table 3.3: List of Site Activities (SA) required to perform any of the Restricted Activities (RA)

#	Site Activity
SA1	Storage of goods
SA2	Movement or operation of cranes, hoists, other lifting equipment and any machinery
SA3	Installation of boreholes and wells
SA4	Dredging of sea-beds and canal-beds
SA5	Construction of underground passageways
SA6	Excavation of trenches and earth movement
SA7	Demolition
SA8	Use of explosives and fireworks and the lighting of fires
SA9	Erection of scaffolding and other temporary structures
SA10	Installation or replacement of conduits for any utilities
SA11	Other activities to be controlled

The matrix below provides an indicative information for possible site activity required to perform restricted activity. It is the applicant responsibility to provide detailed information on all site activities required to perform the proposed work/restricted activities specified in the application.

Table 3.4: The indicative matrix of associated site activities for any restricted activity

RA NO.	SA1	SA2	SA3	SA4	SA5	SA6	SA7	SA8	SA9	SA10	SA11
RA1	x	x	x		x	x			x	x	x
RA2	x	x	x			x			x		x
RA3	x	x							x		x
RA4		x		x		x					x
RA5	x	x			x	x			x	x	x
RA6	x	x				x			x		x
RA7	x	x			x	x			x	x	x

RA NO.	SA1	SA2	SA3	SA4	SA5	SA6	SA7	SA8	SA9	SA10	SA11
RA8	x	x				x			x		x
RA9	x	x							x		x
RA10	x	x				x				x	x
RA11	x	x				x			x	x	x
RA12	x	x				x	x		x		x
RA13	x							x			x
RA14	x	x	x	x	x	x	x	x	x	x	x

3.4. Planning for Safety

- 3.4.1. The Applicant shall take account of all safety considerations when planning to carry out any Restricted Activities in the Railway Protection Zones.
- 3.4.2. The Applicant shall firstly aim to eliminate as many hazards as possible through design. During the planning process, the Applicant shall prepare a hazard identification and risk assessment to identify all the hazards and to assess all possible risks that the Applicants proposed works may pose to the Railway Infrastructure to safeguard operation of the Railway. The Applicant shall then propose measures to control these risks. This shall include studies of the use of suitable methods /equipment/construction plant and appropriate and effective Control Measures that could be implemented by suitably trained and qualified workers, operators, supervisors and management staff.
- 3.4.3. The process for carrying out a risk assessment is included in Section 8.

4. Hazard Identification and Risk Assessment

4.1. Discription of Site Activities, Associated Risks & Control Measures

4.1.1. SA1: Storage of Goods

This Site Activity is the storage or placement of any goods, material or item whether it be a solid, liquid or gaseous matter or substance

4.1.1.1. Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › The load imposed by goods, materials, heavy machineries or equipment placed directly above or close to any underground Railway Infrastructure may impose high stresses upon the Railway Infrastructure leading to structural damage.
- › Stored goods, materials or items may interfere or may facilitate interference (e.g. trespass, vandalism) with the operation, maintenance and inspection of Railway Assets.
- › Stored goods may block ventilation inlets and outlets which could affect the ventilation of Railway Infrastructure.
- › Stored materials may prevent access for maintenance or inspection of the Railway.
- › Stored goods, materials or items may compromise fire safety by obstructing evacuation routes, places of safety and/or assembling areas.
- › Stored goods, materials or items may create a potential fire hazard next to the Railway through storage of combustible materials. Stored combustible materials, if ignited, may cause smoke and fumes to enter the stations (e.g. through ventilation ports or station entrances).
- › Storage or placing of combustible materials, flammable liquid and gas (including diesel/petrol powered equipment, LPG and oxy-acetylene cylinders and storage tanks) could pose a risk of fire and/or explosion.

- › Vehicles carrying dangerous goods as defined in the UAE Regulations (e.g. tankers carrying flammable materials) parked adjacent to the Railway Infrastructure may catch fire or explode.
- › Improper use of electrical equipment could pose a risk of electrical fire.
- › Stored materials containing fluids may leak resulting in fluids entering the Railway Infrastructure
- › Stored materials may alter existing drainage paths and direct water into the Railway system.

4.1.1.2. Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the activities and mitigating the potential impacts.

General

- › Ensure compliance with the requirements of the latest version of the Code of Construction Safety Practice published by the Dubai Municipality.
- › Ensure there is a plan/drawing of the positioning and layout of equipment and materials. Ensure the plan is followed by supervision on site.
- › Design hoardings and similar temporary structures to withstand the effects of wind.
- › Ensure safety conditions on site are inspected daily to confirm they are implemented effectively. Keep inspection records on site to be shown to RROW inspection team at any time.
- › Store and secure materials to minimise the risk of debris being blown onto the Railway.
- › Clearly indicate the location, depth and contents of existing underground storage tanks and associated Infrastructure with signage.
- › Store hazardous chemicals in accordance with Dubai Municipality requirements and outside the Critical Zone.

Obstructions

- › Position equipment so that station entrances, ventilation inlets and outlets and emergency access and egress points are always kept clear of obstructions.
- › Place any generators and associated plant outside the Critical Zone with exhaust vents facing away from the Railway Infrastructure.

Excessive Loading

- › Demonstrate through calculation to the Agency's satisfaction that the additional stresses caused by placement of a predefined load of equipment and/or material stockpile above or adjacent to underground Railway structures are acceptable (refer Figure 4.1).

Fire Safety

- › Prohibit combustible materials, flammable fluid and diesel/petrol powered equipment materials from being stored or placed in the Critical Zone.
- › Prohibit vehicles carrying dangerous goods, e.g. tankers carrying flammable materials from entering the Critical Zone.

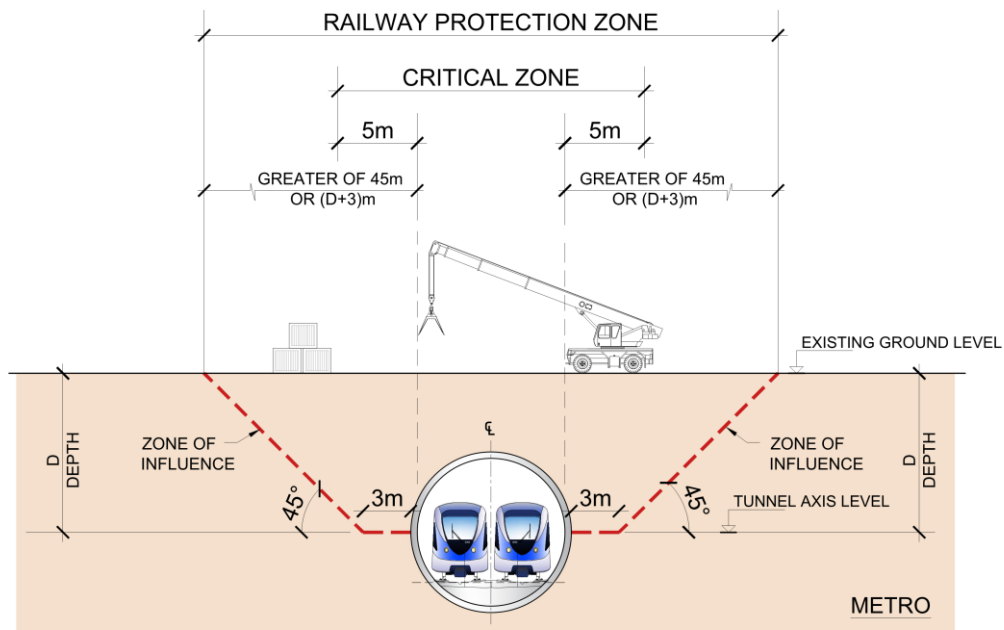


Figure 4.1: Loads Imposed by Placing or Using Heavy Machinery or Goods above Railway Structures Shall Be Checked Against the Allowable Limits.

- › Ensure any underground storage tanks and pipe work containing any flammable and combustible liquids or gases are non-pressurized and are located outside the Critical Zone (refer Figure 4.2)

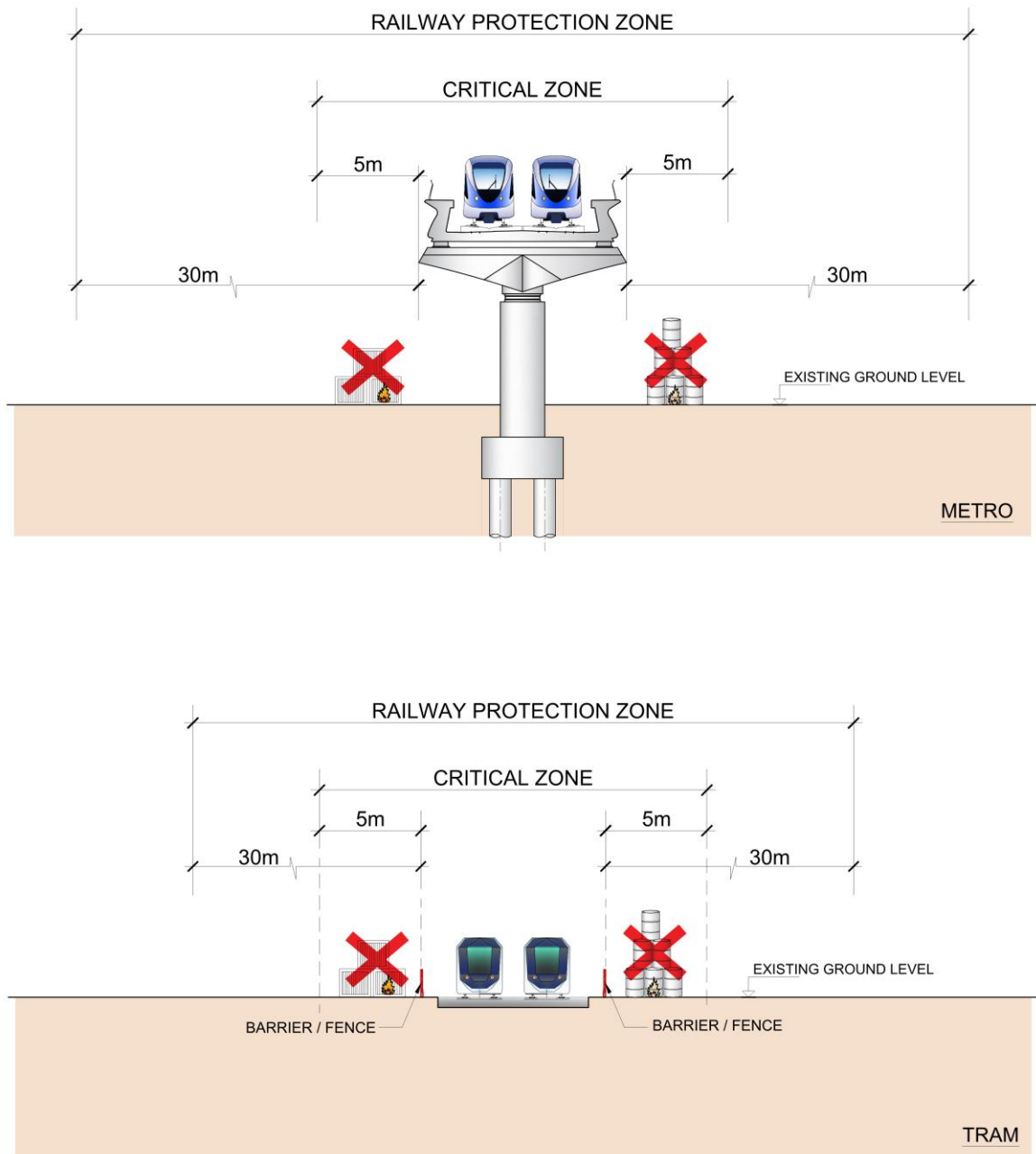


Figure 4.2: All Flammable, Combustible or Explosive Goods (e.g. Tankers, Fuel Containers, and Gas Cylinders) Shall Be kept outside the Critical Zone.

- › Ensure any underground storage tanks for any flammable and combustible liquids or gases within the Railway Protection Zone are of double wall construction.

- › Provide any pipe work or storage tanks carrying flammable and combustible liquids or gases within the Railway Protection Zone with leakage detection and monitoring systems.
- › Provide above ground storage tanks and related Infrastructure (i.e. pipe work, valves etc.) for flammable and combustible liquids or gasses with fire rated walls if they are located close to the Railway Infrastructure.
- › Use anti-corrosion materials for storage tanks and pipe work.
- › Ensure above ground surface storage tanks for flammable and combustible liquids, or gasses, are of double-wall construction with their contents clearly identified.
- › Provide firefighting facilities for flammable and combustible liquids, gasses and solids.
- › Separate combustible materials (i.e. cardboard, timber, rags, etc.) from tanks with flammable and combustible liquids or gasses.
- › Do not store additional diesel/petrol on any equipment for re-fuelling purposes.
- › Check generators monthly to ensure they are electrically safe and within the safe load capacity and properly earthed.
- › Check all powered equipment on a regular basis to be electrically safe and working within the safe load capacity.
- › Grade the surface around any dispensing area for flammable, combustible liquids or gases so that any spills will be directed away from the Railway Infrastructure.
- › Provide Bunding around above ground single skin storage tanks for flammable and combustible liquids or gasses.
- › Ensure Bunding is sufficient to hold the full contents of the tank.

Power Generators

- › Implement the principles of the Dubai Municipality Code of Construction Safety Practice and Dubai Civil Defence and National Fire Protection Association (NFPA) for fire protection.
- › Locate suitable and sufficient firefighting extinguishers beside the generator.
- › Provide a sink (drip tray) below the generator to control any leakage of oil or fuel. Ensure the tray is cleaned periodically.
- › Ensure the certified generator is refuelled as per the approved procedure and under supervision of a competent person.
- › Install board on site showing emergency response plan. Clearly identify the emergency contacts who are available for 24hrs a day and 7 days per week.
- › Regularly inspect equipment and replace defective or damaged parts in a timely manner.
- › Ensure manufacturer's instructions and recommendations are followed for the installation, repair and maintenance of equipment.

- › Keep the area around the generator free of clutter and of any hazardous combustible material.
- › Ensure there is proper isolation between the generator's electric system and utility distribution system.
- › Ensure the risk of back feed (wherein an improperly connected generator begins to feed electricity back into the power lines) is avoided as this may damage the unit and cause explosion or fire.
- › Ensure all electrical connections, such as wires, cables and terminals are properly insulated and covered.
- › Ensure the frame of the generator and any external conducting parts are electrically earthed.
- › Ensure all wiring, cable and cord sets are of the recommended capacity.

Storage of Goods within Easement Inside Private Plot

- › For storage of goods located within easement of overground section provided inside private plot the following to be considered:
 - › Storage of goods, excluding combustible and flammable materials, inside private plot is permanent storage facility serving daily business activities that shall comply with legislation and regulation of local authorities, included but not limited to, Dubai Civil Defense DCD, Dubai Municipality DM and others
 - › Service Level Agreement shall be signed between Rail Agency and plot owner to regulate, but not limited to, the following:
 - daily activity performed by plot owner within railway protection zone.
 - ensure safety of railway infrastructure and operation.
 - inspection activities carried out by Rail Agency inspectors inside the plot.
 - › Control measures and conditions to ensure safety of railway infrastructure and operation during performing daily activity of plot owner within railway protection zone, not including storage of combustible and flammable materials or use of crane, shall be included in the service level agreement.
 - › For using crane or storing combustible and flammable materials plot owner shall be authorised by approved NOC from Rail Agency.

4.1.2. SA2: Movement or Operation of Cranes, Hoists, Other Lifting Equipment and Any Machinery

This Site Activity is the movement or operation of any crane, whether fixed or mobile, machinery, hoists, ladder, drilling or piling equipment, excavator or any other mechanical equipment or vehicle. The following equipment is considered.

- › Mobile cranes.
- › Tower cranes (fixed or luffing jib).

- › Hoists, Lifts and Mobile Elevated Work Platforms (MEWPs).
- › 360 degree excavators used as cranes.
- › Telehandlers.
- › Concrete pumps.
- › Aerial lifting.

Any work involving plant, equipment or materials within the Railway Protection Zone, may only be undertaken with the prior written agreement of the Agency.

4.1.2.1. Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › The Railway Infrastructure/Railway Vehicles could be damaged or the operation of the Railway could be affected by;
 - › Toppling of lifting equipment (due to fatigue, structural or foundation failure for example).
 - › Uncontrolled slew of equipment booms.
 - › Swing of materials suspended by lifting equipment.
 - › Objects falling from lifting equipment (including people or materials).
 - › Failure of lifting equipment component (e.g. failure of structural element, wire rope, lifting gear, etc.)
 - › Electrical fault or exposed electrical conductors.
 - › Failure of lifting equipment through overloading.
 - › Obstruction caused by lifting operations poses problem for public access during normal operations or in the case of emergency.
 - › Collision between several cranes in motion
 - › Collision between the moving crane and fixed obstacles.
 - › Over flying forbidden or critical areas.
 - › The in-terference between cranes and no-fly zones.
 - › Collisions between the hoist rope of an overflying crane and the jib and counter jib of a crane below. This facility is called the interference function

4.1.2.2. Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the proposed activities and mitigating the potential impacts.

General

- › Ensure compliance with the requirements of the latest version of the Code of Construction Safety Practice published by the Dubai Municipality.
- › Include location and fixing details of all heavy equipment in the Applicant's NOC application.
- › Avoid the use of construction plant, equipment or materials that, in the event of mishandling or failure, could encroach within the Critical Zone.
- › Agree a safe method of work with the Agency.
- › Ensure minimal dust and debris created by activities especially near station entrances and ventilation inlets.
- › Provide lifting operation plan that considers;
 - › The load, its characteristics and the method of lifting.
 - › The suitability of the type of lifting equipment used for the lifting operation.
 - › Lifting equipment position and location of the load before, during and after the operation supported with drawings.
 - › The sequence of the operation (e.g. from site preparation, arrival of the equipment and mobilisation, positioning of the lifting equipment, lifting and placing of the load, dismantling the lifting equipment, to demobilisation).
 - › Clearances between the load, the lifting equipment and the Railway Infrastructure.
 - › The type of accessories for lifting.
 - › The weight to be considered in assessing the load on the lifting equipment.
 - › Installation procedures, as per the manufacturer recommendations.
- › Provide method statement that includes;
 - › A step-by-step description of the safe system of work for the entire lifting operation.
 - › The schedule of responsibilities (e.g. type of hire, road closures, base preparation, isolation of live services).
 - › The required pre-use checks to be completed.
 - › A clear statement of the allocation of tasks to all parties involved in the lifting operation.
 - › Full details of the lifting equipment(s) including certificates.
 - › Details of ancillary equipment.
 - › Details of any lifting accessories.
 - › The name of the lifting equipment supervisor and certification.
- › Appoint independent 3rd party Lifting Supervisor to supervise critical lifting operations. 3rd party Lifting Supervisor shall be approved by the Rail Agency.

- › Design working platforms of lifting equipment to resist all loads including wind load.
- › Provide barriers (e.g. Vehicle Containment Barriers, VCBs) or ensure sufficient distance is maintained to ensure separation of lifting equipment to prevent collision with construction traffic, moving vehicles or other lifting equipment.
- › Provide safe access routes to the public around the worksite to prevent risk of public being struck by moving loads or traffic.
- › Verify the bearing capacity is sufficient to support the lifting equipment. Full design checks should be demonstrated based on suitable codes such as BRE 470.
- › Method statement and lifting plan for critical lifts shall be approved by the project consultant and endorsed by independent 3rd party testing facility approved by the Rail Agency.
- › Wind speed records shall be available and the method statement shall specify the maximum allowed wind speed in accordance with the equipment manufacturer recommendations.
- › The critical limiting environmental conditions where the lifting operations shall be put on hold (e.g. wind speed, rains, lightning, foggy weather, etc.) shall be clearly specified.
- › Avoid blind lifting operations toward Railway Infrastructure.

Certificates, Qualifications and Records

- › Confirm that test certificates are present and examined for the machine and its lifting tackle.
- › Confirm that proposed lifting equipment operatives are in possession of the appropriate competency certificates.
- › All personnel involved in lifting or machinery operation activities such as operator, rigger and supervisor shall be certified by approved DM inspection / testing body. For critical operations special training / certification shall be provided according to Rail Agency to follow the Railway Protection Code of Practice.
- › Confirm that all lifting equipment is tested and certified by a competent person at least once every 12 months. For critical lifting Rail Agency may request recertification of the equipment before using the machinery.
- › Confirm all lifting accessories such as slings, belts and chains have been tested and certified by a competent person every 6 months and inspected for damage before each use. Do not use damaged lifting accessories.
- › Keep maintenance records for all lifting equipment or any machinery to prove that regular and satisfactory proactive and preventive maintenance is being carried out.
- › After any major maintenance, repair, upgrade or modifications to the machinery conditions, an approved DM inspection body shall recertify the machinery / lifting machine.

- › Confirm all mechanical equipment and machinery has been maintained at least every 3 months, and/or in accordance with the operations and maintenance manual. All proactive and preventive maintenance carried out must be recorded. Log shall be available during inspection visits.
- › Ensure daily safety checklists and records are maintained and available for inspection at site.

Equipment

- › Fully extend outriggers of lifting equipment and confirm they are supported on solid plates over firm ground through supervision of a competent engineer.
- › Confirm the known safe working load for any lifting points and/or attachments for any lifting equipment. Check that this safe working load is not exceeded by the lifting load. Safety factor shall be specified and for critical lifts along Railway critical zone higher safety factor shall be considered
- › Confirm that any lifting equipment has a rated object handling capacity table available inside the operator's cabin.
- › Use mechanized lifting equipment on the non-rail face of the property for residential only plots.
- › Mark slew restrictions on the ground and check their adequacy with a test.
- › Connect the lifting equipment to Railway earth if any part of the lifting equipment or load can come within touching distance (2m) of any metallic Railway equipment.
- › Conduct test to ensure that the safe load indicator is working.
- › Provide slew restrictions on lifting equipment.
- › Provide anti-collision system where multiple cranes are operating and may interface with each other within the Railway Protection Zone.

Positioning

- › Avoid lifting of materials/equipment in the Critical Zones.
- › Position lifting equipment such that any boom or extension, whilst stationary, in movement or operation, will not encroach on the Critical Zone directly adjacent to the Railway Infrastructure.
- › Provide physical barriers to control the movement of equipment.
- › Ensure the lifting equipment is positioned greater than the collapse radius from the Critical Zone (refer Figure 4.3) where collapse radius of the lifting equipment is greater than the sum of the maximum extent of a lifting equipment collapse (whether by rotation of the boom about its pivot or rotation of the whole lifting equipment about its most heavily loaded outriggers) plus half the length of a horizontal load or the full height of any vertical load (whichever is the greater).
- › Avoid lifting materials and equipment over the area directly adjacent to the Railway Infrastructure.

- › Position machines so that the fumes and exhaust gases are directed away from the air circulation shafts of Railway Infrastructure and station entrances.
- › Establish exclusion zones to prevent the unwanted interaction of lifting equipment, suspended loads and people.
- › Where operation of equipment within the Critical Zone below elevated Railway sections is unavoidable, ensure equipment cannot encroach within minimum 1m clearance of underside of elevated structures as shown in Figure 4.4.
- › The ground supporting the crane / machinery shall be stabilized and in case of non-stabilized platform, a compacted road base layer or concrete planks can be provided.
- › Check the existing services / utilities within the equipment / crane proposed positions and also at the outrigger locations. The existing services / utilities shall be protected against loading resulting from lifting activities. NOC shall be obtained from the utilities owner for such loading activity.

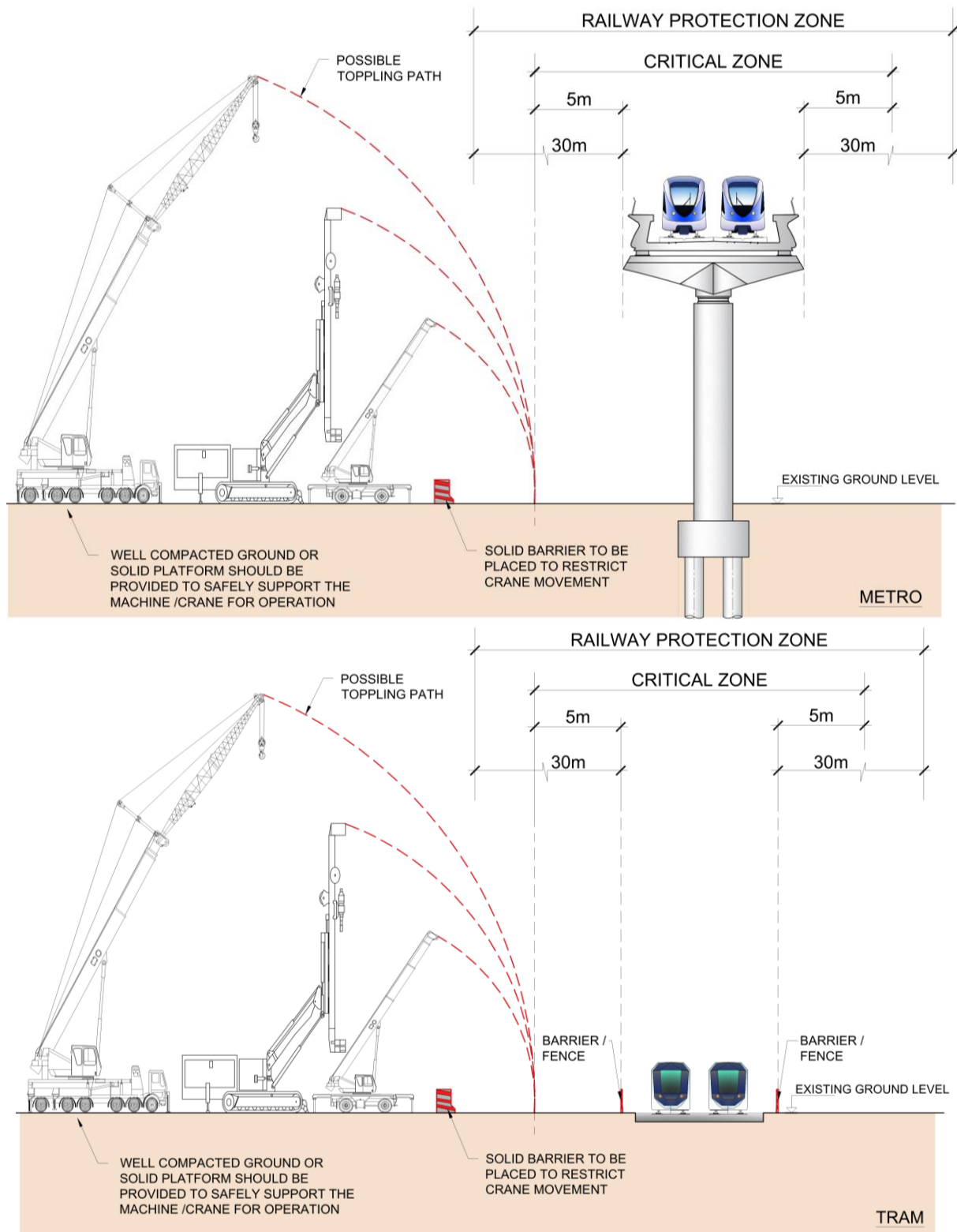


Figure 4.3: Equipment shall not operate within, or be able to collapse into the Critical Zone.

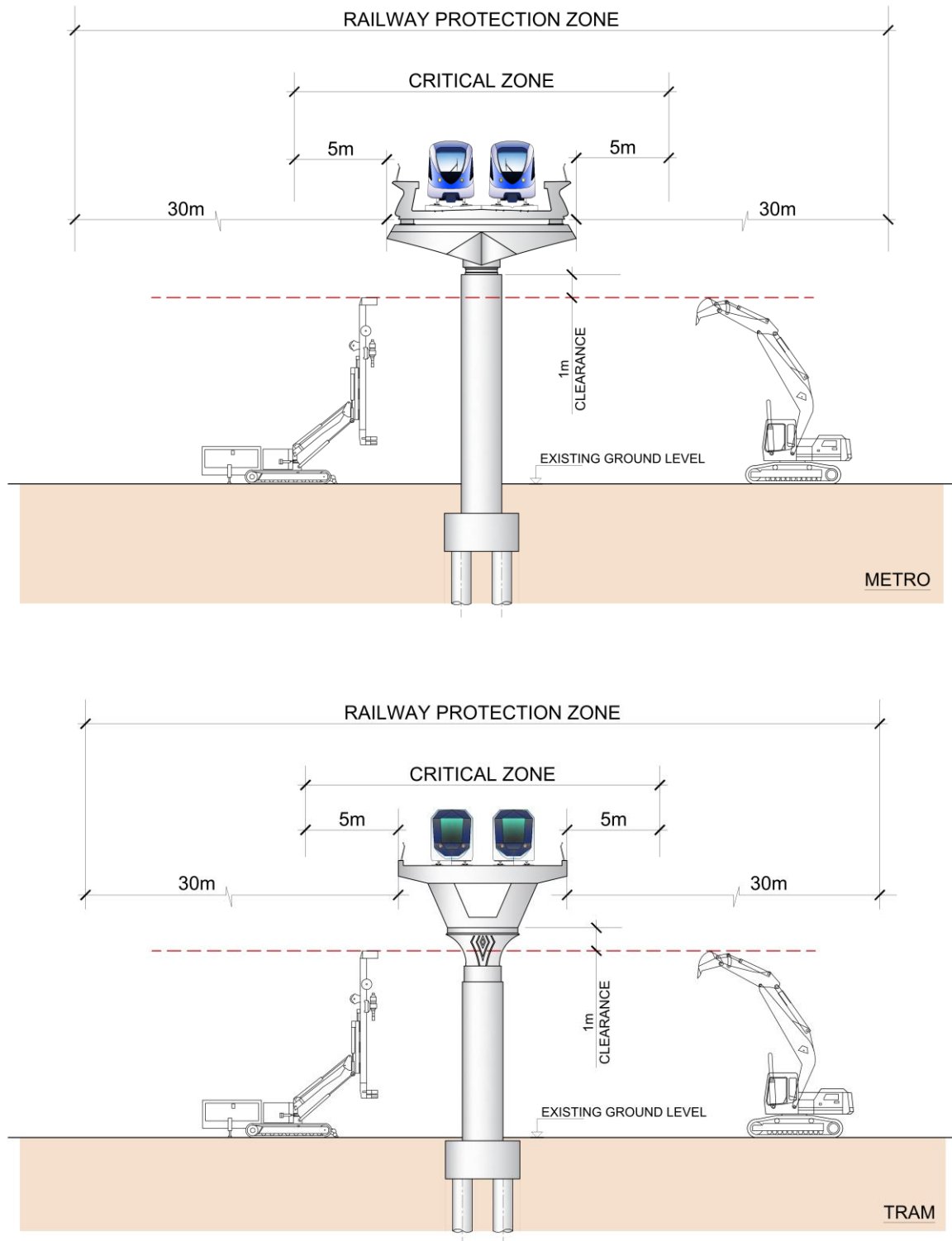


Figure 4.4: Operation of Equipment directly below Railway Structures shall keep minimum 1m clearance from the underside of the structure.

Lifting Operations

- › Verify that there is no risk of equipment contacting overhead or underground power lines.
- › Check and confirm that there are no hidden hazards below the machine.
- › Consider weather conditions during lifting operations (such as wind speed, visibility, etc.). No lifting shall be done during high wind speed or poor visibility due to sand storms or fog.
- › Provide tag line to prevent load from swinging towards the Railway.
- › For night work, provide sufficient lighting to all areas of lifting operation including loading and unloading area, and top of building.
- › Verify cable lengths are appropriate especially for lifts below crane base level.
- › Provide particularly close supervision for the following lifting operations:
 - › Lifting operations close to the Railway.
 - › Where there is more than one piece of lifting equipment in the vicinity.
 - › Tandem lifts.
 - › Lifts involving long loads.

Human Controls

- › Ensure only technically qualified and experienced persons (approved by the Dubai Central Laboratory and Dubai Municipality) examine, test and certify lifting equipment or machinery.
- › Ensure lifting equipment is operated by experienced, certified and qualified personnel and supervised by lifting supervisor or safety officer.
- › Hold tool box and safety induction meetings with the lifting team prior to starting the work.
- › Ensure personnel involved in the lifting operation (supervisor, coordinator, operator, slinger, signaller, erector, maintenance personnel) have the minimum following attributes:
 - › Competent to perform the tasks required of them.
 - › Experienced, adequately trained and/or successfully assessed.
 - › Able to present a record of training and assessment.
 - › Physically able to carry out the work.
- › Implement appropriate communication systems for communications between the lifting operator and the signaller (e.g. hand signals, radio communications, etc.).
- › Use only a certified, competent person, trained in object handling or lifting activities, to operate any earth-moving equipment or machinery used for object handling. The person must have the ability to read and understand the rated object handling capacity table.

4.1.2.3. Special Conditions for Works within the Critical Zone

- › Inspect and certify lifting equipment are in good working condition at least once every three months by a qualified and experienced mechanical engineer.
- › Provide standing certified supervision and 3rd party supervisor during all lifting operation.
- › Submit undertaking to the Agency to supervise crane operation within Railway Protection Zones.
- › Provide copies of checklist from the mechanical engineer and records of supervision on site for inspection by the Agency.
- › Carry out lifting operations within the Critical Zone after operational hours if the Site Activities will endanger safe Railway Vehicle operation.
- › Provide temporary protection structure if it is unavoidable that loads are lifted directly above or adjacent to the elevated or at-grade Railway. Design the protection structure to withstand the impact of the heaviest loads expected.
- › Provide a contingency plan and emergency procedure endorsed by a project consultant, this might be included in the risk assessment or method statements provided by the Applicant

4.1.2.4. Control Measures for Tower Cranes

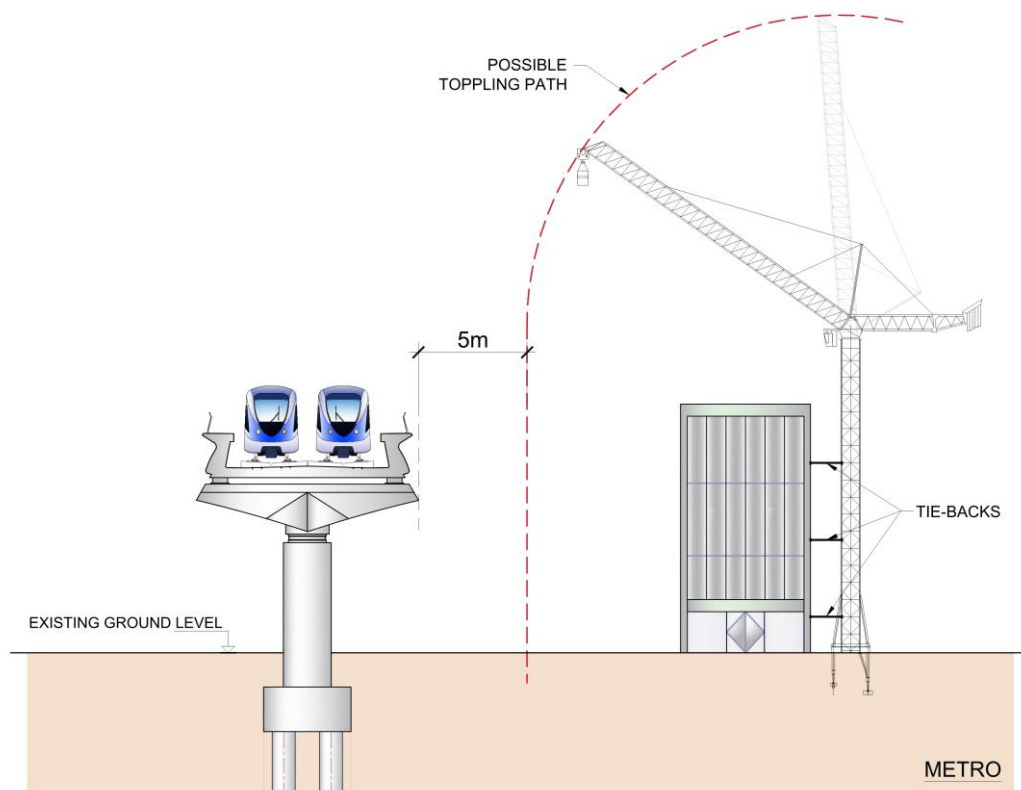
- › Position tower cranes behind the building under construction and away from the Railway Infrastructure and ensure the tower crane is tied back to the building structure. (Refer to Figure 4.5).
- › Ensure the clear distance between a tower crane base and the operational Railway boundary is not less than the diagonal dimension from the foot of the tower to the end of the jib plus either 5m or one tenth of the height of the tower, whichever is greater.
- › For a tower crane with a luffing jib, ensure the clear distance between a tower crane base and the operational Railway boundary is not less than the diagonal dimension from the foot of the tower to the end of the jib when the hook is at the minimum radius and when the jib is at the steepest angle to the vertical.
- › Ensure all details of tower crane operations and equipment shall be included in NOC applications, as described in this Code of Practice.
- › Design lifting equipment foundations and supervise construction by a competent civil engineer.
- › Design the tower cranes to comply with the requirements of BS EN 14439 or similar standard.
- › Provide complete list and details of machinery, equipment, etc. to be used.
- › Provide names of qualified site supervisors, safety officers, lifting supervisors and machinery operators with a copies of their certificates of competency.

- › Erect free standing tower cranes at a sufficient distance from the Railway to prevent the jib toppling into the Critical Zone of the Railway Infrastructure. (Refer to Figure 4.6).
- › Provide copies of test certificates for all lifting appliances to be used.
- › Provide calculations to check the stability of the working platform or foundation.
- › Submit proposal to the Agency's satisfaction demonstrating how dismantling of the tower crane does not endanger the Railway Infrastructure.
- › Test tower cranes before operation and provide copies of the inspection certificates before the commencement of operations for inspection by the Agency.
- › Provide slew restrictions to avoid the load being swung within the Critical Zone of the operational Railway boundary.
- › Provide collision protection systems where multiple, overlapping tower cranes are in use.
- › Ensure the tower crane mast is adequately tied back to building superstructure before erecting or jacking up to the next height.
- › Reduce the tower crane capacity if the tower cannot be restrained to the Agency's satisfaction.
- › As per requirement of European standard EN14439: "Each tower crane shall be capable of being equipped with an anti-collision device. This device shall stop motions to avoid entering in a forbidden area and allow the reverse movement. All connection points necessary for the installation of the device on the crane motion shall be assembled in a specific collector or on a dedicated cable. The specific collector or dedicated cable shall be installed on all cranes except on Self erecting cranes".
- › Provide zoning and anti-collision system where multiple cranes are operating and may interface with each other within the Railway Protection Zone as illustrated in figure 4.6. below.
- › The installation of zoning and anti-collision system shall consider the following:
 - › The location or rotation of the jib of tower cranes within railway protection zone.
 - › The toppling of tower crane with railway protection zone.
 - › Falling object can be reached railway infrastructures
- › Zoning and anti-collision system shall be provided where tower cranes are operating and interfacing with each other within the Railway Protection Zone, as per following cases:
 - › For installation and operation of single tower crane, zoning and rotation of tower crane shall be controlled either by providing automatic zoning system or limit switches.
 - › For installation and operation of multiple tower cranes (two or more tower crane), zoning system and anti-collision system shall be applied.

4.1.2.5. Control Measures for Aerial Lifting

- › Provide a risk assessment for any aerial lifting.

- › Provide aerial lifting plan that meets the above requirements for ground-based lifting, including:
 - › Downdraft control strategy detailing clearance between load and height of helicopter when lifting and placing loads.
 - › Exclusion zones so there is no risk of loose material or debris blowing onto the Railway.
 - › Flight plan.
 - › Certificate of airworthiness from the local aviation authority.
- › Provide a comprehensive submission comprising;
 - › Method statement.
 - › Lift plan.
 - › Operating procedures.
 - › Test certification.
 - › Certificate of airworthiness risk.
 - › Assessment/risk Control Measures.
 - › Emergency plan.
- › Provide an exclusion zone for the helicopter extending 10 metres from the Critical Zone in the event of any conceivable failure mode.



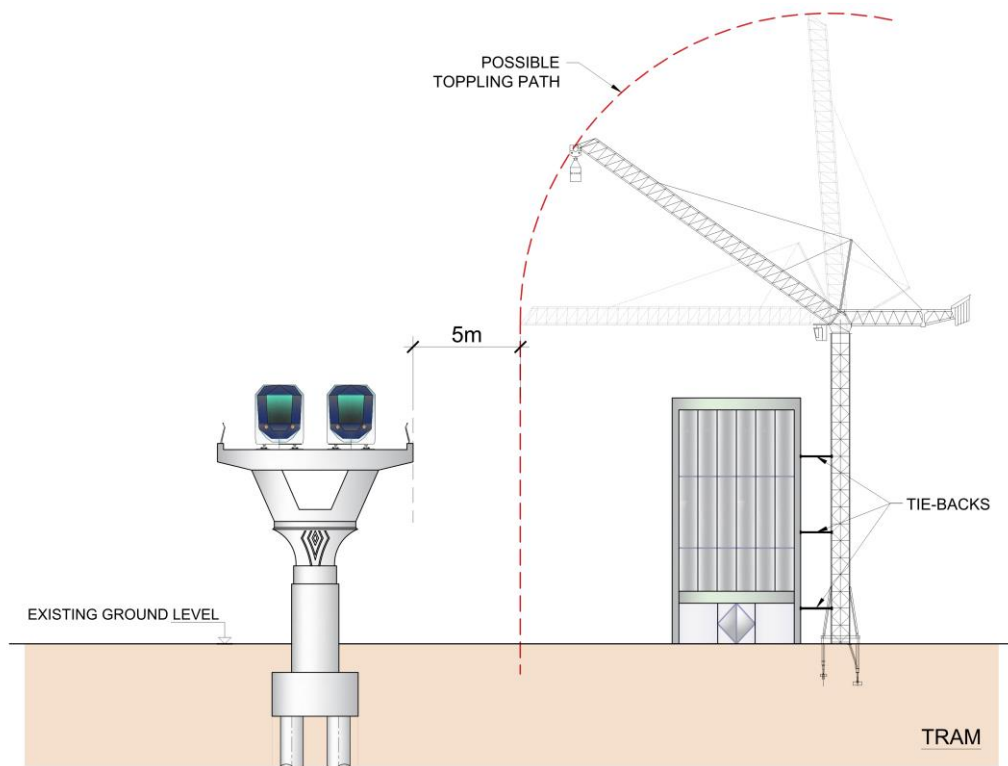
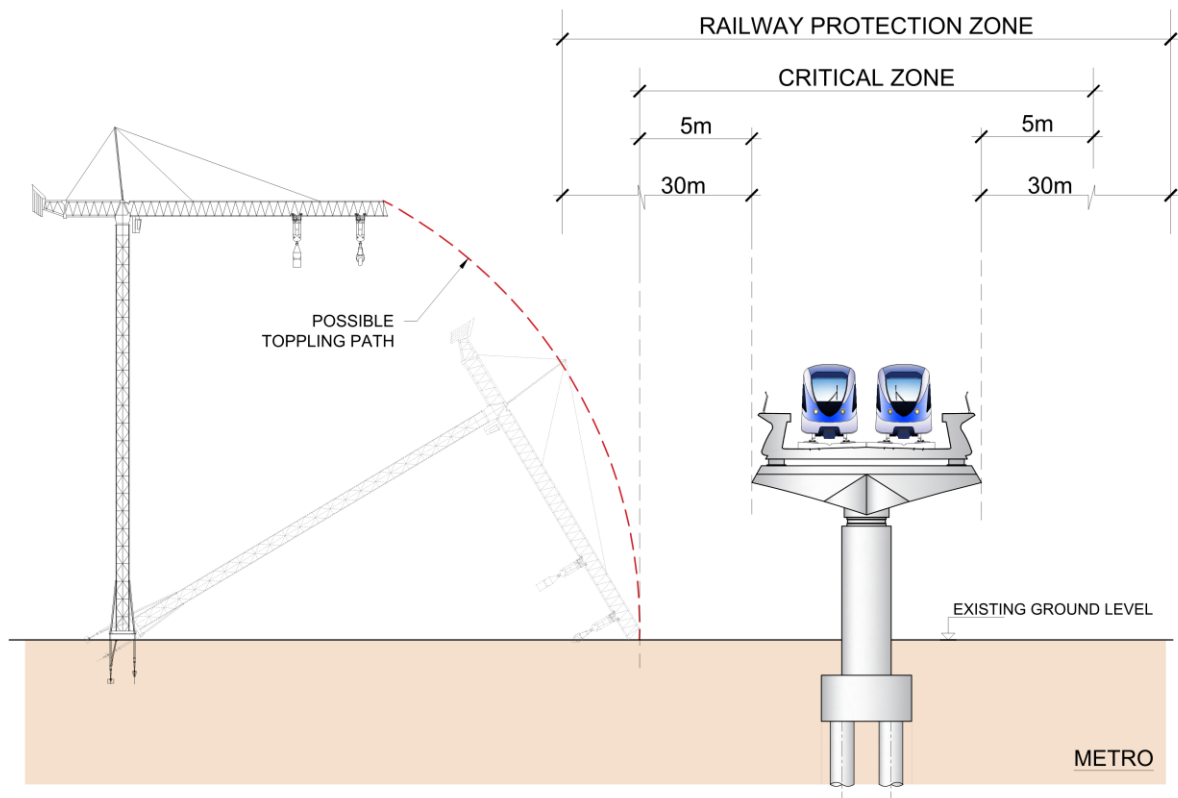
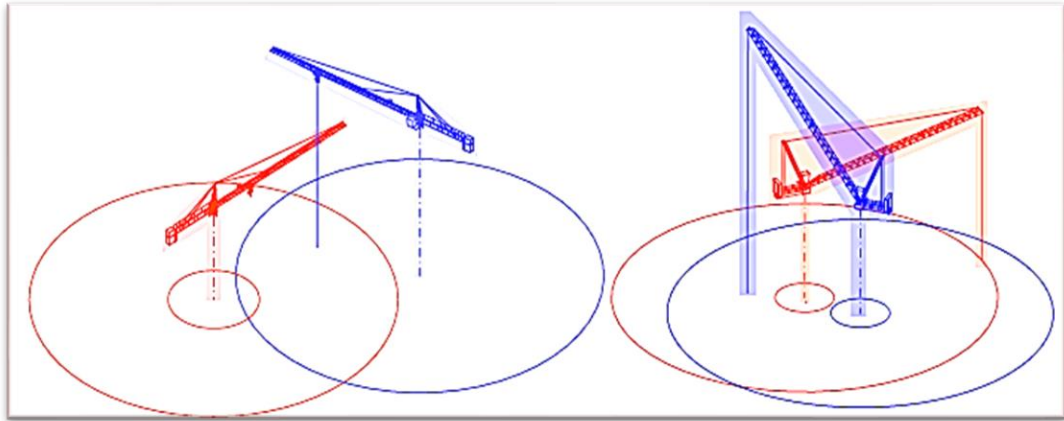


Figure 4.5: Tower Crane and its parts erected behind building and tied-back shall topple outside the Critical Zone.



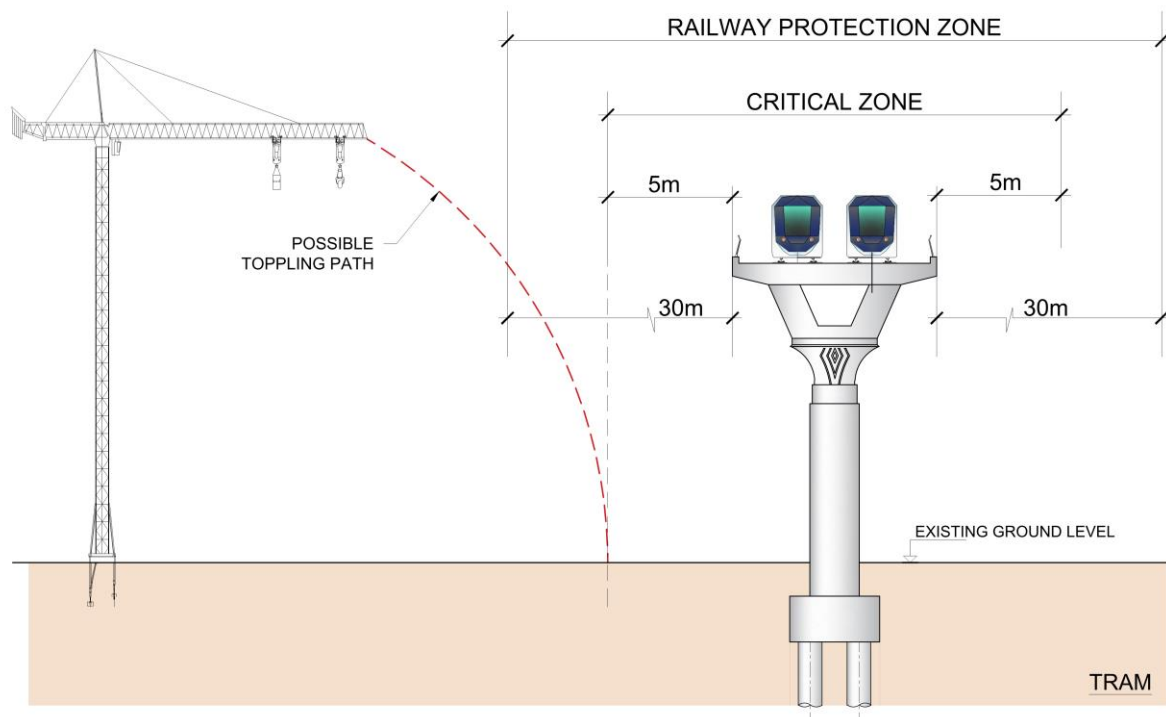


Figure 4.6: Illustration of zoning and anti-collision system for multiple cranes and toppling path of crane (e.g. Free-Standing Tower Crane).

4.1.3. SA3: Installation of Boreholes and Wells

This Site Activity is the installation of boreholes, wells, piles, ground anchors and horizontal tie-backs.

4.1.3.1. Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › Drilling, boring or ground anchoring could damage the Railway Infrastructure (including tunnels, station structures, piles and foundations) by;
 - › Drilling into the underground Railway Infrastructure.
 - › Vibration caused by drilling activities.
 - › Contact of the drilling rig with above-ground Railway Infrastructure.
 - › Reduction of in-situ pressures (e.g. caused by collapse of the borehole or drilled shaft, or reduced pore water pressures).
 - › Increase of in-situ pressure (e.g. caused by grouting operations or increases in pore water pressures).

- › Drilling operations could affect the safety and comfort of the passengers using the Railway system (e.g. through exhaust, vibrations, dust, etc.).
- › Electrocution risk through striking electrical services.
- › Utility strike results in loss of utility (e.g. water, power, etc.) to Railway Infrastructure affecting operations.
- › Severed water main may result in flooding of Railway Infrastructure.

4.1.3.2. Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the proposed activities and mitigating the potential impacts.

General

- › Ensure compliance with the requirements of the latest version of the Code of Construction Safety Practice published by the Dubai Municipality.
- › Ensure the principles of Site Activity SA2 are complied with respect to movement and risk of collapse of mechanical plant.
- › Contact the local authorities and verify on plan the buried services in the vicinity.
- › Carefully expose any services on site to verify their location.
- › Conduct a full survey to ascertain the existence, location and nature of services.
- › Stop any work in the vicinity of the service if any unknown or unexpected service is discovered or uncovered and inform the Agency. Take appropriate precautions for protection prior to restarting.

Planning

- › Only drill boreholes and piles outside the Critical Zone. Use a competent geotechnical engineer to demonstrate the effect upon Railway Infrastructure is acceptable to the Agency's satisfaction (refer Figure 4.7).
- › Show the location of the existing Railway Infrastructure on plans prior to any site work (including existing earthing systems, existing underground structures e.g. pile caps, footings, tunnels, and foundations).
- › Use a qualified surveyor to set out the positions of the existing Railway Infrastructure and the proposed works within the Railway Protection Zone.
- › Include a thorough study of ground water conditions and confirm the control and/or protection measures to be taken in the Applicant's NOC Design Report.
- › Use cast-in-situ piles in preference of driven piles.
- › Check and verify the location of underground structures, utilities and groundwater levels before installation of ground anchors.

- › Use temporary casings to prevent collapse of drilled shafts. Ensure sufficient depth of embedment.
- › Verify the bearing capacity is sufficient to support the drilling equipment. Full design checks should be demonstrated based on suitable codes such as BRE 470.

Site Operations

- › Grout soil investigation boreholes with cement-bentonite mixture or equivalent materials (refer Figure 4.7).
- › Provide interlocked vehicle containment barriers (VCBs) to prevent construction vehicles approaching the Railway.
- › Provide physical barriers to prevent personnel, materials, lifting tackle or ancillary equipment accidentally falling or straying towards the Railway.
- › Provide visible markers delineating the plant movement boundary (for example at the edge of the piling platform).
- › Operate machineries (such as excavator, drilling equipment, etc.) at least 1m clear from the underside of the viaduct. Use suitable low headroom equipment.
- › Provide height restriction gantries on both sides of the viaduct for movement of crane or other mechanical equipment under the elevated sections. Ensure machinery will not encroach within minimum height clearance of 1m to underside of elevated structures.
- › Control dust generated from the activities especially near stations and areas where there is frequent movement of people.

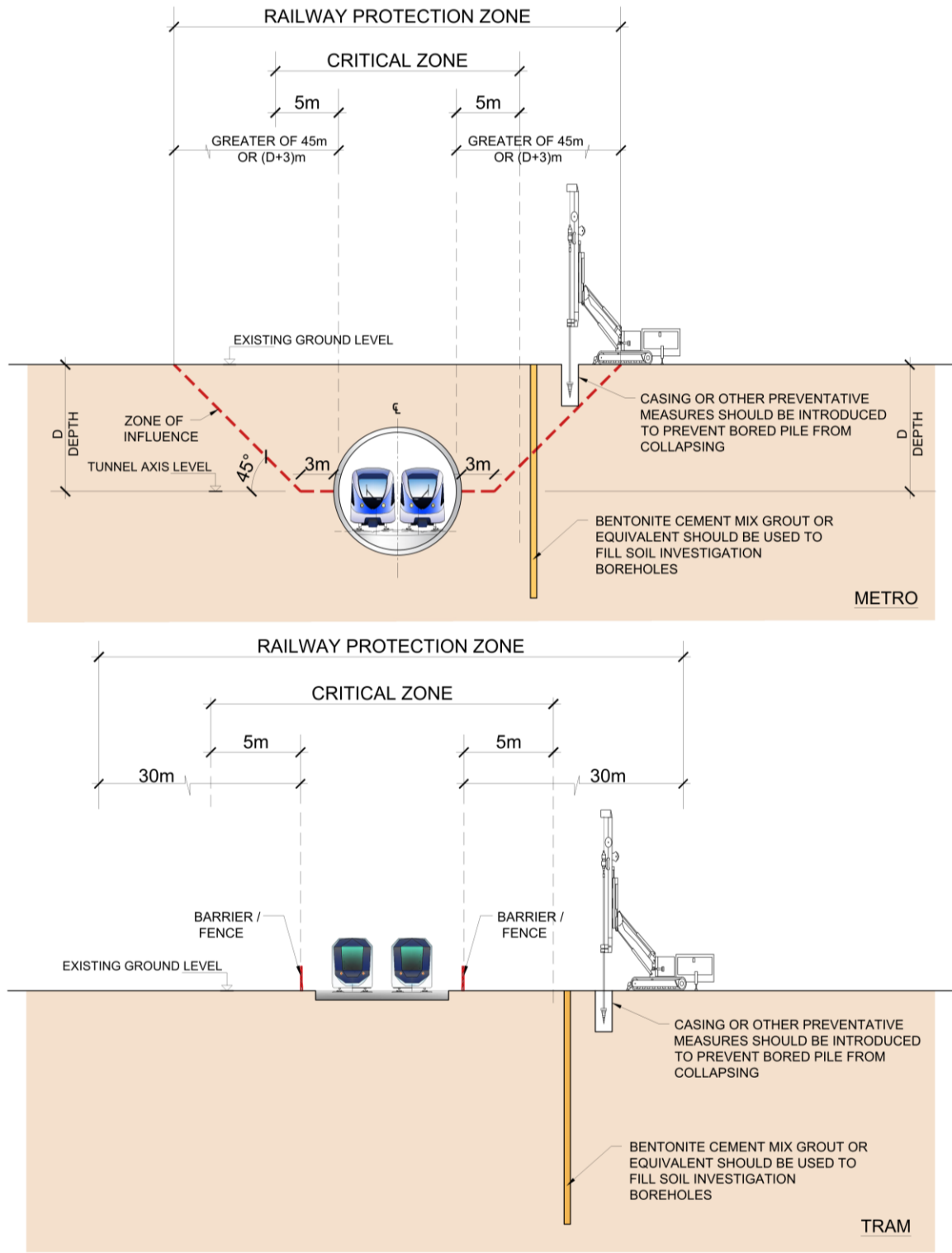


Figure 4.7: Boreholes and Piles shall be outside the Critical Zone and shall be checked for potential impacts on Railway Infrastructure.

- › Position machineries so that the fumes and exhaust are directed away from the station intake/supply shafts and entrances to avoid drawing fumes and exhaust into the station. This could activate the smoke detectors and fire alarm system in the station.
- › Monitor the ground water conditions and vibrations to ensure they remain within the acceptable limits agreed with the Agency until the completion of the work.
- › Use secondary restraints e.g. back-up slings when lifting.
- › Splice pile cages to reduce the lifted length.
- › Use Tag lines to control suspended materials.
- › Installation of the piling platform shall be in accordance with the design and shall be undertaken by a competent contractor.

4.1.4. SA4: Marine works and Dredging of Sea-Beds and Canal-Beds

This Site Activity is related to marine works and dredging of sea beds or canal beds and the anchoring of vessels.

4.1.4.1. Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › Uncotrolled marine traffic that could cause damage to railway infrastructure
- › Tunnel structures could be damaged from dredging causing water ingress and structural failure.
- › Dredging near underwater foundations could damage the structural system of the foundations and/or cause settlement or loss of capacity.
- › Dredging equipment may strike the Railway Infrastructure and any supporting Infrastructure causing damage.
- › Anchoring of vessels may damage the Railway Infrastructure and any supporting Infrastructure.
- › Waterproofing systems and protective systems for durability could be damaged from dredging activities near underwater structures.

4.1.4.2. Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the proposed activities and mitigating the potential impacts.

- › Ensure compliance with the requirements of the latest version of the Code of Construction Safety Practice published by the Dubai Municipality.

- › Marine traffic within railway protection zone shall be approved by the concerned authorities
- › Do not carry out dredging within the Railway Protection Zone.
- › Do not anchor vessels inside the Railway Protection Zone of bridge sections and the Critical Zone of tunnel sections (refer Figure 4.8 and Figure 4.9).

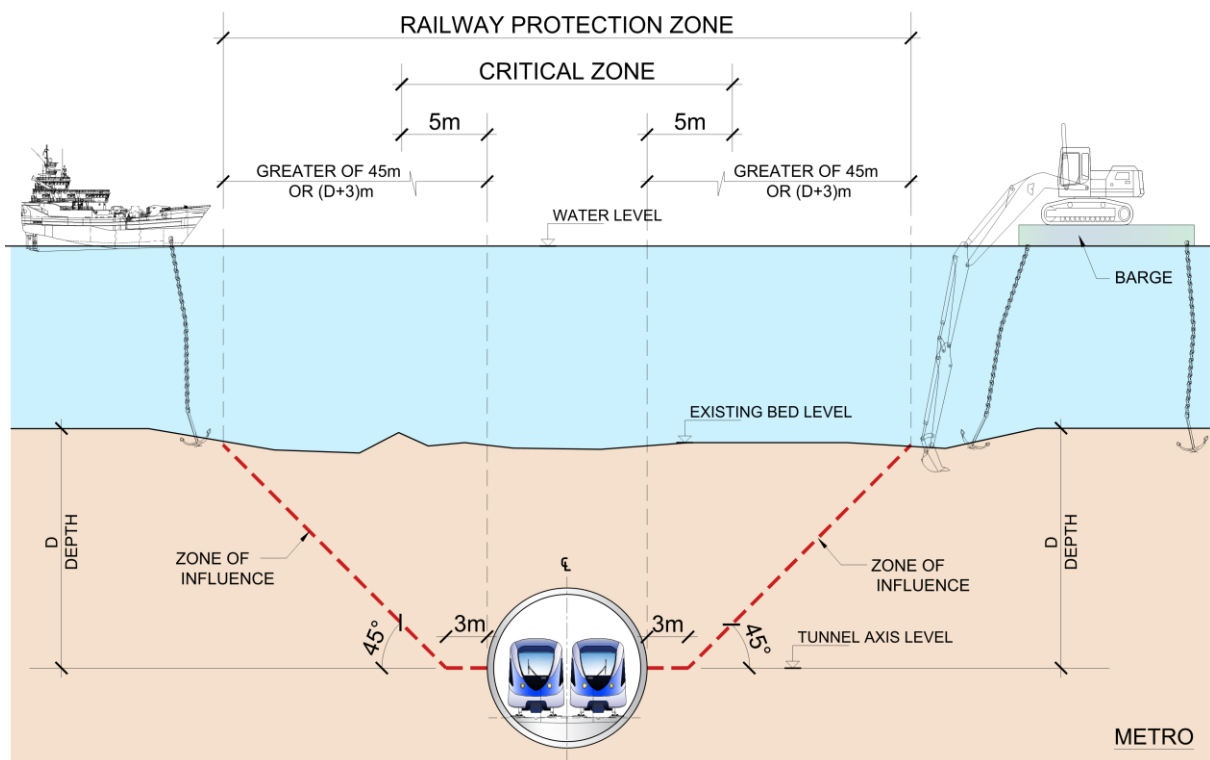


Figure 4.8: Vessels shall be anchored outside the Critical Zone and Dredging shall be outside the Railway Protection Zone for Tunnels.

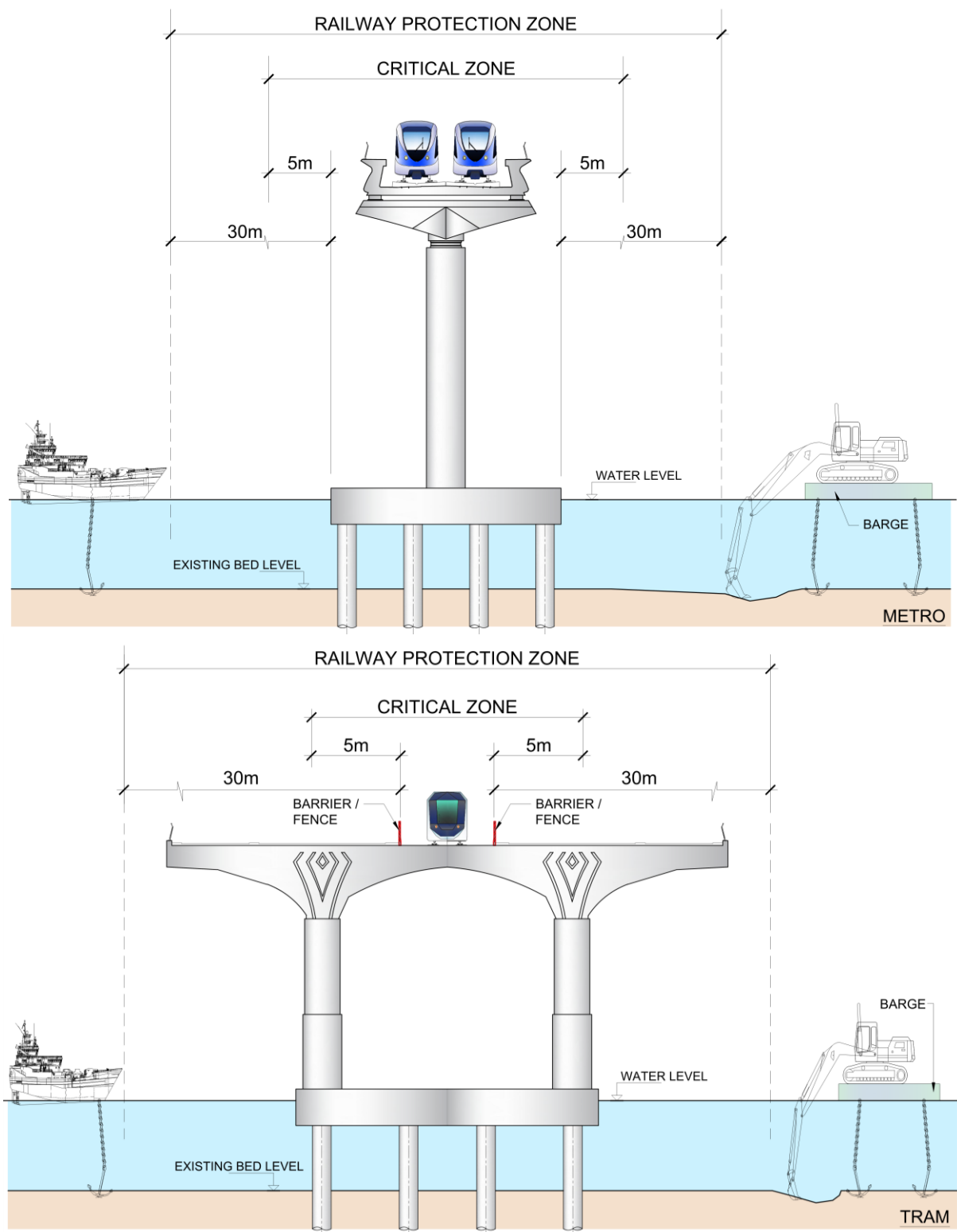


Figure 4.9: Anchoring of Vessels and Dredging Shall be Outside the Railway Protection Zone for Bridges.

4.1.5. SA5: Construction of Underground Passageways

This Site Activity is the construction of underground passageways to serve as a conduit for utilities, access for people, vehicles or equipment to an underground work site.

4.1.5.1. Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › Tunnelling and excavation works may cause changes to the original ground conditions (e.g. excessive ground movement or change in groundwater conditions) which may cause stress changes and thereby damage the Railway Infrastructure or affect Railway Operations.
- › Vibration generated from underground works may affect the Railway Infrastructure.
- › Excavation for launching, jacking and receiving shafts, access adits, etc. could result in ground movement affecting the Railway Infrastructure and safe operation of the Railway.
- › Works associated with underground works may affect passenger entry and exit points from the Railway during either normal or emergency operations.
- › Refer also to risks in SA6: Excavation of Trenches and Earth Movement.

4.1.5.2. Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the proposed activities and mitigating the potential impacts.

- › Ensure compliance with the requirements of the latest version of the Code of Construction Safety Practice published by the Dubai Municipality.
- › Implement best engineering practice, standards and procedures in the design and construction of tunnels to ensure minimal effects upon the surrounding Railway Infrastructure.
- › Provide fully detailed work methodology and Risk Assessment Report as part of the NOC application. Clearly indicate potential risks involved in the construction methods chosen and the Control Measures to mitigate them.
- › Fully develop monitoring plans as part of the NOC application package.
- › Provide properly engineered ground support systems to prevent excessive ground loss, surface settlement and failure. Include details of proposed support systems in the method statement.

- › Conduct a thorough study of groundwater conditions including the effect of lowering ground water levels and the sensitivity of the Railway Infrastructure to change in water levels. Provide mitigation measures in the NOC application.
- › Include contingency plans in method statements so that any potential risk or signs of impending failure of the support system could be rectified immediately.
- › Use manual excavation if close to the Railway Infrastructure and utilities.
- › Use a qualified surveyor to confirm the location of underground Railway Infrastructure and utilities before commencing any underground works.
- › Clearly define the method of grouting following tunnelling works to minimise settlement.
- › Ensure temporary or permanent tunnel linings are installed immediately to provide support to the excavated ground.
- › Carefully study the sequence of excavation, installation of temporary ground support and stabilisation of ground before excavation to maintain stability of the face and the temporary tunnel lining.
- › Use watertight linings.
- › Refer also to Control Measures in SA6: Excavation of Trenches and Earth Movement.

4.1.6. SA6: Excavation of Trenches and Earth Movement

This Site Activity is the digging or excavation of trenches or pits, shoring of excavations, constructing earthworks and backfilling, dewatering of ground water, or the shifting or pushing of earth or soil from one area to another, whether or not such activities are carried out manually or by mechanical means.

4.1.6.1. Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › Excavation equipment may directly contact and damage the Railway Infrastructure.
- › Collapse or movement of excavations may lead to change in ground stresses and result in damage to the Railway Infrastructure.
- › Change in groundwater conditions arising from excavations may change in-situ pore pressures leading to ground settlement or change in stress upon Railway Infrastructure.
- › Excessive vibration generated by machinery used for excavation or earth moving may cause damage to the Railway Infrastructure or affect passenger comfort.
- › Excavations or operations may obstruct passenger access and egress during both normal and emergency operations. Emergency response teams may be obstructed by existing excavations.

- › Excavations may alter current stormwater flowpaths and may direct water into the Railway structures.
- › Electrocution risk through striking electrical services.
- › Utility strike results in loss of utility (water, power, etc.) to Railway Infrastructure affecting operations.
- › Severed water main may result in flooding of Railway Infrastructure.

4.1.6.2. Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the proposed activities and mitigating the potential impacts.

- › Ensure compliance with the requirements of the latest version of the Code of Construction Safety Practice published by the Dubai Municipality.
- › Implement best engineering practice, standards and procedures in design and construction. Plan and design the works to minimise disruption to Railway Infrastructure.
- › Contact the local authorities and verify on plan the buried services in the vicinity.
- › Carefully expose any services on site to verify their location.
- › Conduct a full survey to ascertain the existence, location and nature of services.
- › Stop any work in the vicinity of the service if any unknown or unexpected service is discovered or uncovered and inform the Agency. Take appropriate precautions for protection prior to restarting.
- › Study the potential impact of proposed excavations upon the Railway Infrastructure through analysis to verify impacts are minimal before carrying out the works (refer Figure 4.10).
- › Conduct a thorough study of existing and proposed change in groundwater conditions during the works. The effect of lowering (or raising) of groundwater levels upon the Railway Infrastructure shall be fully studied and details of the proposed mitigation measures shall be provided in the NOC application.
- › Select equipment and methods such that the Peak Particle Velocity (PPV) is within the recommendations of the Code of Practice.
- › Use a qualified surveyor to check the location of underground Railway Infrastructure and utilities before commencing any underground works.
- › Backfill and compact trenches immediately after completion of underground works such as laying of utilities or pipes.
- › Strictly control the use of equipment or machinery near the Railway utility lines through close supervision and placing of physical barriers.
- › Maintain close control through survey and supervision to avoid overexcavation.

- › Trial trenches shall not be open for period more than two weeks.

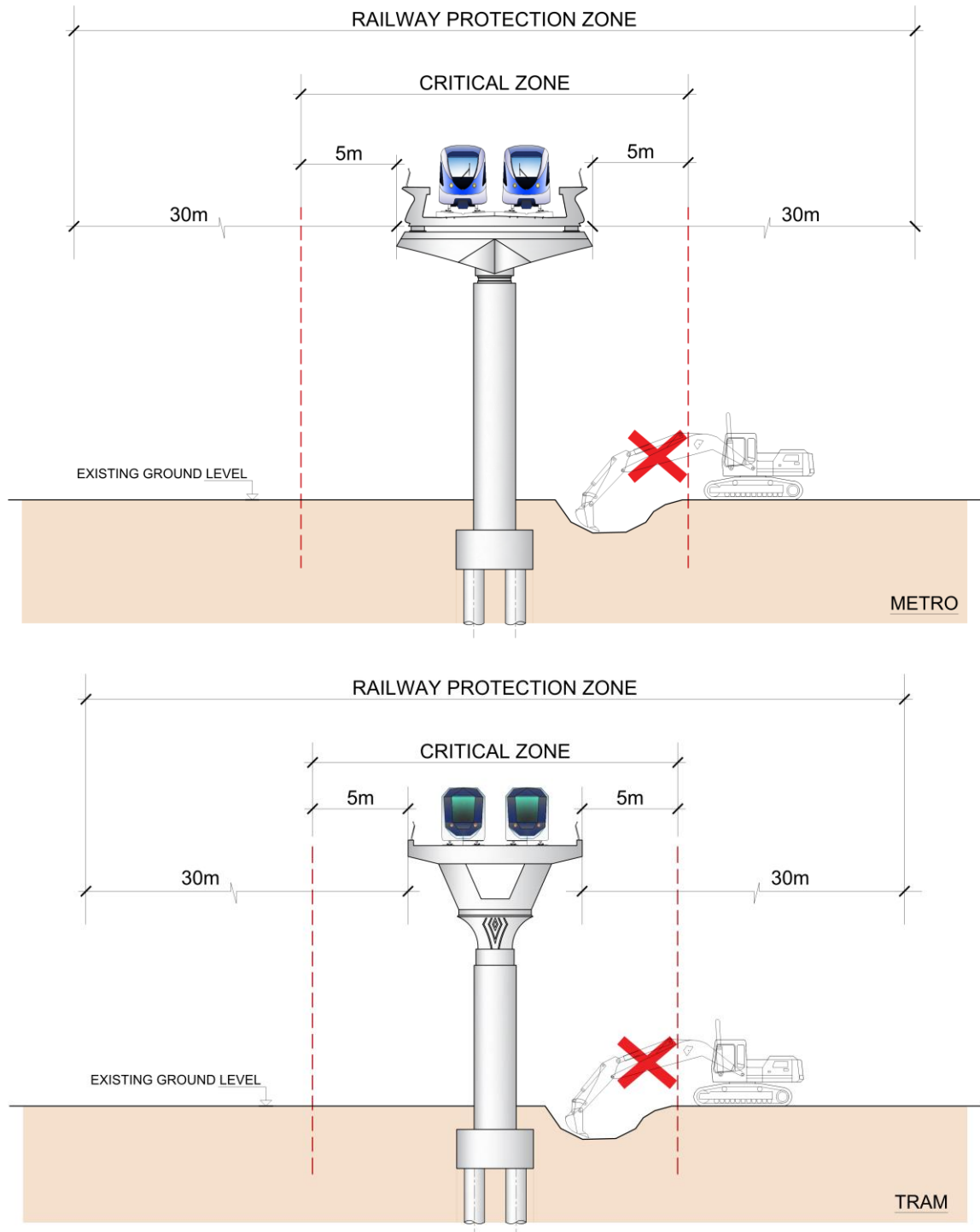


Figure 4.10: Excavation or Earthmoving Activities within the Critical Zone shall not be

carried out before Engineering Analysis has been undertaken.

- › Provide sufficient stormwater drainage or barriers near at-grade Railway Infrastructure such that stormwater or any unexpected water flows (e.g. dewatering pipe failure) are directed away from the Railway Infrastructure.
- › Use Shoring, Battering or Benching for all excavations greater than 1.5m. Verify to the Agency's satisfaction the stability of the proposed Shoring systems and/or Benching or Battering geometries.
- › Use a competent and experienced geotechnical engineer to:
 - › Approve in writing all sides of the trench as safe from collapse.
 - › State in writing how long the approval lasts if there is no stated natural occurrence that could affect adversely the stability of the trench.
 - › State in writing the natural occurrences that could affect adversely the stability of the trench. Avoid placing stockpiles, overburden or other materials on the edge of the excavation (this includes earth moving machinery).
- › Backfill and compact trenches immediately after services or pipes are laid.
- › Orient machineries operating near the station ventilation shafts and entrances so that exhaust and fumes are directed away from the station intake/supply shafts and entrances.
- › Ensure sufficient measures are implemented to minimize dust arising from construction activities near the entrance structures and ventilation inlets/outlets.

4.1.7. SA7: Demolition

This Site Activity is concerned with the tearing-down of buildings and other structures manually or using hydraulic equipment, wrecking ball, or blasting methods.

Demolition of structures directly connected to the Railway is not covered here and shall be raised directly with the Rail Agency prior to any work being carried out as very specialised precautions are required.

4.1.7.1. Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › Excessive vibration generated by demolition works could damage the Railway Infrastructure or affect passenger comfort.
- › Debris or objects could be projected onto the Railway Infrastructure resulting from demolition activities causing damage.
- › Demolition equipment may strike the Railway Infrastructure causing damage.

- › Demolition debris, equipment or the site compound may obstruct passenger access and egress during both normal and emergency operations. Emergency response teams may be obstructed.
- › Dust arising from demolition activities may result in passenger discomfort.
- › Demolition activities may create fire or explosion affecting the Railway.

4.1.7.2. Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the proposed activities and mitigating the potential impacts.

- › Ensure compliance with the requirements of the latest version of the Code of Construction Safety Practice published by the Dubai Municipality.
- › Ensure equipment remains stable with potential failure path away from Railway Infrastructure.
- › Implement best engineering practice, standards and procedures in the design and site works.
- › Do not use blasting within any Railway Protection Zone.
- › Select demolition equipment which minimizes vibration and noise levels. Include a list of equipment with specifications and detailed methods of demolition in the NOC application.
- › Provide proper shields or robust protection screens to ensure no debris or objects are projected on to the Railway Infrastructure (refer Figure 4.11).
- › Suppress the generation of dust and noise disturbance or inconvenience to the commuters during operational hours of Railways.
- › Provide protection shelter over Railway to resist toppling equipment/materials or projected debris (refer Figure 4.12)

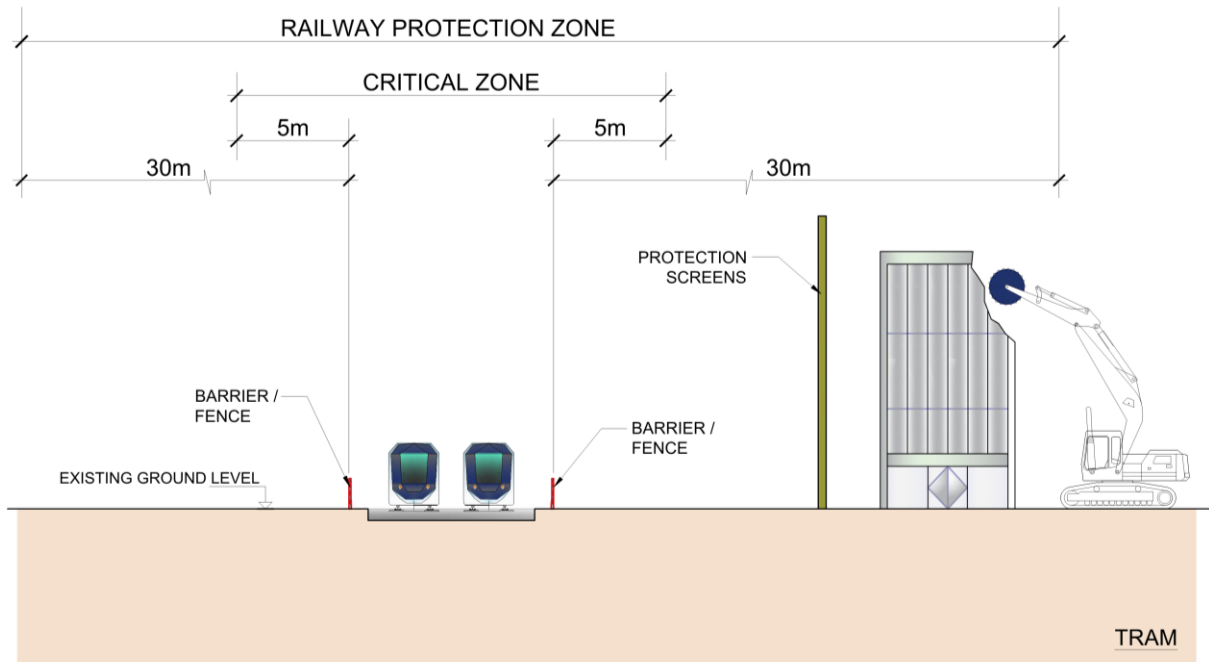


Figure 4.11: Robust Safety Protection Screens shall be provided during Demolition Works within the Railway Protection Zone.

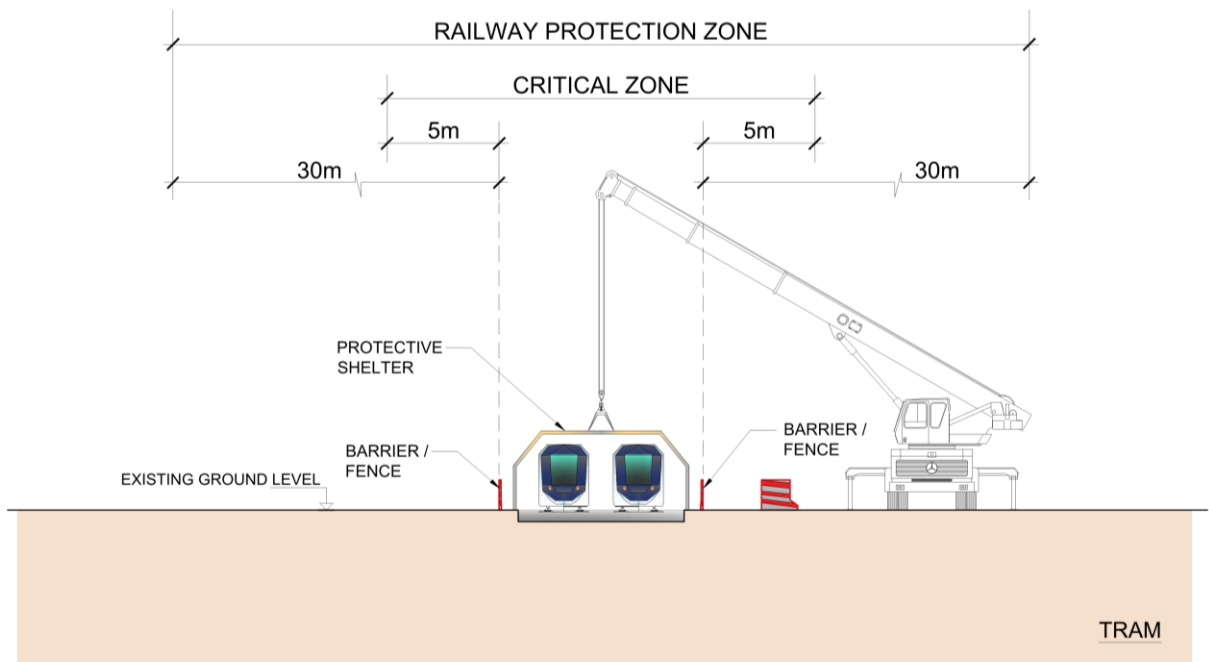


Figure 4.12: Protection Shelter over Railway.

- › Use equipment such as hand-held breakers and crushers.
- › Provide cushioning to the ground with energy absorbing material to reduce the impact on the ground from demolition rubble.
- › Use demolition methods such as stitch coring, diamond cutter or hydro-cutting.
- › Install vibration sensors on Railway structures for vibration monitoring during demolition activities.
- › Plan for maximum acceptable dimensions of debris stockpiles to avoid excess loads upon the Railway. Clear debris as soon as possible such that the allowable surcharge load on the Railway structures will not be exceeded.

4.1.8. SA8: Use of Explosives and Fireworks and the Lighting of Fires

This Site Activity is the use of explosive material, fireworks and lighting of fire for any purpose including blasting, demolition, removal of rocks, or construction.

4.1.8.1. Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › An explosion or a fire within the Railway Protection Zone could damage the Railway Infrastructure and disrupt Railway Operations.
- › Vibration generated from the use of explosives could damage the Railway Infrastructure and disrupt Railway Operations.
- › Burning debris from fireworks poses a risk of fire and injury to passengers.
- › Aerial shells may drift in the wind causing shells to deflagrate near the Railway posing a risk of fire and injury to passengers.
- › Debris from explosives, fireworks and fires could be projected onto the trackway.
- › Smoke from fires may cause passenger discomfort and ill-health.
- › Water used for extinguishing any fires may enter the Railway.

4.1.8.2. Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the proposed activities and mitigating the potential impacts.

- › Implement the principles of the Dubai Municipality Code of Construction Safety Practice and Dubai Civil Defence and National Fire Protection Association (NFPA) for fire protection.
- › Do not use blasting or explosives within the Railway Protection Zone.

- › Do not use fireworks or light fires within the Critical Zone (refer Figure 4.13).

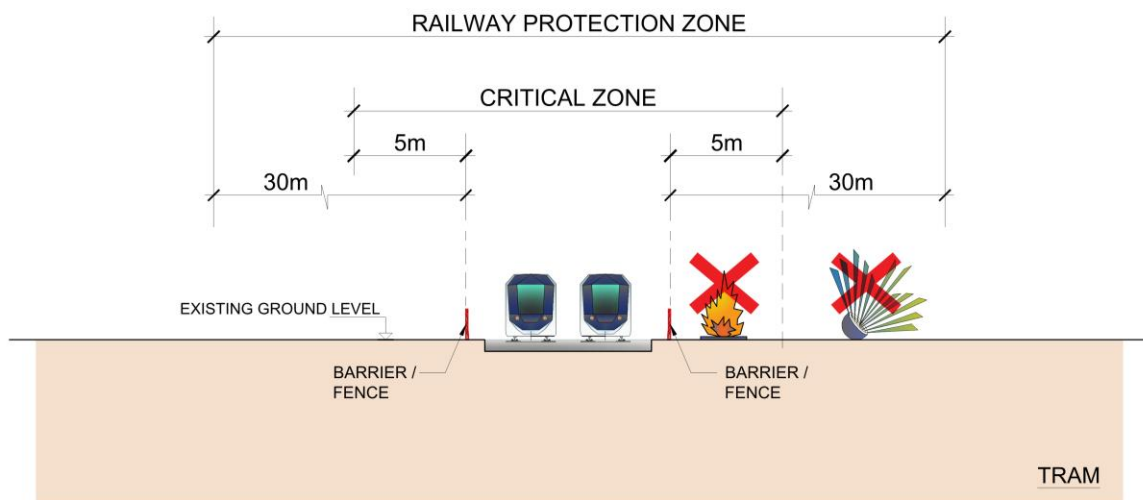
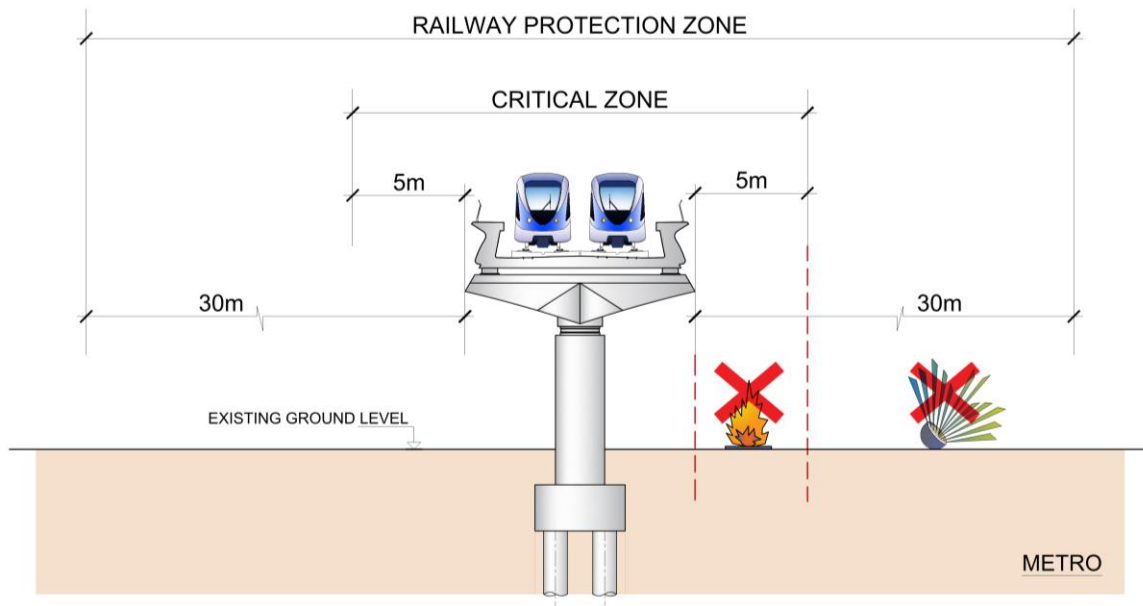


Figure 4.13: Fires shall not be lit in the Critical Zone / Explosives shall not be used in the Railway Protection Zone.

- › Ensure sufficient precautionary measures are in place for using fireworks within the Railway Protection Zone.
- › Provide measures to prevent fragments during the fireworks from hitting Railway Infrastructure or passing Railway Vehicles.

- › Use only a competent and experienced operator who has received formal training in fireworks safety and the use of commercial grade fireworks, special effects and close proximity fireworks.
- › Minimum clearance distances from the Railway Infrastructure are required dependent upon the size and type of the firework.
- › Ensure fire Control Measures are available when lighting any type of fire for example a fire extinguisher, fire blanket or garden hose (as appropriate for the type of potential fire).

4.1.9. SA9: Erection of Scaffolding and Other Temporary Structures

The erection of temporary structures such as sheds, shelters, tents, scaffolding, temporary maintenance towers, ladders, hoardings, site offices, workers' quarters, concrete batching plants and other structures for any purpose.

4.1.9.1. Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › Scaffolding and other temporary structures could fall onto the Railway Infrastructure or passenger access routes.
- › Materials from scaffolding and temporary structures could fall onto Railway Infrastructure or passenger access routes.
- › Scaffolding and other temporary structures could provide unauthorised access to the Railway Infrastructure.
- › Tents, shelters and temporary structures using combustible materials could pose a fire risk to the Railway Infrastructure.
- › The location and layout of tents, shelters and temporary structures could obstruct or interfere with Railway safety provisions such as emergency egress points, ventilation shafts and emergency response facilities.
- › People working on or close to the temporary structures, may be electrocuted if exposed to unacceptable touch voltages through connection between the structures and the Railway.
- › Temporary structures may affect drainage or surface water Control Measures resulting in water ingress to the Railway Infrastructure.

4.1.9.2. Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the proposed activities and mitigating the potential impacts.

- › Ensure compliance with the requirements of the latest version of the Code of Construction Safety Practice published by the Dubai Municipality.
- › Do not erect temporary structures within the Critical Zone of elevated or at grade Railway sections. Locate temporary buildings for site works outside of the Critical Zone.
- › Position temporary structures to ensure that third parties cannot gain access to the Railway Infrastructure.
- › Position scaffolding and other structures erected within the Protection Zone so that in the event of collapse it will not impact on the Railway Infrastructure. Consider the height of the structure and distance to the Railway Infrastructure to determine the safe distance and / or suitable Control Measures if sufficient distance cannot be obtained.
- › Ensure sufficient distance between temporary structures and Railway ventilation ports to avoid interference with the free flow of air into and out of the Railway Infrastructure.
- › Use a competent engineer to design and check temporary structures for stability and safety. Design scaffolding such that it is stable, robust and suitably tied back to prevent any collapse onto the above ground Railway structure.
- › Provide nets or other suitable screens to prevent any debris, tools, etc. from falling onto the Railway Infrastructure (refer Figure 4.14).

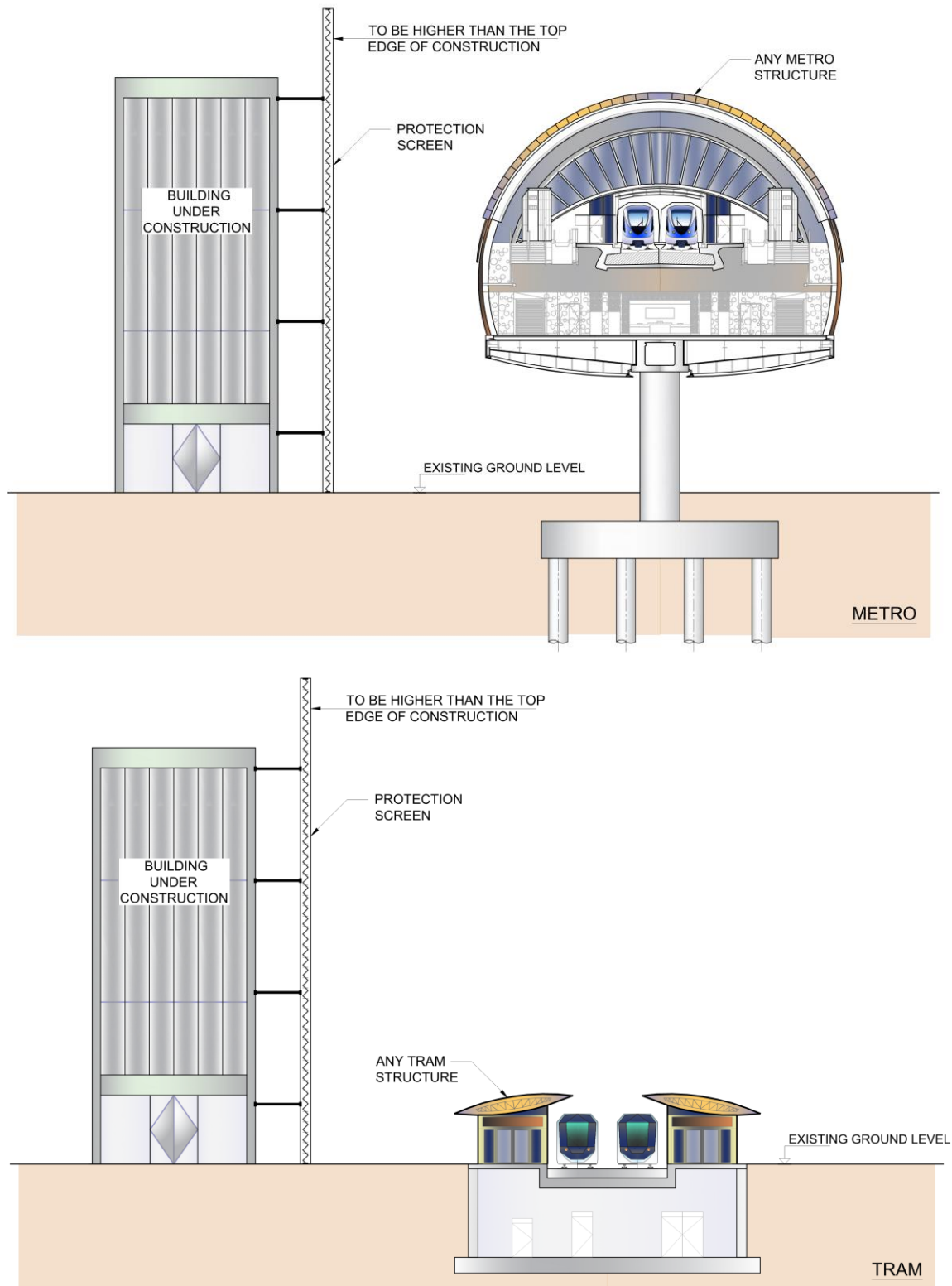


Figure 4.14: Installation of Protection Screen for Building under Construction.

- › Use a competent person under full supervision to ensure the erection of scaffolding and tower structures are in accordance with the designer's requirements.
- › Securely install safety nets, safety mesh and/or containment screening on scaffolding, towers or buildings under construction, facing the Railway, to prevent materials or objects from falling onto the Railway Infrastructure.
- › Secure the formwork when installing or removing to prevent formwork falling from site. Consider the safe working load of the proposed attachment method and the weight of the formwork when selecting an appropriate method.
- › Inspect all scaffolding, temporary structures and mobile scaffold towers on a pre-determined basis (based on Dubai Municipality requirements and the level of risk) to ensure that no damage has occurred. A scaffold tag shall be attached to the scaffolding, temporary structures and mobile scaffold towers detailing when it was assembled and when the next inspection is due.
- › Ensure temporary earthing due to induction or touch potential is considered for temporary metal structures such as scaffolding. No structure shall be earthed to the track, fencing or other RTA equipment without consulting the Agency.
- › Use flame resistant materials for temporary structures.
- › Provide adequate fire protection measures for temporary structures in compliance with the relevant Regulations (refer Figure 4.15).
- › Position tent and temporary structures so that they do not obstruct fire engine and emergency access and egress points, breeching inlets, fire escape stairs, etc. or interfere with the airflow of Railway vent shafts.
- › Use non-combustible materials for the erection of any temporary structure located within the Critical Zone.
- › Ensure no fire risk activities within any temporary structure located within the Critical Zone.
- › Provide fire compartmentation to work area. Maintain existing fire safety and fire protection systems.
- › Maintain clear minimum width for Railway passengers during normal and emergency events (e.g. fire, evacuation, etc.).
- › Ensure safe and protected passageway access into and out of Railway Infrastructure.

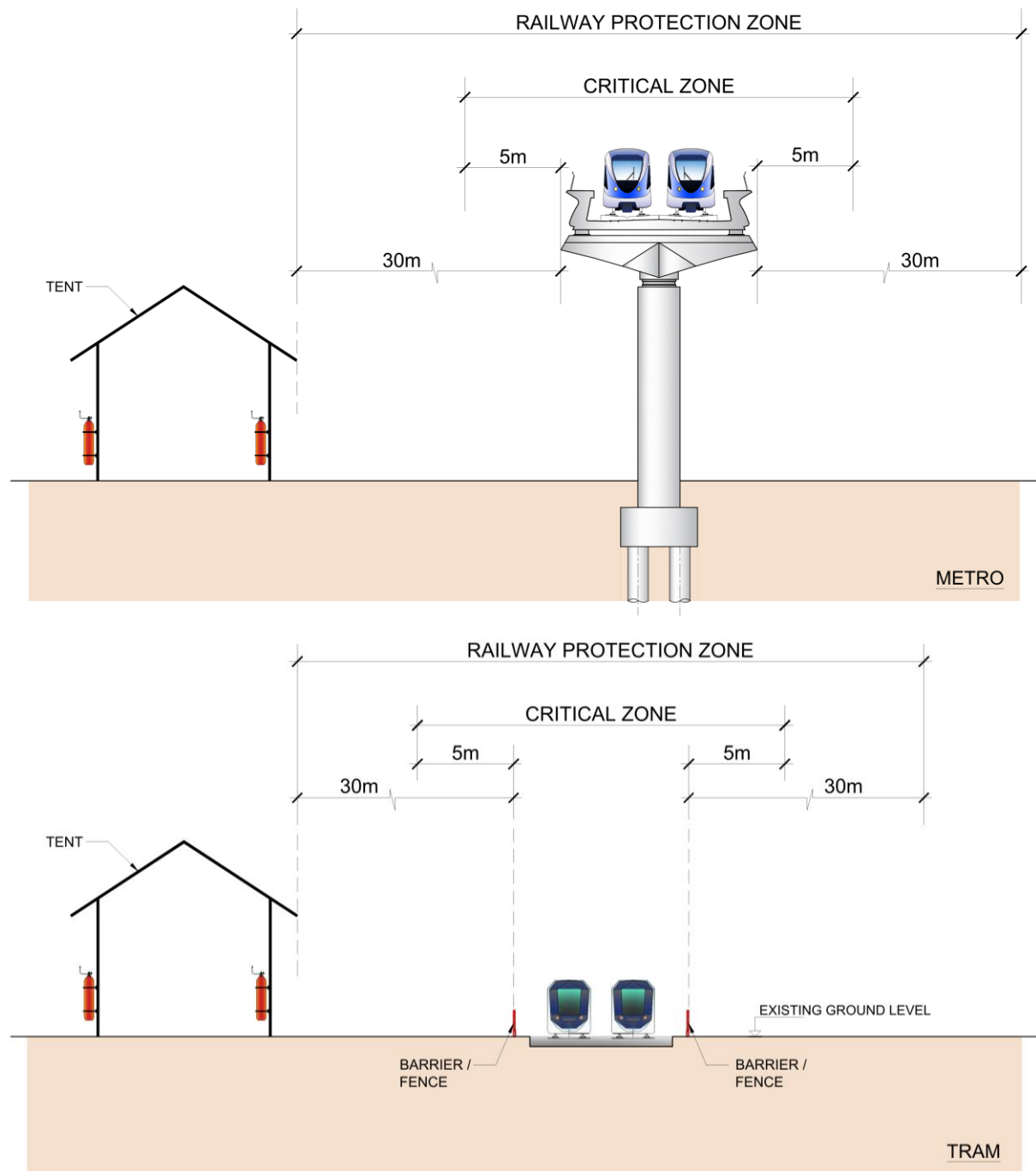


Figure 4.15 : Tents or Sheds shall have appropriate Fire Protection Measures.

4.1.10. SA10: Installation or Replacement of Conduits for Any Utilities

This Site Activity is the installation or replacement of conduits for any telecommunications, electrical and mechanical utilities, including power transmission lines and associated structures.

4.1.10.1. Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › Installation of new transmission or power lines in the Railway Protection Zone could affect the operation and safety of critical Railway systems and equipment.
- › Installation or replacement of conduits and associated works within the Railway Protection Zone could also pose the risks identified in Site Activity SA2, SA6 and SA9.

4.1.10.2. Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the proposed activities and mitigating the potential impacts.

- › Ensure compliance with the requirements of the latest version of the Code of Construction Safety Practice published by the Dubai Municipality.
- › Use fully trained and qualified personnel to operate the equipment and machinery.
- › Conduct an electromagnetic compatibility analysis of the potential effects imposed by the power lines or associated facilities such as sub-stations in the Risk Assessment Report included in the Applicant's NOC package. Mitigation measures for this shall be included in reports prepared by relevant specialists.
- › Risks which are identical to those in Site Activity SA2, SA6 and SA9 shall follow the corresponding Control Measures for each Site Activity.

4.1.11. SA11: Other Activities to be Controlled

The below list is not exhaustive. The Applicant shall seek advice from the Rail Right of Way Department to determine whether there is a risk to the Railway from any other proposed activities, not limited to the following below.

4.1.11.1. Planting of Trees and Shrubs

The planting of trees or shrubs where branches or the root system could enter the Critical Zone of the Railway Infrastructure.

Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › Debris from trees (leaves, branches, etc.) could fall onto the track affecting Railway operations.
- › Encroachment of tree branches could be an obstruction to the Railway Vehicle causing damage or affecting operations.
- › Encroachment of tree branches could be a visual obstruction to the driver of the Railway Vehicles (e.g. Tramway)
- › Encroachment of tree or shrub roots into the Critical Zone could cause damage of the Railway Infrastructure through ground movement.
- › Maintenance of vegetation may lead to activities affecting the Railway (e.g. fall from height, dropping of pruning equipment or collapse of temporary structure).
- › Overgrown vegetation if ignited may represent fire risk to the Railway Infrastructure.
- › Overgrown vegetation may obstruct ventilation inlets and outlets to the Railway Infrastructure.
- › Overgrown vegetation may obstruct passenger access and egress during both normal and emergency operations.
- › Emergency response teams may be obstructed.
- › Faulty irrigation systems or excessive irrigation may direct water into at-grade sections of the Railway Infrastructure through surface flow or buildup of groundwater.

Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the proposed activities and mitigating the potential impacts.

- › Ensure compliance with the requirements of the latest version of the Code of Construction Safety Practice published by the Dubai Municipality.

- › Plant larger trees and shrubs outside the Critical Zone and in an area where the branches or roots cannot enter the Critical Zones (refer Figure 4.16).

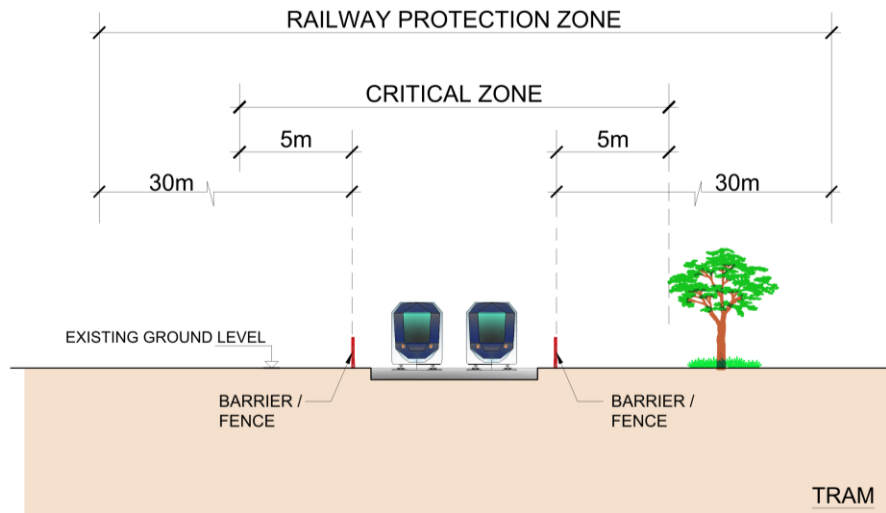




Figure 4.16: Trees and Shrubs shall be outside the Critical Zone.

- › Demonstrate that the distance of tree or shrub from the Railway Infrastructure is greater than $1.5 \times$ the height of the fully grown plant.
- › Submit a maintenance plan for the tree canopy demonstrating that the width of the tree canopy or shrub when fully grown will be managed such that it will not impact on the Railway Infrastructure. Pruning activities shall be considered such that they do not pose a risk to the Railway (e.g. risk of scaffolding or fall of materials onto track).
- › Use root barrier products when planting within the Railway Protection Zone to prevent root and branch penetration into the Critical Zones.
- › Do not use the following species of plant within 20 metres of Railway Infrastructure due to the invasive nature of the root system (refer Table 4.1).

Table 4.1: List of Prohibited Plants

COMMON NAME	BOTANICAL NAME	PHOTOGRAPH
Damas Tree	<i>Conocarpus lancifolius</i>	
Weeping fig	<i>Ficus benjamina</i>	

4.1.11.2. Diversion of Pedestrian or Vehicular Traffic

Any traffic or pedestrian diversion that may affect the safe and continuous operation of the Railway will require an NOC to ensure the safety of the Railway is not affected by the proposed diversion.

Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › Diversion directs pedestrians into or very close to the Railway Infrastructure or path of the Railway Vehicles.
- › Diversion directs vehicles into or very close to the Railway Infrastructure or path of the Railway Vehicles. This may increase loads, increase risk of vehicle collision or increase fire risk to Railway Infrastructure.
- › Diversion affects the line-of-sight of the driver of the Railway (e.g. Tram).
- › Diversion takes space that is required for passenger access and egress during both normal and emergency operations. Emergency response teams may be obstructed.

Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the proposed activities and mitigating the potential impacts.

- › Ensure compliance with the requirements of the latest version of the Code of Construction Safety Practice published by the Dubai Municipality.

- › Ensure all proposed traffic and pedestrian diversion plans are assessed by the Traffic Department and Rail Right of Way Department.
- › Provide enhanced protective measures to prevent risk of collision (e.g. barriers, traffic lights to regulate traffic, speed restrictions, speed humps, etc.)

4.1.11.3. Use of Unmanned Aerial Vehicles (UAV)/Drones

The use of any Unmanned Aerial Vehicle (UAV) that may affect the safe and continuous operation of the Railway will require an NOC to ensure the safety of the Railway is not affected by the use of the UAV.

Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › UAV could fall (through mechanical, electrical, signal failure or interference) causing damage to Railway Infrastructure, obstruction to Railway track or injury to passengers and public.
- › Item could detach and fall from UAV causing damage to Railway Infrastructure, obstruction to Railway track or injury to passengers and public.
- › UAV could become uncontrolled (through operator inexperience, error or interference) causing damage to Railway Infrastructure, obstruction to Railway track or injury to passengers and public.
- › UAV may collide with other UAVs resulting in damage to Railway Infrastructure, obstruction to Railway track or injury to passengers and public.
- › Electromagnetic interference or control signals from UAV could affect existing Railway electromagnetic radio and communication systems.

Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the proposed activities and mitigating the potential impacts.

- › Comply with requirements of Law No. (4) of 2020 “Regulating Unmanned Aircraft in the Emirate of Dubai”
- › Avoid using UAV within Railway Protection Zone.
- › Use operator of UAV with license, training and/or certification for use of UAVs in populated / critical areas.
- › Ensure local aviation authority is notified and has provided written authorization for the use of the UAV for the proposed works.

- › Ensure other appropriate authorities (e.g. Dubai Police, Dubai Municipality, etc.) are notified and given written authorization for the use of the UAV for the proposed works.
- › Verify through study to the approval of the Agency that there is compatibility between UAV and Railway radio, communication and control systems.
- › Inspect drone prior to use to ensure all systems and components are fully functional.

Obligations Related to the Operation UAV

An Operator, an Unmanned Aircraft Pilot, a Controller, or a Crew Member, as the case may be, must:

- › Comply with the safety requirements and procedures prescribed by the DCAA and with the instructions of the manufacturer;
- › Comply with the security requirements prescribed by the DCAA in coordination with the DANS and concerned entities;
- › Comply with the procedures and rules for operating Unmanned Aircraft and their systems, including pre-flight procedures as well as safety procedures for taking off, approaching, landing, and Aircraft separation distance;
- › Ensure that Unmanned Aircraft and their systems are in a good working condition prior to taking off; and comply with the instructions of the manufacturer in this respect;
- › be familiar with all details of the relevant flight or Operation;
- › comply with the procedures prescribed by the DCAA for handing over the control of Unmanned Aircraft to another Unmanned Aircraft Pilot or Controller;
- › comply with the instructions of the DCAA and the manufacturer in respect of operating more than one Unmanned Aircraft using a single Remote Control Station;
- › comply with the conditions and rules prescribed by the DCAA in respect of the load of Unmanned Aircraft;
- › not use Unmanned Aircraft in a reckless manner; violate any legal obligation; or take any action or conduct any activity that may compromise the Airspace Safety and security or the safety of Persons or property in any way or manner whatsoever;
- › ensure the provision of a third party liability insurance to cover damage that may result from Operations or Operation Tests, in accordance with the conditions and rules prescribed by the DCAA in this respect;
- › ensure that the Unmanned Aircraft Airport is suitable for conducting Operations, taking off, and landing and that it is in compliance with the safety requirements prescribed by the DCAA;
- › immediately suspend Operations or Operation Tests in case of any possible danger that may compromise the safety of aviation, Persons, or property;
- › comply with the emergency plan approved by the DCAA in case of the breakdown of Unmanned Aircraft or the failure of their systems, the Remote Control Stations, or the equipment used for Operations; in case of losing connection with, or losing control

over, an Unmanned Aircraft; in case of terminating flights; and in any other cases determined by the DCAA;

- › immediately notify the Rail Agency upon the occurrence of any Accident, Incident, or violation of the terms of a Permit;
- › perform periodic maintenance of Unmanned Aircraft and their systems in accordance with the manufacturer's manual and other manuals adopted by the DCAA;

4.1.11.4. Installation of Wireless Equipment

The use of any wireless equipment (e.g. CCTV cameras, etc.) adjacent to the Railway that may affect the safe and continuous operation of the Railway will require an NOC to ensure the safety of the Railway is not affected.

Associated Risks

The following list identifies a number of risks associated with this Site Activity when working within the Railway Protection Zone. The list is not exhaustive and the Applicant is responsible for identifying and mitigating all risks to the Railway Infrastructure arising from the proposed activities.

- › Wireless equipment may generate signals or receive signals that may interfere with existing Railway wireless, radio, communication and electromagnetic systems.

Control Measures

The following list is provided to assist the Applicant in developing any Control Measures to address the risks arising from Site Activity. The list is not exhaustive and the Applicant is responsible for identifying risks to the Railway Infrastructure arising from the proposed activities and mitigating the potential impacts.

- › Verify through study to the approval of the Agency that there is compatibility between proposed wireless equipment and Railway wireless, radio, communication and electromagnetic systems.

4.1.11.5. Other Site Activities

Other activities may be considered as Site Activities depending on the Agency's perception of the Risk to the Railway Infrastructure. The Agency should be consulted on any proposed activities within the Railway Protection Zone and will advise whether any other activities will be considered as Restricted. Such Activities include but are not limited to the following;

- › Road works and Road maintenance works.
- › Building works.
- › Installation of monitoring devices.
- › Installation or operation of plant or machineries.
- › Dewatering.

The Applicant shall provide sufficient Risk and Control Measures associated with these activities to the satisfaction of the Agency prior to the approval of any NOC for these works.

4.2. Low Risk Site Activities

- 4.2.1. Table 4.2 below defines the type of activities which are considered Low Risk Site Activities (LRSAs) within each Site Activity category. The approval of any NOC application for a LRSA will be subject to compliance with the Rail Right of Way (RROW) Department and the Operator general conditions for LRSAs.
- 4.2.2. The approval of any LRSA does not remove the obligation of the Applicant to ensure that all Restricted Activities are performed in a manner that is safe, and minimizes as far as reasonably practicable any risks to the Railway and Railway Infrastructure.
- 4.2.3. The following Low Risk Site Activities are ONLY applicable in the following cases;
- › The work is outside the 5m critical zone (unless specified in Table 4.2 below).
 - › The work involves machinery whose total height does not intrude into the critical zone in the event of collapse.
 - › The works consists of temporary structures whose total height does not intrude into the critical zone in the event of collapse.

Table 4.2: Description of Low Risk Site Activities

SA NO.	ACTIVITY CATEGORY	SUBCATEGORY LOW RISK SITE ACTIVITY
SA1	Storage of goods	<p>SA1.1: Loading, unloading and storage of materials within the Railway Protection Zone for Underground structures that does not affect the safety of the Station Entrance Pods, Annex, Shaft, and any other Railway Infrastructure.</p> <p>SA1.2: Loading, unloading and storage of materials of Supermarket outside Critical Zone that does not affect the safety of the Station Entrance Pods, Annex, Shaft, and any other Railway Infrastructure.</p> <p>SA1.3: Loading, unloading and storage of non-hazardous / non-flammable / incombustible materials outside the Critical Zone that does not affect the safety of the Station Entrance Pods, Annex, Shaft, and any other Railway Infrastructure.</p>

SA NO.	ACTIVITY CATEGORY	SUBCATEGORY LOW RISK SITE ACTIVITY
SA2	Movement or operation of cranes, hoists, other lifting equipment and any machinery	<p>SA2.1: Using mobile crane or any machinery operation within the Railway Protection Zone for Underground structures that does not affect the safety of the Station Entrance Pods, Annex, Shaft, and any other Railway Infrastructure.</p> <p>SA2.2: Using Cradle crane for building cleaning and maintenance within the Railway Protection Zone for Underground structures that does not affect the safety of the Station Entrance Pods, Annex, Shaft, and any other Railway Infrastructure.</p> <p>SA2.3: Use of cherry picker for maintenance activities (e.g. painting, repair, etc.) outside the Critical Zone and within the plot limit of the building being maintained.</p>
SA3	Installation of boreholes and wells	SA3.1 Any soil investigation / bore holes works outside the Critical Zone for overground Railway sections that do not affect the safety of the Station Entrance Pods, Annex, Shaft, and any other Railway Infrastructure.
SA4	Dredging of sea-beds and canal-beds	Not applicable.
SA5	Construction of underground passageways	Not applicable.
SA6	Excavation of trenches, earth movement	<p>SA6.1: Manual excavations for house utility connections.</p> <p>SA6.2: Manual excavation of trial trenches and shallow excavations less than 1.5m outside the Critical Zone.</p> <p>SA6.3: Landscaping work (e.g. laying tiles, construction of garden beds, irrigation installation etc.).</p>
SA7	Demolition	Not applicable.
SA8	Use of explosives and fireworks and the lighting of fires	Not applicable.
SA9	Erection of scaffolding and other temporary structures	<p>SA9.1: Erection of scaffolding or temporary structures outside the Critical Zone for erection/replacement/maintenance of shop signage and advertisement panels that does not affect the safety of the Station Entrance Pods, Annex, Shaft, and any other Railway Infrastructure.</p> <p>SA9.2: Erection of scaffolding or temporary structures within Railway Protection Zones for Underground structures that does not affect the safety of the Station Entrance Pods, Annex, Shaft, and any other Railway Infrastructure.</p> <p>SA9.3: Garden sheds, marquee, tents, inflatable castles, playground equipment, ladders etc. outside the Critical Zone and within the plot limit for residences not exceeding 3 stories only.</p>

SA NO.	ACTIVITY CATEGORY	SUBCATEGORY LOW RISK SITE ACTIVITY
SA10	Installation or replacement of conduits for any utilities	<p>SA10.1: Cabling works for Etisalat and du.</p> <p>SA10.2: Cabling works for DEWA low voltage.</p> <p>SA10.3: Joint box works and fault / emergency repairs.</p> <p>SA10.4: Excavation less than 1.5 m outside the Critical Zone.</p>
SA11	Other activities to be controlled	<p>SA11.1: Interior decoration, modification (including painting) inside building within the Railway Protection Zone.</p> <p>SA11.2: Maintenance or refurbishment of existing building or structures within the Railway Protection Zone for Underground structures that does not affect the safety of the Station Entrance Pods, Annex, Shaft, and any other Railway Infrastructure.</p> <p>SA11.3: Any maintenance or refurbishment works of existing buildings or structures outside the Critical Zone for overground Railway sections that does not affect the safety of the Station Entrance Pods, Annex, Shaft, and any other Railway Infrastructure.</p> <p>SA11.4: Information NOCs.</p> <p>SA11.5: Planting of trees/shrubs whose branches or root systems will not enter the Critical Zone within the plot limit for residences not exceeding 3 stories only.</p>

4.2.4. The following general conditions are applicable for Low Risk Site Activities;

- › Where possible and appropriate the contractor must inform the nearest station of the activity under this NOC.
- › Work areas must be kept clean and tidy.
- › Separation should be kept between the public and the worksite at all times.
- › No flammable material storage is permitted.
- › Risk assessment and method statement should be on site at all times showing NOC approvals.
- › Any damage to the Railway Infrastructure must be reported immediately of it occurring.
- › Any accidents or incidents that occur must be reported to the nearest station.
- › All RTA RROW comments are in conjunction with these conditions.



5. No Objection Certificate

5.1. General

- 5.1.1. Any party (hereafter called 'the Applicant') intending to carry out a Restricted Activity within a Railway Protection Zone shall apply to obtain a No Objection Certificate (NOC) from the Rail Agency prior to commencing any such Restricted Activity.
- 5.1.2. Formal approvals are required for permanent or temporary works whose presence or failure could adversely affect or otherwise interfere with the Railway Infrastructure, Railway Operation or endanger the safety of passengers.
- 5.1.3. A NOC is also mandatory for any works (including constructing buildings, infrastructure or utility services) for any purpose which lies outside the Railway Protection Zone that the Agency considers may impact on the Railway Infrastructure or safe operation. For example;
- › Operation of tall crane masts located outside the RPZ but with collapse radius within the Railway Protection Zone.
 - › Tall cranes where the jib of the crane falls within the RPZ.
 - › Dewatering activities where the zone of influence of groundwater drawdown falls within the RPZ.
- 5.1.4. As part of the NOC process, the Applicant shall agree with the Agency a schedule of submissions based on the various phases of the project.
- 5.1.5. To minimise the need for onerous or costly protective measures the Applicant should give consideration in design and planning to the following:
- › Avoiding any work within the boundaries of the operational Railway.
 - › Eliminating any need to modify any Railway Infrastructure, including utilities.
 - › Avoiding any work outside the operational Railway but nevertheless within the Railway Protection Zone.
 - › Adopting a construction methodology which avoids the need to gain access to the track.
 - › Designing to minimise any risks to the Railway.
 - › Designing the structure considering maintenance requirements. Note that access to the exterior of a structure within the RPZ for maintenance will require a NOC from the Agency each time maintenance is carried out.
 - › For a possession, assessing the risks of possession overrun (or other operational delay) and implementing appropriate mitigation measures and safe working systems.

- › Carrying out any essential critical activities in engineering hours (Non-operational hours of the Railway).

5.1.6. Minimising interruption to Railway operations during construction shall be a prime consideration in the design phase.

5.2. Types of NOC

5.2.1. The types of NOC that may be granted are outlined in Table 5.1 below:

Table 5.1: List of NOC Types

NOC TYPE	DESCRIPTION
INFORMATIONAL NOC	NOC allows the Applicant access to available and relevant Rail Agency as-built information, manual or design.
DESIGN NOC	NOC allows the Applicant to proceed to Construction NOC. There are three types; <ul style="list-style-type: none"> › Concept Design NOC › Preliminary Design NOC › Final Design NOC
TRIAL TRENCHES NOC	NOC allows the Applicant to excavate hand-excavated trial trenches around existing Rail Infrastructure.
CONSTRUCTION NOC	NOC allows the Applicant to proceed with construction of planned works.

5.2.2. Other NOCs are listed in the e-NOC portal (e.g. submission of design study reports, monitoring records, preconstruction surveys, etc.) which can be used by the Applicant whenever the activity is located within the RPZ and is not required to be reviewed by authorities other than the Rail Agency.

5.2.3. Each NOC can be applied for using the RTA e-NOC system which is located in the following link below;

<https://noc.rta.ae/RTAeNOC/Webpages/common/login/login.aspx>

5.2.4. Each NOC may include requirements and/or conditions, which may differ depending on the status of the affected Railway, whether it is planned, under construction or operational.

5.2.5. A list of Frequently Asked Questions for NOC Applicants is provided in Appendix A.

5.2.6. In the event of emergencies, NOC procedures will follow the emergency procedures agreed between the Agency and relevant stakeholders. In any case, the emergency call centre should be contacted as per the Incident/Accident Management procedure outlined in Section 10.5.

5.3. Stakeholder Coordination

- 5.3.1. The NOCs listed in Table 5.1 above are relevant to the Rail Agency only. It is the responsibility of the Applicant to obtain any other NOCs which may be required from utility companies and/or authorities other than the Rail Agency. Note that award of a Rail Agency NOC may be conditional upon receiving NOC from other authorities.
- 5.3.2. The Agency will coordinate and liaise with the Operator of the relevant Railway and any other Stakeholder likely to be affected by the Restricted Activity, prior to issuing any NOC under the current By-Laws. Where a Restricted Activity is proposed within the Railway Protection Zone, the Applicant shall comply with the conditions and any relevant Permit systems of the Operator.
- 5.3.3. The Applicant shall ensure that they coordinate with all stakeholders who may be affected by their project. A list of potential stakeholders is provided in Appendix B for guidance only.
- 5.3.4. All survey works, design drawings, specifications, and reports for NOC applications shall be prepared by the Applicant and endorsed by whichever authorities/stakeholders are affected by the works.

5.4. Utilities

- 5.4.1. The Applicant shall identify any buried utility locations and depths prior to detailed design and the proposed works shall avoid both damage to any buried service during construction and any limitations on post-construction access to the utility. Where these requirements cannot be met the Agency will advise whether the Applicant is to divert the service before the start of construction. Diversion will be subject to Agency approval.
- 5.4.2. The Applicant should be aware that diversion or disruption of any utilities not directly rail related may impact upon Railway services (e.g. interference with road traffic signals may affect operations where at-grade Railway services interface with road traffic). The Applicant shall clearly demonstrate how existing Railway services will not be affected by the impacts of non-rail utility diversions or temporary shutdown of such utilities.
- 5.4.3. Should any of the Agency's utilities be affected by the proposed works they shall be suitably repaired and reinstated to the Agency's satisfaction.

5.5. e-NOC System

- 5.5.1. The Applicant shall register to use the RTA e-NOC system. A description of how to register in the eNOC system is given in the following weblink;
<https://noc.rta.ae/RTAeNOC/Docs/Howtoregister.pdf>

- 5.5.2. Once registered, the Applicant shall submit a NOC application through the e-NOC system. In an exceptional case, the Applicant may submit a manual application if the submitted uploaded supporting documents are above the e-NOC system capacity.
- 5.5.3. Electronic copies and CAD drawings of the submitted application documents shall be uploaded to the e-NOC application or submitted to the Rail Right of Way (RROW) Department on CD for manual applications.
- 5.5.4. The RROW Department will receive the NOC application and assess its potential impact upon the Railway Infrastructure (including all Railways that are planned, under construction or operational). The Agency will use the RTA Geographic Information System to identify the location of the proposed work/activity and the affected Railway line.
- 5.5.5. The RROW Department may request further information or meetings with the Applicant as part of the evaluation process. Incomplete or missing information may cause a delay in the processing time of the NOC application.
- 5.5.6. Following review of the NOC application, the RROW Department will either issue the NOC, issue comments or issue an objection.
- 5.5.7. The Applicant may revise and resubmit the NOC application if comments or an objection is given to the original application.
- 5.5.8. If there is a later substantive change to the scheme the Agency may require a further submission, or parts of a submission.

5.6. Informational NOC Requirements

- 5.6.1. The application submitted for an Informational NOC shall contain at least the following;
- › Cover Letter.
 - › Affection Plan.
 - › Layout Plan showing the location of the activity with respect to the Railway.
 - › Cross-Sections.
- 5.6.2. Layout Plans shall include scale, clear distance from the proposed development to the Railway Infrastructure, extent of Railway Protection Zone, outline of the boundary of the development, including boundary lines of any building. Any changes in topography shall be clearly indicated.
- 5.6.3. Cross-Sections shall include scale, clear distance from the development to the Railway Infrastructure, extent of Railway Protection Zone and depths/elevations of the proposed works.

- 5.6.4. The Informational NOC request is submitted through the e-NOC portal and once this is approved, plans of the extent of the Railway Protection Zone and Critical Zone will be released to the Applicant.
- 5.6.5. Should the Applicant require more detailed information of the Railway Network, Cross Sections, structural details and other related details of Railway Infrastructure, the Applicant must fill out the Request for Engineering Information (RFI) form (attached in Appendix C) to the Rail Engineering & Information Section of the Rail Right of Way Department.
- 5.6.6. Once the Applicant has completed the RFI form, it shall be submitted to the following email address;
RFI_RES@rta.ae.
- 5.6.7. Following submittal of the RFI form, the Applicant will be informed if the RFI has been received and whether the request has been approved. If the RFI is approved, the Applicant will be notified that the information may be collected from the Rail Engineering & Information Section of the Rail Right of Way Department.
- 5.6.8. Where it is identified that changes are required to the information currently held by Rail Engineering & Information Section (e.g. where it is identified some details are incorrect or will be superseded by the works proposed by the Applicant) these changes must be made through the Asset Change Configuration Management and Drawing/ Document Control procedure of the Rail Engineering & Information Section. The Applicant can obtain these procedures from the Rail Engineering & Information Section of the Rail Right of Way Department. Within this procedure an application for Configuration Management change should also be made to the Operator of the Railway.

5.7. Design NOC Requirements

- 5.7.1. The following section outlines the information typically required for a Design NOC. The Applicant is encouraged to liaise with the Rail Agency prior to submitting a formal NOC application to determine the exact information required for their project.
- 5.7.2. Depending on the complexity of the proposed works the Agency may require a phased approach in review of the scheme as per the following;
- › Concept Design NOC.
 - › Preliminary Design NOC.
 - › Final Design NOC.
- 5.7.3. A Concept and/or Preliminary Design NOC should be prepared once the design concepts have been established but well before the start of detailed design, to allow the Agency time to review. To avoid delays, misunderstandings and abortive work, early communication shall be established between the various parties involved in the Concept and/or Preliminary Design NOC process. The Concept and/or Preliminary Design NOC

may be required for only some elements of the scheme. For example, a multi-storey building next to a tunnel may require a NOC for the foundations and load case only.

- 5.7.4.** A Detailed Design NOC is required for all elements of the scheme that may affect the safety, operation, and maintenance of the Railway. In addition to demonstrating that the development does not adversely affect the Railway, the submission of an application for Detailed Design NOC shall demonstrate that the Rail Agency or other stakeholder comments from earlier stages have been addressed.
- 5.7.5.** In addition to the information above, Design NOC applications shall contain at least the following information;
- › Design Drawings.
 - › Design Reports.
 - › Design Risk Assessment.
 - › Survey Plans.
- 5.7.6.** Design Drawings shall be prepared and endorsed by the responsible engineers and planners showing the Applicant's project plan. The plans shall be drawn to a legible scale. The Agency may request plans or drawings in a specific scale depending on the nature of the works proposed. The plans shall clearly show the location of the proposed works indicating the Railway Protection Zone, Critical Zone and how the planned works interface with those zones. Sufficient cross sections shall also be provided showing elevations and clear distances between the planned works, Railway Protection Zone boundary lines and the Railway Infrastructure.
- 5.7.7.** Design Reports shall be prepared and endorsed by the responsible engineers and justify that the geotechnical, architectural, structural, electrical, mechanical and plumbing designs (where applicable) have been performed in accordance with local and other applicable international codes, standards and Regulations. The report shall include a section demonstrating that the safety and integrity of the existing Railway Infrastructure is maintained. The design report shall;
- › Explain the purpose and usage of the proposed development.
 - › Assess the geotechnical conditions at the site including a description of the geotechnical and other relevant investigations and surveys that have been undertaken.
 - › Confirm the proposed design loadings (including accidental loadings).
 - › Confirm the proposed design standards and methods of design.
 - › Confirm the requirements of this Railway Protection Code of Practice are adequately addressed, with justification of any proposed departures.
 - › Address any significant design matters not covered by existing codes or standards.
 - › Confirm the scheme will not result in unsatisfactory clearances or other constraints on the operational Railway.
 - › Briefly describe the construction methods to be used.

- › Calculate ground and structural movements generated by the proposed construction sequence.
- › Assess the impact of movements upon the Railway Infrastructure. The effects on structural integrity, track beds, structure gauge clearances, drainage of the existing systems, etc. shall be considered.
- › Analyse the sensitivity of the assessment to variations in input parameters and construction conditions.

5.7.8. The Design Risk Assessment specific to the proposed development shall be prepared and endorsed by the responsible engineers and planners. The requirements for Design Risk Assessments are outlined in Section 8 and shall;

- › Identify all possible design-related hazards to the Railway system.
- › Assess the risks associated with each design related hazard.
- › Describe the Control Measures to mitigate each risk.
- › Demonstrate that the Applicant has carried out an appropriate assessment of the risks to the Railway Infrastructure, Operations and passengers.
- › Demonstrate that the risks have been mitigated to ensure they are 'As Low As Reasonably Practicable' (ALARP).
- › Outline the proposed monitoring instrumentation regime.

A risk assessment is also required in cases where the Restricted Activity lies outside the Railway Protection Zone but may still impact on the Railway Infrastructure or its Operations (e.g. for a tall crane with very large collapse radius, dewatering over a very large area, etc.). A sample risk register is attached in Appendix D.

5.7.9. Survey Plans shall be prepared and endorsed by a qualified and experienced surveyor. The survey plans, as minimum shall show;

- › Scale.
- › Boundary lines of planned works.
- › Existing structures.
- › Coordinates and chainages.
- › vertical and horizontal distances of the works (site preparation, substructures and building construction works, etc.) in relation to the existing Railway Infrastructure and RPZ.
- › Boundary lines of the Railway Protection Zone and Critical Zone.

5.7.10. Site Photographs are recommended to identify relevant project areas in relation to the Railway Protection Zone. The photographs shall be annotated with simple arrows, callouts or explanatory notes.

5.7.11. In addition to the above, the Rail Agency reserves the right to request any other information and specify any additional requirements they consider necessary to safeguard the Railway Infrastructure.

5.7.12. A flowchart showing the Design NOC review process is included in Appendix E.

5.8. Categories of Design Verification

5.8.1. For any design works associated with the NOC application, the Applicant shall ensure design verification to the levels shown in Table 5.2 below to reflect the risk to the safety, operation and maintenance of the Railway Infrastructure. The Agency will determine the category of design verification applicable based on their perception of the safety critical risk to the Railway Infrastructure created by the design.

Table 5.2: Design NOC Review Categories

CATEGORY	RAIL AGENCY PERCEPTION OF RISK	VERIFICATION ACTIONS BY DESIGNER
0	Design which can be adequately checked by inspection and where failure could not affect safety or operation of the Railway.	No formal design check required (albeit internal design checks are expected and shall nevertheless be conducted).
I	Designs where failure could not conceivably affect safety or operation of the Railway but which could have an adverse impact on short or long term liabilities such as additional maintenance.	The design shall be checked in the same group or team as that which prepared the design, but by people other than the designers. Those carrying out the design check may refer to the design calculations and the assumptions on which the calculations are based, but shall critically consider whether the assumptions are valid.
II	Designs where failure could not conceivably affect safety or operation of the Railway but could adversely affect the safety or operation of other Railway Infrastructure.	The design shall be checked by the same organisation as that which prepared the design, but in a separate group of team which has not been concerned with the development of the design.
III	Designs where failure could prejudice the safety or operation of the Railway.	The design shall be checked by an independent third party. Normally this means an organisation which is a separate legal entity.

5.8.2. The following works are considered of particular concern to the Agency and will generally be treated as Category III.

- › Deep Excavations within the Railway Protection Zone.
- › Foundations within the Critical Zone of the Railway Protection Zone.
- › Shoring or Dewatering within the Railway Protection Zone.

- › Connections to existing Railway Infrastructure (e.g. stations, footbridges, etc.).
 - › Any works potentially affecting Railway bridges.
 - › Use of heavy and/or tall equipment (e.g. cranes, etc.) within the Railway Protection Zone.
- 5.8.3.** The designer and reviewer shall have the experience and qualifications commensurate with the magnitude and complexity of the design in question.
- 5.8.4.** The designer and independent review organization (if applicable) shall both be prequalified with the RTA.
- 5.8.5.** A design check shall consider the following:
- › Structural adequacy of the design.
 - › Any effects on surrounding Infrastructure.
 - › Non-structural safety related aspects of the design.
 - › Site conditions that could affect the safety and practicability of construction or operation.
 - › Clearance between the proposed work and the potentially affected Railway Infrastructure.
- 5.8.6.** Where the Agency identifies that the method of design employed by the designer is novel, the method of checking shall not use the same method as that used for the design. In such cases, where practicable, recognised methods shall be used for the design check.
- 5.8.7.** For more complex designs the Agency may require a design check statement from the reviewer to confirm the design check methodology to be used. This statement shall:
- › Specify the method of analysis to be used, including any computerised methods.
 - › Detail the programme for the design check.
 - › State interfaces with the designer.
 - › State how compliance with the requirements of this section will be achieved.
- 5.8.8.** A design check may start before the design is complete provided the independence specified in Table 5.2 is maintained. The designer shall liaise with the checker as necessary to ensure that the designer's results are comparable with those of the checker and to resolve any points of disagreement that may arise.
- 5.8.9.** Any differences between the designer and checker which cannot be resolved shall be referred to the Agency for resolution.

5.9. Construction NOC Requirements

- 5.9.1. The following section outlines the information typically required for a Construction NOC. The Applicant is encouraged to liaise with the Rail Agency prior to submitting a formal Construction NOC application to determine the exact information required for their project.
- 5.9.2. Construction NOC applications shall contain at least the following information;
- › Name of Contractor and any sub-contractor.
 - › Contact list of key people.
 - › Programme and Plan for the proposed construction works.
 - › Certified Survey plans.
 - › Pre-condition Survey Report.
 - › Instrumentation and Monitoring Plan.
 - › Method Statement of Work, including description of method and equipment to be used.
 - › Construction Risk Assessment.
 - › Contingency Plan/Emergency Procedure.
 - › Insurance Policy.
 - › Traffic Control Plan/Drainage Control Plan (where required).
 - › Undertaking for Supervision.
- 5.9.3. The Contact list of key people shall contain the name and contact number of all the key personnel including the project manager, the site supervisors, etc. The list shall be updated whenever there are changes and shall be resubmitted to the Agency at least 48 hours prior to a change in personnel.
- 5.9.4. The Programme and Plan for the proposed works shall confirm the timeframe and construction sequence for the proposed works and provides further information on the nature of the construction process.
- 5.9.5. Survey plans submitted during the design NOC phase shall be updated to reflect the greater degree of detail required for construction works and re-endorsed by the surveyor.
- 5.9.6. The Pre-Condition Survey report shall include a physical survey of the potentially affected Railway Infrastructure including a photographic record. The Applicant shall ensure that access is available to the Railway corridor which will involve coordination with the Agency and the Operator (refer to Section 5.12).
- 5.9.7. The Instrumentation and Monitoring Plan shall explain in detail how the proposed works and Railway Infrastructure will be monitored during construction. The monitoring plan shall contain a full list of monitoring devices and instruments to be used with their

location, purpose, frequency and method of monitoring. The Agency has the right to impose any additional requirements deemed necessary to protect the Railway Infrastructure at the Applicant's cost. The Applicants shall comply with the general monitoring requirements outlined in Section 9. The plan shall include details of the following;

- › Layout plans and relevant cross-sections showing locations of instruments relative to the Railway Infrastructure.
- › Details of instruments and equipment (type, function, installation requirements, depths).
- › Calibration certificates.
- › Anticipated programme of equipment installation, including access requirements to install equipment (e.g. frequency and dates).
- › Frequency of monitoring.
- › Trigger levels for risk control.
- › Contingency plan.

5.9.8. The Construction Method Statement shall include;

- › A layout plan showing the location of the works relative to the Railway Infrastructure.
- › A description of the Restricted Activities.
- › A step by step sequence of how each phase of the works will be executed.
- › Full details of the construction program, methods and man-power.
- › A full list of equipment and machinery to be used during construction.
- › A letter of approval for the method statement by the designer of the design risk assessment approved for the Design NOC.
- › A Construction Method Statement Checklist is provided in Appendix F for further guidance.

5.9.9. The Construction Risk Assessment shall;

- › Identify all possible construction-related hazards to the Railway Infrastructure.
- › Assess the risks associated with each hazard.
- › Describe the Control Measures to mitigate each risk.
- › Demonstrate that the Applicant has carried out an appropriate assessment of the risks to the operational Railway and associated Infrastructure and systems.
- › Demonstrate that the risks have been mitigated to ensure they are 'As Low As Reasonably Practicable' (ALARP).
- › Outline the proposed instrumentation and monitoring regime.

5.9.10. The Contingency Plan/Emergency Procedure shall be prepared focusing on any potential incidents that may relate to the Railway Infrastructure (ref Section 10.4). The plan and procedure shall be based on the hazards identified in the Risk Assessment

Report. It shall describe the activities or actions that would be implemented and availability of materials and equipment at site to deal with each situation identified in the procedure.

- 5.9.11. The Insurance Policy shall include third party property damage insurance and other insurance policies required by the government.
- 5.9.12. The Traffic Control Plan shall show the proposed temporary traffic diversions during the construction ensuring the safety of Railway users. The Applicant shall provide schematic drawings showing the road diversion plans, list of signage and schedule.
- 5.9.13. The Drainage Control Plan shall outline the measures to protect the Railway Infrastructure from excessive water inflows caused by the construction works. The Applicants shall carry out studies to determine stormwater runoff and explain how the stormwater runoff will be controlled. Consideration shall be given to the likelihood of extreme events and how these will be managed. Drainage should be directed away from the Railway and into an existing drainage or storage system. Connection to existing Railway drainage systems will not be permitted unless agreed with the Agency. The Applicant will be responsible for obtaining drainage consent.
- 5.9.14. The Rail Agency reserves the right to request any other information and requirements they consider necessary to safeguard the Railway Infrastructure. Such additional information may include the items shown below;
 - › Machinery and Equipment Certificate.
 - › Operators Certificate.
 - › Temporary Structure / Scaffold Certificate.
 - › Any other certificate deemed necessary by the Agency.
- 5.9.15. Where the Agency assesses that the development increases the risk of trespass or vandalism to the Railway the Applicant will be asked to provide mitigation measures (e.g. higher specification fencing, enhanced security, etc.).
- 5.9.16. Where any of the above information directly conflicts with the conditions or submissions associated with any previous NOC, then the conflicting condition or submission shall be revalidated prior to approving the construction NOC.
- 5.9.17. A flowchart showing the Construction NOC review process is included in Appendix E.

5.10. NOC Review Process

- 5.10.1. The Agency will review the NOC application based on the general requirements stipulated in this Code of Practice and other applicable design criteria and operational requirements where necessary.

- 5.10.2. All NOC applications shall be processed within the predefined KPIs as per project type. However, if the application requires further information or there is missing information that is required for final decision, the processing time will be more.
- 5.10.3. If the application consisted of change in railway assets, the applicant shall obtain Change Impact Management Plan (CIMP) from Rail Engineering & Information Section. In addition, the applicant shall liaise with the Operator to obtain Permit To work (PTW) and Asset Change Configuration Application (ACCA).
- 5.10.4. For information NOC related to Railway assets, the applicant shall obtain Request For Information (RFI) from Rail Engineering & Information Section.
- 5.10.5. After full review of the application, the Agency will notify the Applicant of the result via the e-NOC portal. The application may be approved with conditions imposed by the Agency and Operator, allowing the Applicant to proceed subject to the conditions being fulfilled.
- 5.10.6. The Applicant shall note that in the event of any conflict between the programme of works related to the approved NOC and any works carried out by the RTA, the RTA's programme of works shall have priority at all times, unless otherwise granted by the RTA.
- 5.10.7. Any potential interface issues including work programme shall be discussed with the RTA or the RTA's contractor in advance and the Applicant's work programme shall allow for such interfaces so that the works carried out by the RTA are not delayed.

5.11. Responsible Project Engineer (RPE)

- 5.11.1. If the Agency decides that the activity is critical, the Agency shall require the Applicant to appoint a Responsible Project Engineer (RPE) to ensure that the works being undertaken reflect the concerns of the Rail Agency throughout the life cycle of the project. A RPE shall be identified by the Applicant who will hold responsibility for ensuring that the conditions of the NOC are implemented on site.
- 5.11.2. The RPE shall hold a technical qualification and be a member of the UAE Society of Engineers. Notwithstanding the above, the RTA may request additional qualifications of the RPE at their discretion.
- 5.11.3. The RPE will be a named individual on the NOC and be the key contact person for the RTA throughout the NOC process.
- 5.11.4. The RPE will be responsible for ensuring the HSE staff used on the project have been awarded with Certificates of Competence for HSE works within the Railway Protection Zone.

- 5.11.5. The RPE shall have the relevant experience to understand the requirements of the NOC conditions and have the appropriate powers within the project team to ensure the NOC conditions are adhered to on site.
- 5.11.6. In the absence of the named RPE a replacement shall be named immediately and notified to the RTA. Failure to replace the RPE may lead to enforcement action from the Agency.
- 5.11.7. The RPE shall notify the Agency, including the Agency's inspection section (email: rrow.wn@rta.ae), at least two weeks in advance of commencement of work within the Railway Protection Zone.

5.12. Access to the Railway Infrastructure

- 5.12.1. All personnel working on the Railway shall abide by the rules and conditions of the Agency and the Operator.
- 5.12.2. Where the Applicant requires access to the Railway Infrastructure, they should submit plans in sufficient detail to allow discussion with the Agency and Operator to identify possible track access conflicts or issues. Note that in many cases significant advance notice may be required.
- 5.12.3. A request for access to the Railway Infrastructure shall be made to the Rail Agency at least four weeks in advance of the access required. The Agency may refer the Applicant to liaise directly with the Operator so the Applicant can understand the requirements of the Operator.
- 5.12.4. Access to the Railway Infrastructure will require either a Permit to Enter (PTE) or a Permit to Work (PTW) where;
- › A Permit to Enter (PTE) is a written approval granted by the Operator that authorises a person or persons to carry out specific work within a specified time frame outside of the Railway track area.
 - › A Permit to Work (PTW) is a written approval granted by the Operator that authorises a person or persons to carry out specific work within a specified time frame within the Railway track area.
- 5.12.5. Access to the Railway Track may only be obtained during non-operational hours of the Railway.
- 5.12.6. The Applicant shall clearly state the following items when applying for a PTE/PTW:
- › The reason(s) for requesting an access to Railway Infrastructure.
 - › The names and identification of all personnel gaining access to Railway Infrastructure.
 - › List and details of equipment, tools to be brought to the Railway Infrastructure.

- 5.12.7. The Agency and Operator shall require the Applicant to employ a Person-In-Charge (PIC) for any works on the track. A PIC is a person who is approved by the Operator and has the sufficient training and experience to manage the safety of a workgroup working within a worksite so that others are not unduly affected by the acts or omissions of this workgroup.
- 5.12.8. The PIC shall;
- › Possess a safety qualification related to working on the track.
 - › Be able to clearly communicate safety critical information in English.
 - › Have successfully passed PTW training provided by the Operator.
- 5.12.9. The Agency and Operator shall satisfy themselves that the personnel proposed by the Applicant for access to the track are:
- › Physically fit.
 - › Adequately supervised.
 - › Satisfactorily briefed.
- 5.12.10. The Agency will refer the Applicant to the Operator to arrange the requested access if all the information is found to be in order and the reason(s) for requesting the access is acceptable.
- 5.12.11. The Applicant will be notified once the PTE/PTW is granted. The actual date and time of Railway Infrastructure access will be determined by the Operator. The Applicant shall liaise with the Operators representatives to finalise the date of access. The Applicant must establish and maintain robust procedures and actions to prevent unauthorised access.
- 5.12.12. All persons working on Railway Infrastructure shall comply with the rules, procedures and Regulations of the Operator and instructions from the Agency.
- 5.12.13. Possessions of the track are only available during non-operational hours of the Railway Vehicles. Possessions will be necessary for work:
- › Within the boundary of the operational Railway tracks.
 - › Where, in the opinion of the Railway Operator, construction would actually or potentially interfere with the normal running of the Railway.
- 5.12.14. The Infrastructure Access Controller (IAC) from the Operator will be responsible for ensuring that the PIC is authorised to access the track and for providing the security access to enable works to be carried out.
- 5.12.15. The IAC will not give up a possession until he is satisfied that the works are complete, the Railway is safe and clear for traffic and he has received a certificate from the contractor confirming that all work requiring the possession is complete and that all of his employees are clear of the line. The contractor must allow adequate time for taking and giving up a possession when planning the possession work scope.

- 5.12.16. The costs of delay to Railway operations in the event of a possession overrun are punitive. Only the Operator will define the working time within which the Applicant will be allowed to work during the Possession. The Applicant must therefore assure himself, the Agency and the Rail Operator that the work can be completed within the possession.
- 5.12.17. For more complex works or those where early curtailment is not possible the Agency may require the Applicant to undertake a possession overrun risk assessment. This will detail the risks of overrun and their mitigations, as well as the break points and times at which the work will be curtailed. Works considered by the Agency and Operator to have a significant risk of overrun will not be approved.

5.13. Deviation from the Approved Plan

- 5.13.1. If the Applicant intends to change or deviate from the conditions of any NOC which has been issued, then the Applicant shall immediately notify the Agency in writing with details of the changes and the Agency will decide if a new NOC application is required.
- 5.13.2. An application for approval of an amended plan shall be accompanied by copies of all amended details, plans, reports and method statements including updated risk assessments for the reused elements of the works.
- 5.13.3. The Agency may require additional information to be submitted for approval if the Agency considers any construction works depart or deviate from the approved plan.
- 5.13.4. The Applicant is not permitted to carry out any works that deviate from the approved terms and conditions of the NOC until the amended application has been approved by the Agency.

5.14. Commencement of Works and Assurance of Compliance to NOC Conditions

- 5.14.1. No work shall commence on site without coordination with the RROW Inspection Section of the Agency (contact email: rrow.wn@rta.ae).
- 5.14.2. An undertaking shall be provided by the Applicant to supervise the works in compliance with the terms and conditions of the NOC. For critical projects, the Applicant shall confirm that the RPE (if required by the Agency) is dedicated on site to fulfil the NOC conditions.
- 5.14.3. The organisation undertaking the supervision shall ensure that;
- › The NOC remains valid over the duration of the works and is renewed before its expiry.
 - › The works being undertaken are fully compliant with the NOC conditions.

- › The impact of the works are fully monitored and that the results are complying with the predicted impacts. The supervising organisation will be required to review the results and prepare regular review reports for submission to the Agency outlining any observations in compliance with the approved monitoring plan.
- › Any violation of the NOC conditions committed by the Applicant is immediately reported to the Agency.

6. General Principles of Railway Protection

6.1. General

- 6.1.1. This section provides the general principles that shall be considered by the Applicant when applying to carry out any works in the Railway Protection Zone.

6.2. Principles

- 6.2.1. Any proposal raised by the Applicant shall aim to ensure there is negligible impact upon the following;
- › Railway Structure.
 - › Operation of Railway Assets.
 - › Fire and Life Safety, Emergency Exit Points and Evacuation Systems.
 - › Flood prevention measures and Watertightness.
 - › Inspection and Maintenance.
- 6.2.2. The Applicant must meet the above principles in developing solutions from the concept stage through planning, designing and constructing the works.

Railway Structure

- 6.2.3. The Applicant shall demonstrate that the Railway system remains safe and serviceable during the design and construction of the proposed works when subjected to the:
- › Most onerous combination of imposed loads.
 - › Most onerous combination of imposed movements.
- 6.2.4. The Applicant shall demonstrate how the design life of the Railway Infrastructure and its component systems is ensured.

Operation of Railway Assets

- 6.2.5. The Applicant shall demonstrate that the proposed works do not compromise the following functions of the Railway system:
- › The maximum design speed of the Railway Vehicles.

- › The safety and comfort of passengers.
- › The free flow of public entering and exiting the Railway system.
- › The performance of the mechanical, electrical and plumbing services.
- › The reliability of protective Railway systems.

Fire Safety and Evacuation Systems and Procedures

- 6.2.6.** The Applicant shall demonstrate that the design and construction of any proposed works ensures that:
- › The Railway system is protected from the spread of fire from the proposed works.
 - › The lengths and capacities of fire escape routes from the Railway system from the most remote point in the Railway system to the point of safety are maintained.
 - › The maximum time for full evacuation of the public from the Railway to a point of safety is maintained.
 - › There is no re-circulation of smoke into the Railway system in the event of fire in the station or from the proposed works.
 - › Existing firefighting measures in the Railway system are not compromised.

Flood Prevention Measures and Watertightness

- 6.2.7.** The Applicant shall demonstrate that the design and construction of any works ensures that;
- › No ingress of water into the Railway system occurs due to flooding or other means including runoff from the surface.
 - › The existing waterproofing measures and philosophy is maintained.
 - › The existing groundwater and stormwater Control Measures are not affected.

Inspection and Maintenance

- 6.2.8.** The Applicant shall demonstrate that the design and construction of the proposed works ensures that the following are not compromised:
- › Available facilities for the inspection and maintenance of the Railway Infrastructure.
 - › Existing lightning protection, earthing and drainage systems.
 - › Utilities.
 - › Chilled water pipeline networks.

6.3. Impact Assessment Approaches

- 6.3.1.** To determine the impact of the proposed works on the Railway Infrastructure the Applicant shall adopt a suitable methodology to assess whether the impact of the works

comply with the general principles outlined in Section 6.2. A set of criteria to assist in the preparation of the Impact Assessment is provided in Appendix G.

- 6.3.2. Assessment may be undertaken by one of the following methods or a combination of methods below:

Previous Experience and Evidence

- 6.3.3. This method shall be supported with clear, unambiguous evidence that shows that similar solutions have been proven to be successful in achieving similar objectives under similar circumstances in the past.

Analysis

- 6.3.4. This method requires the use of suitable calculations and models to simulate the actual conditions and verify the criteria outlined in Appendix G are met. The input parameters used and boundary conditions shall be checked with sensitivity studies to check they are reasonable.
- 6.3.5. Notwithstanding the above the Agency may require additional information from the Applicant to ensure their concerns are addressed.

Alternative Proposal

- 6.3.6. Where the Applicant wishes to exceed the criteria in Appendix G an alternative proposal shall be prepared by an organisation that has the necessary experience, skills and knowledge in the technical field of the proposed works and is prequalified for such works with the RTA. The alternative proposal shall offer more detailed analysis and clearly demonstrate how the general principles in Section 6.2 are achieved.

6.4. Building Next to the Railway

- 6.4.1. In some cases the Applicant will be expected to provide mitigation for effects on the development arising from the Railway, such as noise barriers for a new residential development or containment for a nearby oil-filled transformer. The Applicant is reminded of their obligation to ensure appropriate mitigation measures are adopted to protect their development from noise and vibration. The Applicant is responsible for ensuring that the development meets statutory requirements in accordance with the RTA noise and vibration guidelines. The RTA does not offer the right of support nor does it accept liability for any settlement, damage, noise or vibration emanating from the normal operation or maintenance of the Railway.
- 6.4.2. The design and construction of any building located adjacent to any above ground Railway Infrastructure must consider the following:
- › Building setback.
 - › Risk of falling objects.

Building Setback

- 6.4.3.** The minimum clear setback distance shall be the greater of the following (refer Figure 6.1 to Figure 6.3):
- › 8m clear distance from the outermost edge of the Railway superstructure, substructure, structure gauge or fenceline, or
 - › Separation distance calculated in accordance with the requirements of the applicable fire safety codes.
 - › As required by the Agency based on site-specific safety, security, access control, operational and maintenance requirements.
- 6.4.4.** Design of buildings shall comply with setback requirements in accordance with the relevant building codes and Regulations, as well as applicable fire safety codes in Dubai. The requirements of Dubai Municipality and Dubai Civil Defence shall be respected.
- 6.4.5.** Building setback distances should consider inspection and maintenance regimes (including potential emergency response operations) associated with the building to ensure that these operations will have negligible impact upon the Railway.
- 6.4.6.** Any construction within the setback distance must provide the following:
- › 4-hour fire resistance to structural elements near the Railway Infrastructure.
 - › Emergency ventilation, emergency lighting, signages within the Railway complying with the relevant local fire codes.

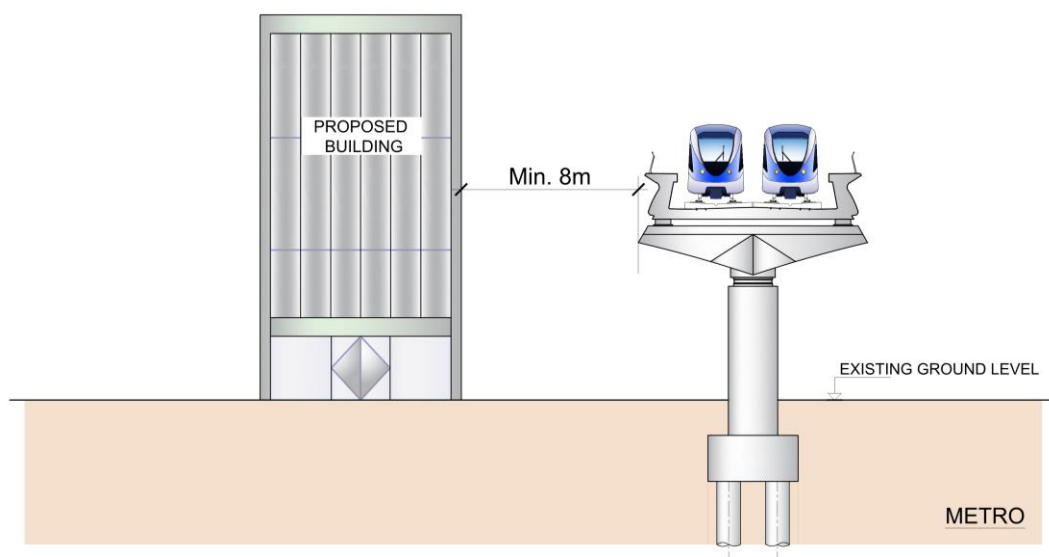


Figure 6.1: Building Setback Requirements (Viaduct)

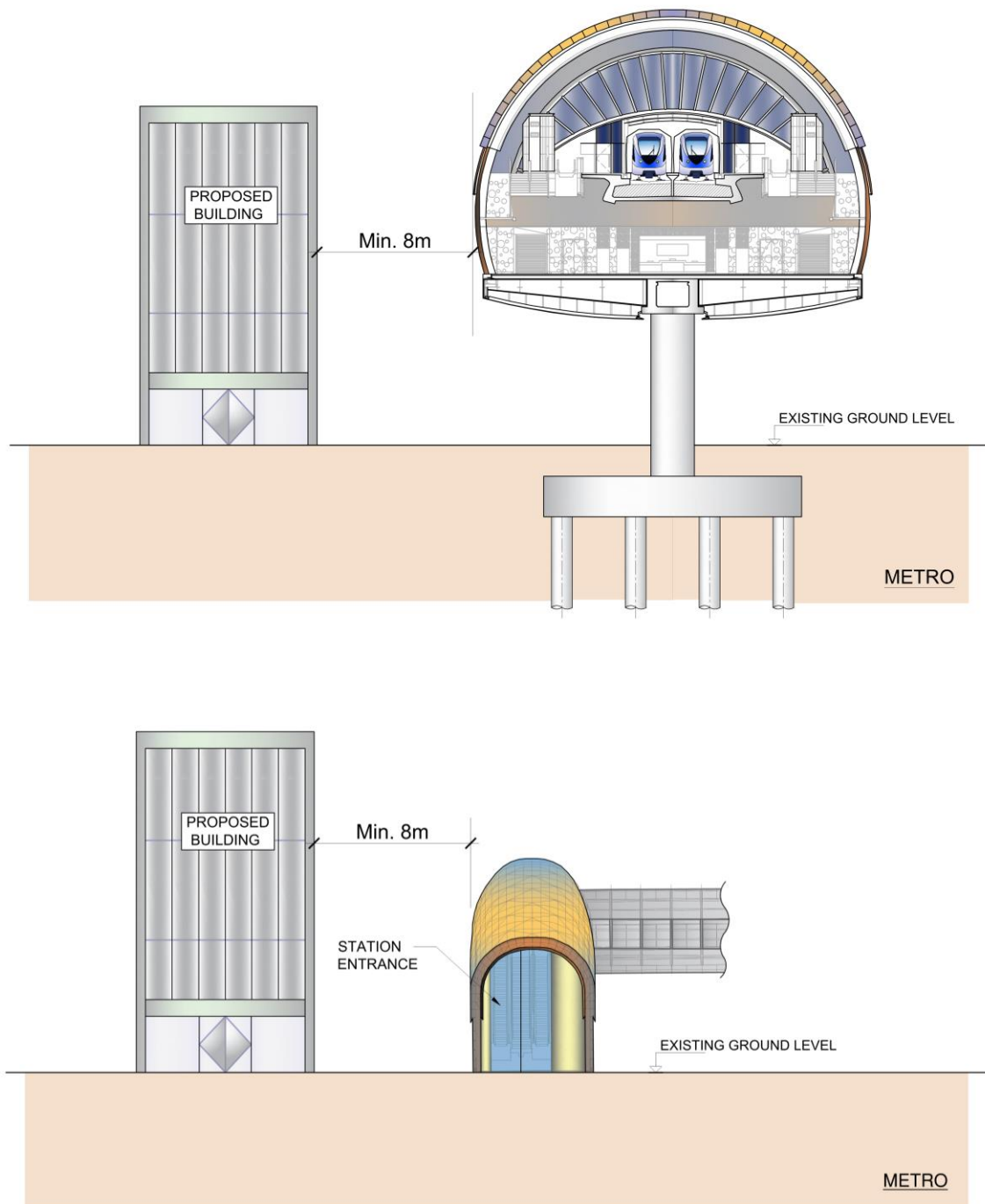


Figure 6.2: Building Setback Requirements (Stations and Entrances)

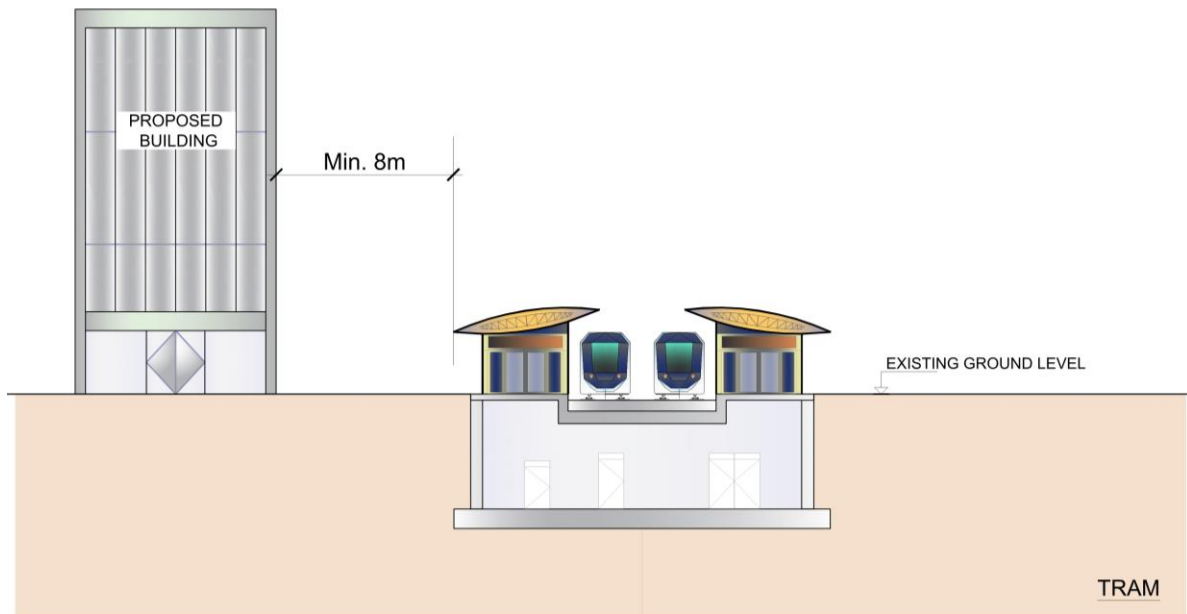


Figure 6.3: Building Setback Requirements (Tram Station)

- › Adequate space around the Railway to satisfy structure gauge clearance and inspection and maintenance operations.
- › Adequate screening of windows or openings of structures facing the Railway Infrastructure.
- › Design such that incidence of litter or unauthorised access that will affect the safety of Railway will not occur.

Risk of Falling Objects

- 6.4.7.** The Railway Infrastructure and the safe operation of the Railway may be jeopardised by objects falling onto the track from openings, windows or roofs of the building facing the Railway. The Applicant should give consideration to have the buildings orientated with end walls facing the Railway.
- 6.4.8.** In any case, the Applicant shall propose measures to mitigate the risk of falling objects for Agency approval.
- 6.4.9.** Design of buildings or similar structures within the Railway Protection Zone, which will require regular maintenance (e.g. cleaning of facades, repair, etc.) and inspection facing the Railway shall consider appropriate safety measures such that no objects can be dropped onto the Railway Infrastructure. The impact upon Railway Infrastructure of emergency response procedures associated with the building should also be considered.

- 6.4.10.** Design considerations for buildings within and adjacent to the Railway Protection Zone are as follows;
- › Design shall be approved by local authority and building permit for approved drawings shall be submitted.
 - › Design shall be certified by an independent 3rd party checker who is approved by the Rail Agency. The peer review certificate shall be submitted during the design NOC phase.
 - › Design of steel structures / cladding shall consider high wind speed / pressure / suction as specified by the local authority and international standards.
 - › Design risk assessment shall be submitted during design phase to mitigate / control any falling object risk towards any Railway assets.
- 6.4.11.** Construction considerations for buildings within and adjacent to the Railway Protection Zone are as follows;
- › All construction drawings and methodologies shall be approved by the project consultant and the appointed 3rd party consultant prior to submission of the same to the Rail Agency during the construction NOC phase.
 - › All QC/QA tests during assembling / installation shall be carried out by an approved inspection testing body.
 - › All welds and bolted connections shall be tested by an approved inspection testing body.
 - › Contractor shall submit construction Risk assessment to mitigate and control any falling object risk towards the Railway assets.
 - › For critical lifts and assembling operations, a safety specialist shall be engaged to control lifting and handling operation and mitigate the risks related to critical lifts and falling object hazard.
 - › The consultant and the appointed 3rd party consultant shall certify the steel structure upon completion of the works and the certificates shall be submitted to the Rail Agency.
 - › For cladding design and construction, a specialist cladding consultant shall be engaged to approve and certify the submitted design.
- 6.4.12.** Operational and maintenance considerations for buildings within and adjacent to the Railway Protection Zone are as follows;
- › Completion certificate from local authorities shall be obtained and submitted.
 - › O&M plan for the steel (or aluminium) structure shall be submitted. Plan shall include the O&M risk assessment to demonstrate how the risk of any falling objects towards the Railway assets are mitigated / controlled.
 - › Owner shall deploy O&M company to ensure the structure integrity during the design life.
 - › Integrity of steel structures and cladding shall be checked and verified periodically to ensure compliance with design / completion certificate requirement.

- › Corrective / preventive maintenances shall be provided to ensure sound and integral structure during the design life.

6.5. Connection with Existing Railway Infrastructure

- 6.5.1. Where a proposed development directly connects with an existing Railway, the Applicant shall ensure that the proposed development complies with the Dubai Rail Planning and Design Guidelines (RPDC).
- 6.5.2. The proposed development and its impact upon the existing Railway system shall also comply with the general principles outlined in Section 6.2.
- 6.5.3. Where the proposed development is likely to impact upon the inflow and outflow of passenger traffic through the Railway system, then the Applicant must demonstrate the impact of the change in ridership demand through the system is acceptable via crowd modelling and pedestrian simulations.
- 6.5.4. Any connection to the existing Railway system (whether structurally, architecturally or interfacing with existing mechanical, electrical and plumbing services and fire safety systems) is of great concern to the Agency and the Agency may have additional requirements that must be satisfied before the proposed works can be approved.
- 6.5.5. Any change to the existing Railway Infrastructure will represent a change to the Railway configuration. Such changes will therefore require a change to the as-built records currently held by the RTA. The Applicant will be required to submit a “Change Impact and Management Plan” (CIMP) to the Rail Engineering & Information Section of the RTA Rail Right of Way Department. Once this plan is approved, the technical documents held by the Rail Engineering & Information Section may require additional modification and/or withdrawal in accordance with the Technical Documents Management Procedure. Within this procedure a similar process for Configuration Management change should also be made to the Operator.
- 6.5.6. Any construction works adjoining Railway Infrastructure shall provide appropriate firefighting facilities, including fire shutters, smoke barriers, sprinkler systems, fire alarms and ventilation in accordance with the relevant codes and Regulations, such that the performance of the original fire safety design of the Railway Infrastructure is not compromised by the construction works.
- 6.5.7. Other systems including the air-conditioning system, public address, CCTV, safety signs and lighting, lightning protection, sanitary system and egress requirements shall comply with the relevant codes and Regulations.
- 6.5.8. Any developments intending to join with underground Railway stations shall have the ground level entrances and exits leading to underground stations sufficiently higher or provide water ingress protection walls with a robust waterproofing system to prevent

water ingress into the underground station. The entrance level to the station shall be above the flood threshold level.

6.6. Works Beneath the Railway

6.6.1. Any Restricted Activities beneath the elevated sections of the Railway or within the setback distance defined in Section 6.4 must:

- › Not affect the existing firefighting facilities.
- › Not involve the use of liquefied petroleum gas or require any storage of flammable liquids or highly combustible substances.
- › Allow at least 1.0m clear distance below the elevated Railway Infrastructure.
- › Provide proper access for the inspection and maintenance of the Railway Infrastructure.
- › Have no effect on existing utilities and MEP services.

6.6.2. If temporary traffic access is required under a Railway viaduct, where the clearance between the deck soffit and the ground is less than 6 m, height control gantries at both sides with minimum gap of 1m between the deck soffit and top of gantry shall be erected. Reflective paint shall be provided on the gantry to enhance visibility (refer Figure 6.4).

6.6.3. The traffic access gantry is to limit the height of machinery entering to the work site under Metro structures, for permanent height limit gantry required for permanent roads, the contractor shall follow the relevant Traffic safety Manuals.

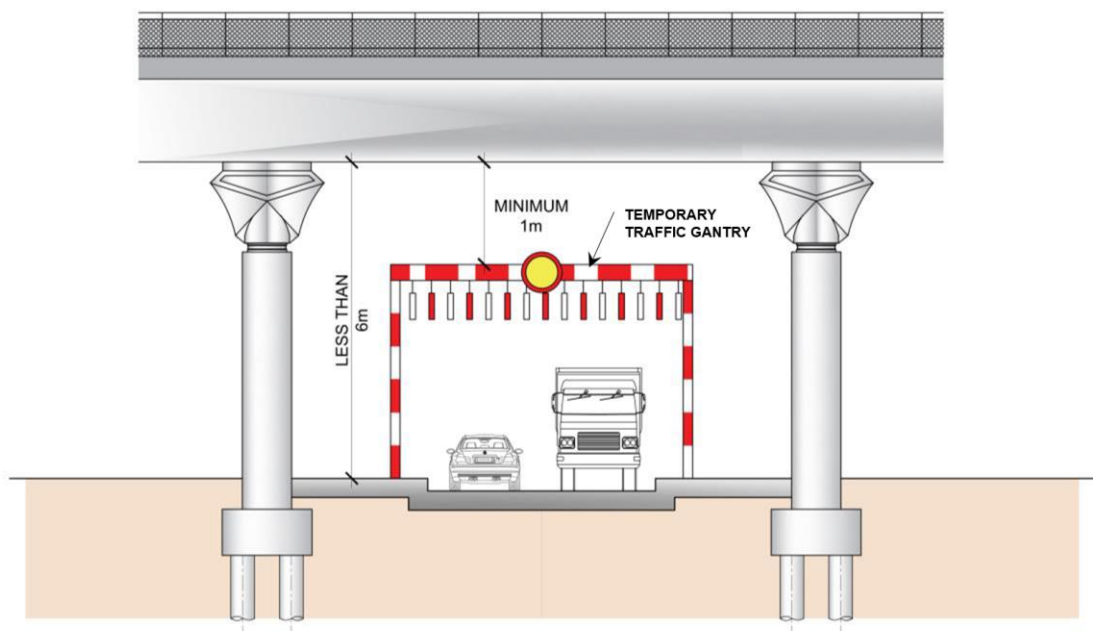


Figure 6.4: Site Preparation - Temporary Traffic Access

6.7. Works Above the Railway

- 6.7.1. Flags or distinctive markers, such as warning tapes, shall be provided at the boundary points of the Railway Protection Zone and Critical Zone, for any intended works. The markers shall be maintained throughout the duration of the works. Each marker in the Critical Zone shall be labelled “Critical Zone” to ensure it is understood on site (refer Figure 6.5).
- 6.7.2. Any structure over Railway lines shall be so designed and protected that they will withstand the effects of a fire on the track for such a time period as specified by the Agency.

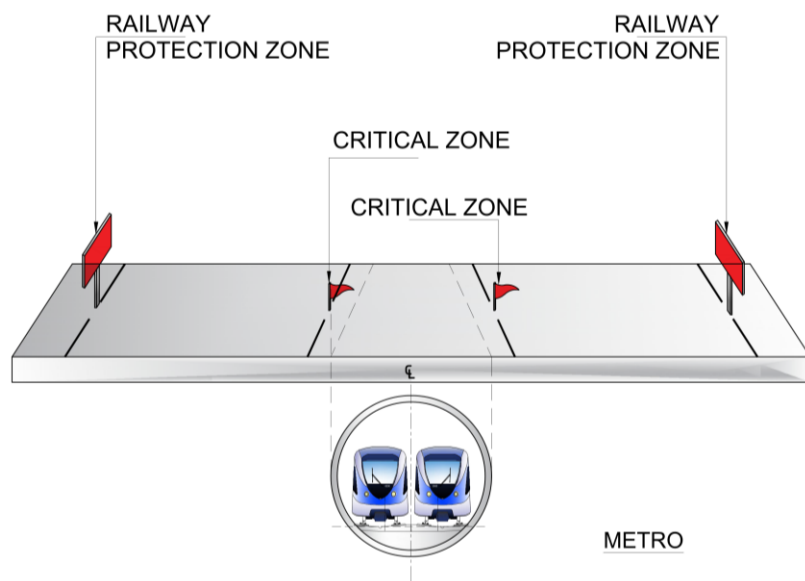


Figure 6.5: Site Preparation – Above Railway Tunnels

- 6.7.3. Buoys with flags or distinctive marks shall be provided at the boundary points of the Railway Protection Zone and Critical Zone, in coordination with the RTA Marine Agency, for marine works (refer Figure 6.6).

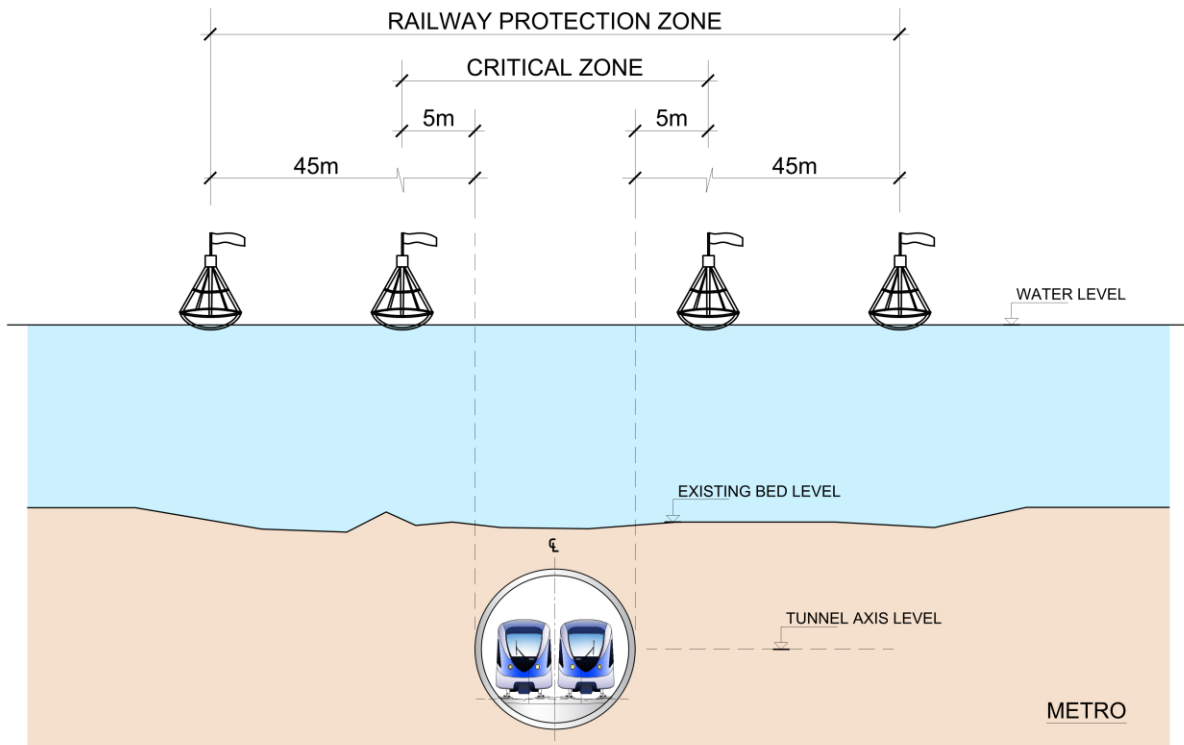


Figure 6.6: Site Preparation – Marine Works Above Railway Tunnels

- 6.7.4.** Any construction over the above ground sections of the Railway must provide the following:
- › Fire resistance of elements of structure around the Railway Infrastructure shall comply with relevant local fire and life safety codes.
 - › Emergency ventilation, emergency lighting, signages within the Railway complying with the relevant local fire codes.
 - › Adequate space around the Railway to satisfy structure gauge clearance and maintenance operations.
 - › Adequate screening of windows or openings of structures facing the Railway Infrastructure.
 - › Design such that incidence of litter or unauthorised access that will affect the safety of Railway will not occur.
- 6.7.5.** Design and construction of over bridge vehicular parapets shall, as a minimum, comply with the Bridge Barrier Performance Criteria TL-6, 'Roadside Design Guide for Dubai' issued by the Traffic Department of the RTA.

- 6.7.6. High containment fences or barriers shall be designed to protect the Railway Infrastructure against traffic or falling objects. The containment fence or barrier shall extend enough distance at both sides to avoid any hazards towards Railway operation.
- 6.7.7. Where there are changes to the road layout near overbridges (or elsewhere adjacent to the line), or changes to the road traffic nature, speed or density the proposed vehicle incursion measures shall be checked and agreed with the Agency.
- 6.7.8. Any construction works above the Railway such as building works or over bridges for any purpose shall provide a full protection shelter or loading gantry which covers all of the affected area over the Railway Infrastructure (refer Figure 6.7). The shelter shall be designed to withstand the impact of the heaviest object to be used in the construction work and be large enough not to disturb the structure gauge. The NOC Holder shall consider the following:
- › The NOC holder shall provide a protection platform to protect the Railway guideway from any falling objects which may fall on the Track during shelter structure assembling/ disassembling. The protection platform shall be certified by a third party.
 - › For any protection shelter structure the contractor shall provide a design certificate of the design certified by an independent third party designer.
 - › The installation and dismantling operation shall be carried out during non-operation hours of Rail and in compliance to the Operator's possession planning procedure.
 - › The NOC Holder shall submit a monitoring plan for the shelter to ensure the safety of the Railway Infrastructure.
 - › Any protection shelter in the vicinity of the Railway traction power system (the third rail) should be electrically earthed.
 - › Consideration should be given to the length of the protection shelter which may require escape routes with signage.
 - › Geometric design of the requested shelter shall consider vertical clearance not less 4.5m (from Rail top level to the soffit of temporary structure), this clearance shall exist during all construction phases of the project.
 - › In case if the shelter is used as scaffolding for bridge construction above Railway, the vertical clearance shall be measured from the defected shape. The clearance from Bridge Deck soffit level and Rail Top shall consider the clearance specified above and additional clearance for the loading gantry and a reasonable gap required for scaffolding used in construction of the bridge.
 - › Design of the loading gantry shall be reviewed by Structural third-party and monitoring system to be installed on the gantry and its foundation to monitor deflection and settlements.
 - › In case of using the shelter as temporary loading gantry, loading test shall be done on typical frames, details of loading test criteria and test results shall be submitted to Rail agency before commencing of installation of the gantry at the protection zone.
 - › Any scaffolding above the proposed gantries shall be design, verified by third-party and tested.

- › Horizontal clearance between columns of proposed steel shelter and Rail structural edge perimeter shall be more than 5.0 meters (min.), special approval is required for distances less than the specified distance.
- › Bridges above the Railway, high containment permanent barriers are required, the barriers shall extend for either side of crossing locations for 15m.

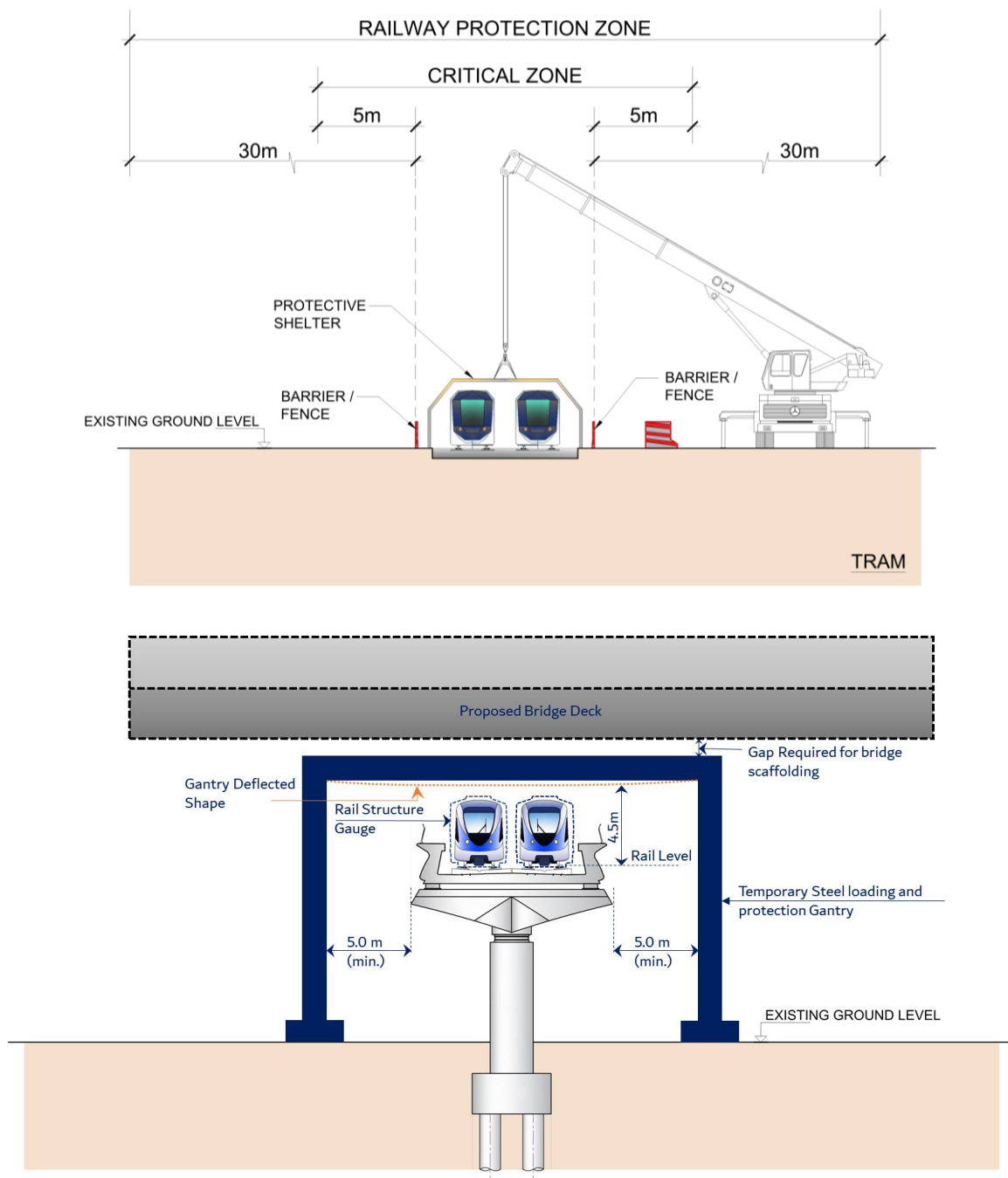


Figure 6.7: Site Preparation – Protection Shelter or loading gantry over Railway

6.8. Water and Drainage

- 6.8.1. The Applicant shall provide full details of any proposed permanent drainage systems. Drainage pathways must be directed away from the Railway into existing sewer or stormwater systems.
- 6.8.2. The use of soakaway drainage is not favoured as it could have a detrimental effect on the Railway Infrastructure.
- 6.8.3. The construction and maintenance of ponds or swimming pools may pose risks to the Railway and leakage or failure could lead to severe financial cost and possible prosecution. The Rail Agency shall be consulted on any proposals.
- 6.8.4. Where altered drainage, flooding risk or significant discharges of water may be anticipated as a result of a proposed development, due regard shall be given to the potentially adverse impacts on foundations, at-grade structures and underground structures.

6.9. Compliance with Dubai Municipality Circulars

- 6.9.1. The NOC holder shall ensure that compliance with all Dubai Municipality circulars is adhered to. This includes the latest requirements for the following;
 - › Temporary site construction fences.
 - › Disposal of construction waste materials at multi-story construction sites.
 - › Protection screens for building elevations during construction phase.
 - › CCTV Monitoring system for construction sites.
 - › Pest control in construction sites.
- 6.9.2. For high risk construction works the contractor shall install CCTV IP camera working 24/7, subject to the following conditions:
 - › Use of lifting machinery located within the critical protection zone at 5 meters from the metro structure.
 - › The use of lifting machinery, scaffolds or construction works for Buildings with a height higher than the level of the Rail structures above the ground and located at a horizontal distance from the structure less than the height of the buildings so that the risks of falling materials are in the critical area.

6.10. Electromagnetic Compatibility (EMC)

- 6.10.1. Compatibility of electromagnetic emissions from proposed projects with the Railway Protection Zone shall be considered through a risk assessment. The detail of the assessment shall be proportionate to the level of risk.
- 6.10.2. Where electromagnetic effects cannot be ruled out, the Agency may require the Applicant to demonstrate how they will ensure Electromagnetic compatibility (EMC) with the existing Railway systems.
- 6.10.3. Earthing and Bonding systems within the Railway Protection Zone shall consider the existing Railway earthing and bonding systems. Any adjacent earthing and bonding shall be designed so that it will not affect the functionality of the existing Railway earthing and bonding. The Applicant shall demonstrate how they will ensure that the existing Railway earthing and bonding system functionality remains and that any coupling with any other system will not introduce risks to persons or Railway Infrastructure.

6.11. Other

- 6.11.1. For proposed works in canals/waterways interfacing with the Railway Infrastructure, consideration should be given to limiting the size of vessels and maximizing clearances to the Railway Infrastructure. In addition protective measures should be considered including but not limited to bogeys, fenders, navigation aids (lights, signs, etc.), and control procedures and CCTV cameras. Any proposals for works in waterways/canals should be discussed and agreed with the Agency in advance to determine their requirements.

7. Foundations, Dewatering, Excavation, and Shoring Requirements

7.1. General

- 7.1.1. In the design and construction of foundations, dewatering, excavations and shoring, the Applicant shall consider the following:
- › The clear distance from the existing Railway Infrastructure.
 - › The construction method.
 - › The construction sequence.
 - › How the loads will be transferred.
 - › The likely stress changes and ground deformations surrounding the Railway Infrastructure.
 - › The adequacy of available geotechnical information (refer Appendix G).

7.2. Shallow Foundations

- 7.2.1. The design and layout of any shallow foundations within the Railway Protection Zone must ensure that sufficient space is provided to allow for inspection and maintenance of the Railway Infrastructure over the design life of the Railway.
- 7.2.2. For works above tunnels, strip and raft foundations will normally be preferable to piled foundations depending on the distance from the tunnel and the likely magnitude of applied loads.
- 7.2.3. The Applicant shall demonstrate that foundations immediately adjacent to the Railway Infrastructure will not:

- › Impose significant loads affecting the stability or serviceability of the Railway Infrastructure or adjacent land.
 - › Compromise the support zone of any existing structure.
- 7.2.4. The Applicant shall consider the effect of overlapping stress distributions from adjacent foundations which may impose more significant stress changes at depth.

7.3. Deep Foundations

- 7.3.1. Deep foundations are generally not allowed within the Critical Zone of the Railway Infrastructure unless approved by the Agency.
- 7.3.2. The precise location, depth and loading of deep foundations shall be carefully specified. As part of the consultation process the Rail Agency may request advance notification of scheduled deep foundation works.
- 7.3.3. Where deep foundations are located within the Railway Protection Zone then the following must be considered:
- › Any excavations for deep foundations must be fully supported at all times to prevent soil collapse.
 - › Positions of deep foundations are to be pegged on site by a registered surveyor based on the approved certified survey plan.
 - › Frequent checks on vertical alignment of the deep foundation must be carried out during installation.
- 7.3.4. Installation of deep foundations must not cause ground movement, displacement or vibration near existing Railway Infrastructure exceeding the limits stated in Appendix G.
- 7.3.5. Construction methods that are likely to generate excessive vibrations are not acceptable. Some examples of such methods are:
- › Use of percussive drilling techniques.
 - › Use of driven piles.
 - › Use of vibratory methods for installing or extracting sheet-piles, H-piles or steel casings.
- 7.3.6. Where deep foundations are required, bored methods are preferred to minimise ground disturbance.
- 7.3.7. The stability of bored holes within the Railway Protection Zone shall always be assured by suitable methods such as the use of casings, forms or support fluids to prevent collapse, as appropriate.
- 7.3.8. Preference should be given to low vibration methods for installing casings. (e.g. rotary oscillators, high frequency vibrators, etc.).

- 7.3.9. The use of drilling support fluids shall be carefully monitored during installation to ensure;
- › Localized increases of piezometer head in the vicinity of the Railway Infrastructure are limited without compromising bore stability.
 - › Correct density of support fluids is maintained to prevent collapse of the pile bore.

Debonding of Deep Foundations

- 7.3.10. To prevent load transfer to soil materials that may subsequently impact upon the Railway Infrastructure, deep foundations located within the Zone of Influence of the underground Railway structures shall be debonded unless the impact upon the Railway Infrastructure is verified through specific study.
- 7.3.11. Debonding shall be carefully considered to ensure the load is transferred away from the Railway Infrastructure and into competent soil materials.
- 7.3.12. The Applicant shall demonstrate the following for debonded deep foundations;
- › How the installation sequence and procedure will ensure the debonded interface is not compromised during construction.
 - › How the interface between the soil and foundation structure will remain debonded over the design life of the foundation.

7.4. Excavation and Shoring Works

- 7.4.1. Excavation of hard strata using conventional blasting methods is not permitted in the Railway Protection Zone.
- 7.4.2. Temporary excavations adjacent to Railway Infrastructure should follow the recommendations as shown in Figure 7.1. Excavations closer to the Railway Infrastructure may be permitted following implementation of adequate shoring and support measures to be agreed with the Rail Agency.
- 7.4.3. Temporary excavations near to underground structures are limited to 1.5m within the Railway Protection Zone. Excavations deeper than this may be permitted following consultation and agreement with the Rail Agency. Any excavation greater than 1.5m should have adequate shoring and support measures to be agreed with the Rail Agency.
- 7.4.4. Any permanent excavation within the Railway Protection Zone may only be permitted following consultation and agreement with the Rail Agency.

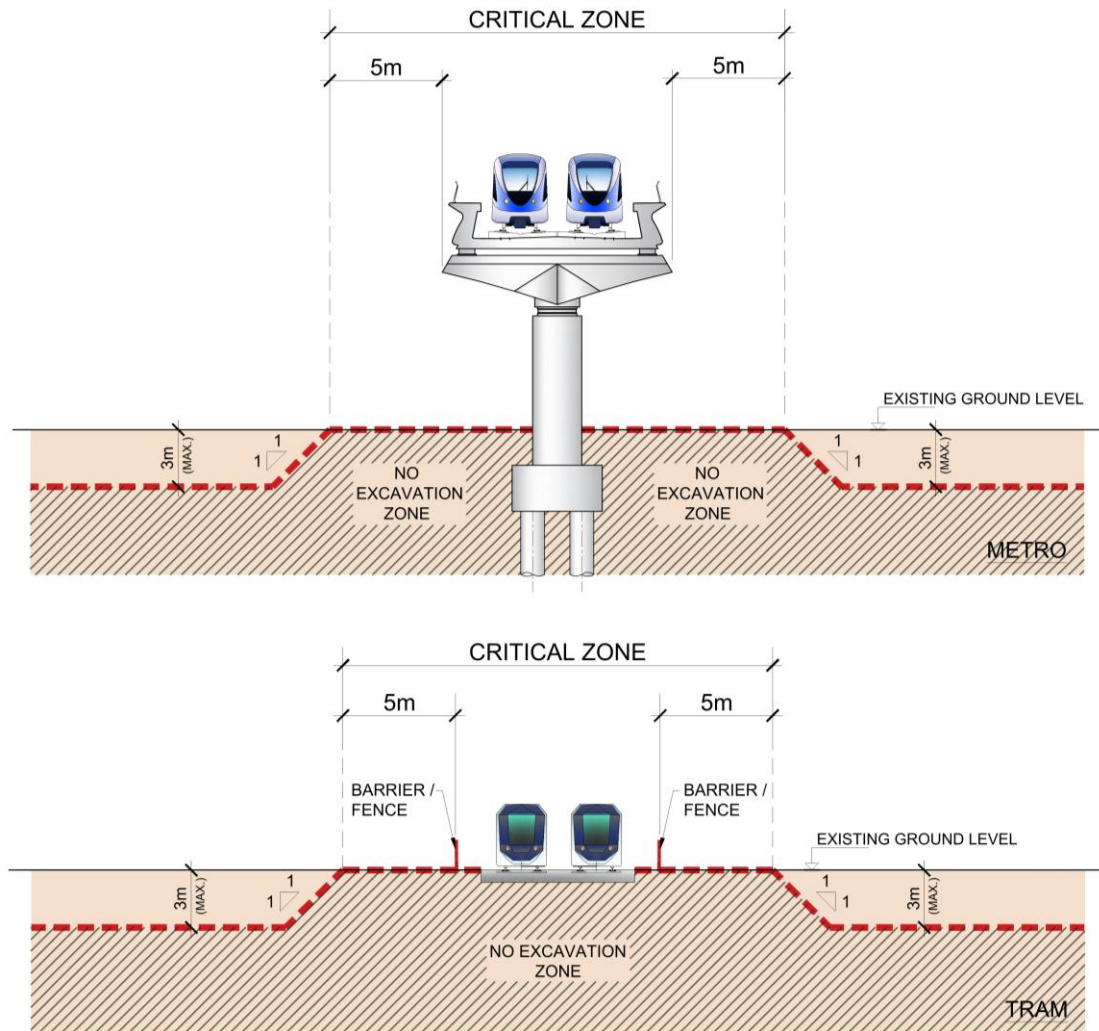


Figure 7.1: Excavation Limits next to Railway Infrastructure.

- 7.4.5.** The retaining system adopted for any excavation in the Railway Protection Zone shall minimise any impact on the Railway Infrastructure. The design of shoring works for excavation shall be in accordance with international standards.
- 7.4.6.** Significant excavations will result in the relief of existing in-situ stresses which may lead to vertical and lateral movement of the surrounding ground (refer Figure 7.2). These factors may have detrimental effects on the Railway Infrastructure and also foundations of neighbouring structures and utilities. Measures to minimise ground movement must be implemented during excavation work near Railway Infrastructure.

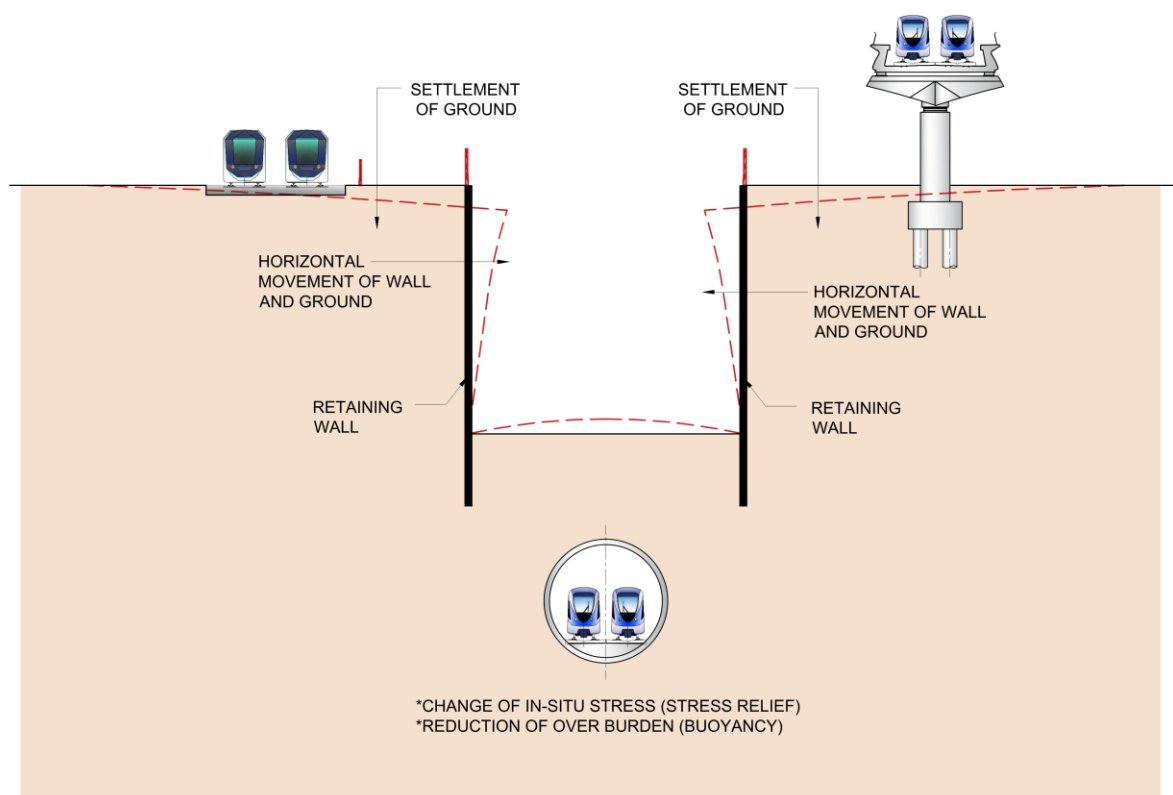


Figure 7.2: Effect of Excavations upon Railway Infrastructure.

7.4.7. To minimise ground movement from shoring walls, the following shall be considered during construction:

- › How the wall is installed e.g. soldier pile walls with lagging may generate significant soil movements as soils are initially unsupported during installation of lagging. Similarly bored methods shall consider the risk of collapse and movements generated prior to placement of concrete.
- › Installing lateral supports to earth retaining walls immediately after each stage of excavation to minimise ground relaxation.
- › Excavating in a compartmentalised manner.
- › Ensuring sufficient attention to interfaces between structural elements (e.g. secant piles or diaphragm walls) to ensure joints are sufficiently watertight to prevent ground water drawdown and inflow between joints in the wall.

7.4.8. To ascertain the changes in stresses and deformations in the shoring structure and the surrounding soil and how they change with the construction sequence, it is necessary to perform soil-structure interaction analyses that model the various construction stages. The limitations in the use of limit-equilibrium methods for analysis of propped excavations shall be clearly understood and accounted for.

7.4.9. For internally propped systems, the props shall be effectively restrained in both major and minor axes. Consideration shall be given to failure of one prop and redundancy of the propping system. Walers shall be continuous for effective load distribution.

7.4.10. In addition, the design of shoring works shall consider the following;

- › Hydrostatic pressures. The highest groundwater levels that could be experienced during the design life of the shoring system shall be considered.
- › Toe level of the wall to ensure both structural and hydraulic stability (refer Section 7.5).
- › The effectiveness of the groundwater cut-off (if required) to restrict water inflows to the excavation to manageable levels and reduce external groundwater drawdowns.
- › Temporary surcharge loads, e.g. construction traffic, crane loads etc.
- › Permanent surcharge loads (e.g. existing building loads).
- › Unplanned excavation allowances.
- › Overall (global) wall stability.
- › Stiffness of the wall and its supports.
- › Nature of any preloading on temporary supports.
- › Quality of construction.

7.4.11. Potential changes in the resistance of underground structures and tunnels to flotation due to excavation works must be checked and measures implemented to prevent any risk of uplift affecting stability of underground Railway Infrastructure.

7.4.12. Where basements are more than 1m below the existing ground water table, they shall be made watertight. The base slab shall be designed for full hydrostatic pressures.

7.5. Dewatering

7.5.1. The dewatering designer shall be responsible for all aspects of the dewatering program.

7.5.2. The dewatering designer shall carefully consider the location, geometry, type of excavation, type of soil to be excavated, rate of excavation and the duration of dewatering in the design of the dewatering system.

7.5.3. The dewatering designer shall ensure that the proposed method is appropriate for the hydrogeological environment, that sufficient flexibility exists within the system to account for any variations shall they be encountered during construction and the system does not create impacts that adversely affect the Railway Infrastructure.

7.5.4. Figure 7.3 illustrates the potential effects of dewatering operations on Railway Infrastructure. The key principles to minimise the impact of groundwater upon Railway Infrastructure are as follows;

- › Ensure groundwater drawdowns are limited to avoid potential settlement of Railway Infrastructure.
- › Ensure that fines are not drawn through the groundwater pumping system which may subsequently cause erosion and instability around the excavation.
- › Ensure groundwater pressures are balanced and/or not significantly changed on any element of Railway Infrastructure.

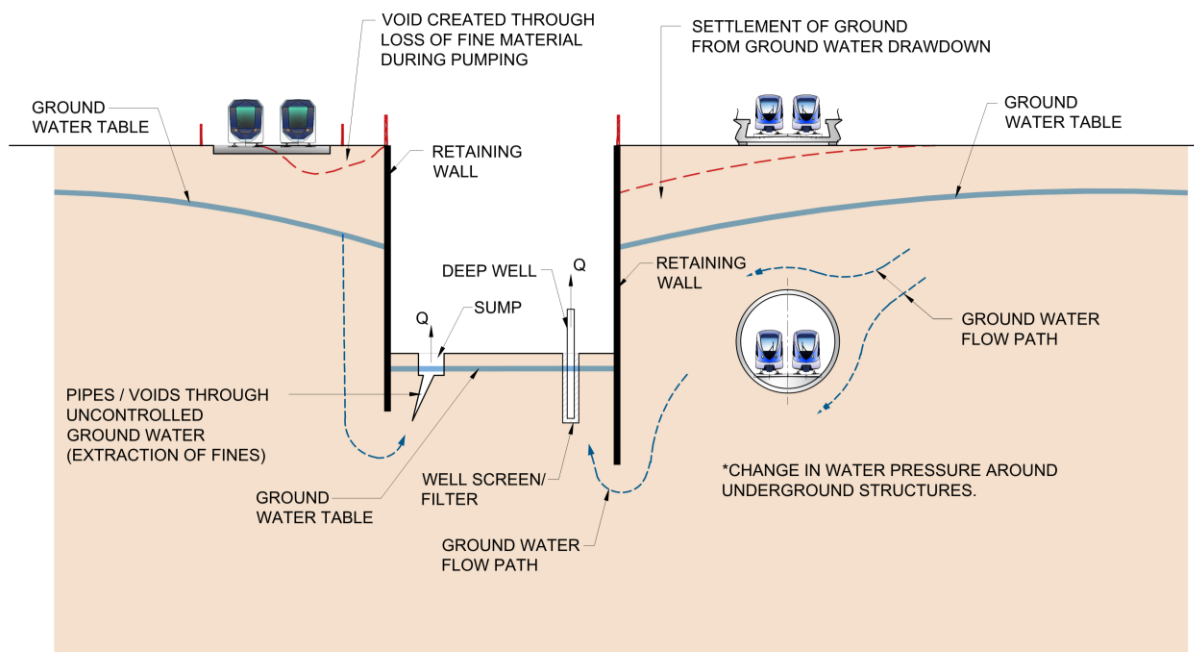


Figure 7.3: Effect of Dewatering upon Railway Infrastructure

- 7.5.5. The Applicant is required to clearly demonstrate in their submission how the above key principles will be achieved during construction of the proposed works.
- 7.5.6. The Applicant shall ensure flexibility is maintained in the chosen dewatering scheme to allow for additional dewatering measures to be added should encountered conditions vary unexpectedly during construction.
- 7.5.7. The water quality and the impact of water disposal shall be considered for any dewatering scheme. Provision of settlement tanks and water treatment facilities shall be provided where required.
- 7.5.8. The Applicant shall refer to Appendix H which outlines the specific requirements for dewatering within the Railway Protection Zone.

7.6. Ground Anchors and Grouting

- 7.6.1. Ground Anchors and grouting operations are not permitted within the Critical Zone unless verified by study. Ground anchors used in excavation works shall be checked for location and required anchor length.
- 7.6.2. No part of the Railway Infrastructure shall be disturbed by the anchors (refer Figure 7.4).

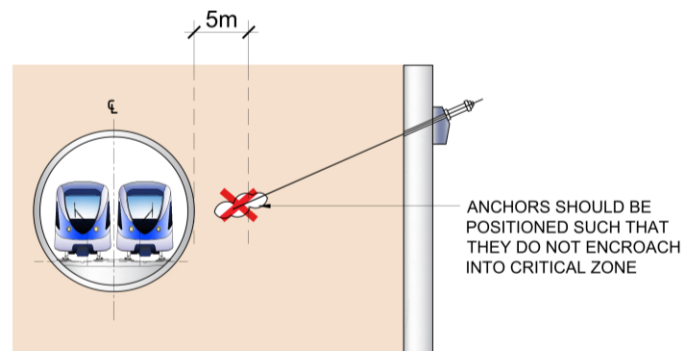


Figure 7.4: Ground Anchor Restrictions next to Tunnel

- 7.6.3. The Contractor shall ensure that ground water levels are not affected by drilling for ground anchor installations.
- 7.6.4. Grouting of anchors must comply with acceptable international standards. Consideration shall be given to the effects of increased pressures due to grouting near existing Railway Infrastructure.

7.7. Ground Improvement

- 7.7.1. The nature of ground improvement techniques will typically involve significant changes in the in-situ stress state of the soil, soil deformations and/or ground vibrations that are unlikely to be acceptable to the Agency. Ground improvement methods will not be acceptable within the Railway Protection Zone unless verified by detailed study.

7.8. Tunnelling Works

- 7.8.1. The allowable proximity of tunnelling works to the Railway Infrastructure is governed by the risk of excessive deformation affecting the existing Railway Infrastructure and track. Deformation caused by ground loss is highly dependent on the tunnelling or construction technique employed and the ground conditions.

- 7.8.2. The Applicant shall clearly demonstrate the need for tunnelling to be carried out beneath or adjacent to existing Railway Infrastructure as well as the methods and equipment to be used.
- 7.8.3. The Applicant shall demonstrate how the following risks are mitigated:
- › Excessive movement of the Railway Infrastructure.
 - › Ground collapse.
 - › Excessive vibration levels which may influence the integrity of the Railway structures and operation of the Railway.
- 7.8.4. Figure 7.5 illustrates some of the effects of tunnelling adjacent to Railway Infrastructure. In addition to ground settlement and change of in-situ stresses caused by excavation, the Applicant shall also consider the impact of groundwater drawdown, tunnel grouting pressures and tunnel face support. Control of excavation overbreak should be minimised to reduce the impact of excavation on the surrounding ground.

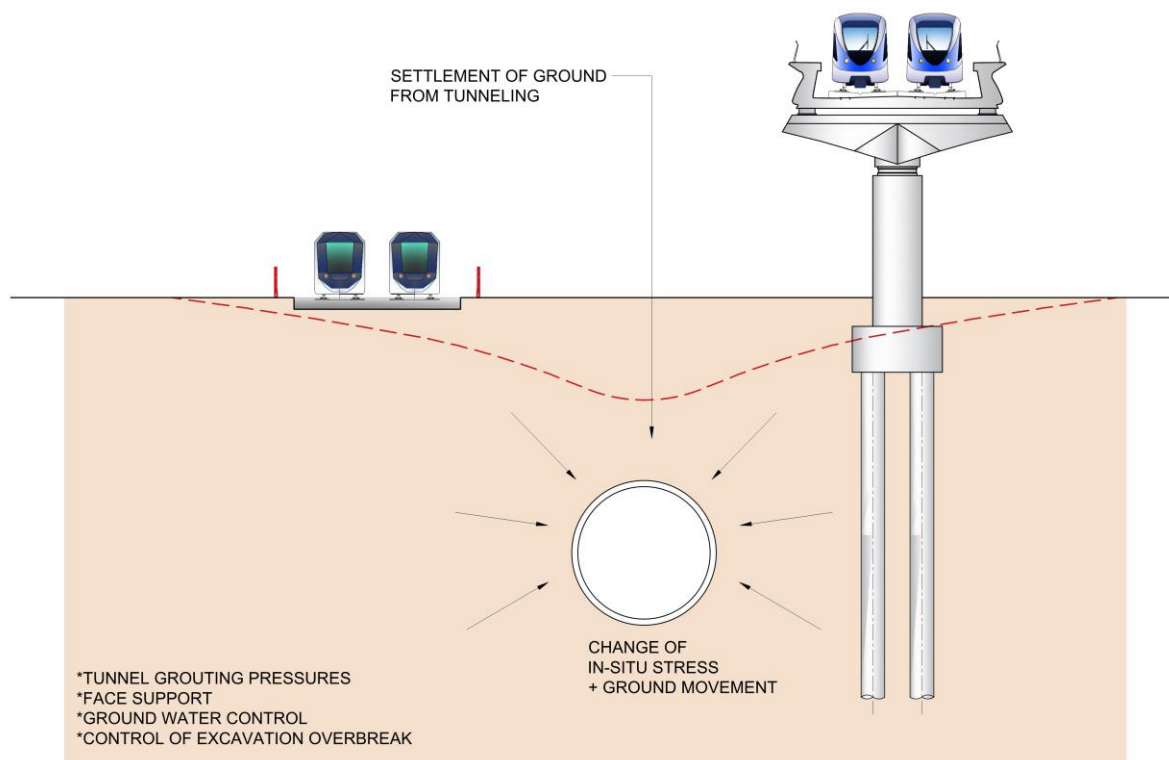


Figure 7.5: Effects of Tunnelling next to Railway Infrastructure

- 7.8.1. To mitigate the risk to the Railway Infrastructure, the Applicant shall consider the following where relevant.
- › Ground support measures such as grouting, pipe arch roof techniques shall be considered to prevent ground collapse, water ingress and ravelling of soil, etc. The

potential impacts of proposed support activities on the Railway Infrastructure shall be demonstrated to be acceptable (e.g. vibration, ground movement, change in in-situ pressures, etc.).

- › Ground loss (from the face, tail void or over-break, etc.) shall be minimised by providing adequate support to the face and continuous tail void grouting.
- › Techniques such as the NATM method where the ground is not immediately supported after excavation is not acceptable unless the contractor demonstrates the risks are reduced to acceptable levels to the Agency's satisfaction.
- › Measures to prevent ingress of water must be implemented. Temporary dewatering measures shall be demonstrated to have no adverse effect upon the Railway Infrastructure. Permanent linings shall be made watertight to prevent any seepage of water into the proposed tunnels under permanent conditions.
- › The tunnel shall be continuously and fully supported with a permanent lining designed to support the full overburden including water load with minimal deformation during the work.
- › Avoidance of blasting techniques to remove hard strata or obstruction.

Submission Requirements

7.8.2. The following items shall be submitted for any tunnelling works;

- › Plan, profile and cross-section drawings of the proposed tunnel including depth below ground surface and any existing underground structures or utilities.
- › Details of the proposed tunnelling system, e.g. TBM, pipejacking, etc., including characteristics of proposed fluids for lubrication and ground support.
- › Plan, elevation and details of the proposed launch and reception shafts (temporary and permanent).
- › List of previous projects and experience of the contractor in carrying out similar works in the UAE.
- › Design calculations including estimated volume loss and predicted ground surface movement.
- › Structural design calculations of loads upon the tunnel lining.
- › Monitoring proposal.
- › methods of dealing with the following;
 - › Face support and stability (including over pressurization of the face).
 - › Groundwater control.
 - › Management of excavation overbreak.
 - › Jacking/thrusting/pulling forces upon the tunnel lining and reaction systems.
 - › Forces imposed due to tunnel grouting pressures.
 - › Segmental/pipe alignment along joints.
 - › Settlement on breaking through launching shaft.

- 7.8.3. Reference shall also be made to Appendix I which outlines RTA requirements for Non Destructive Road Crossing (NDRC) and Non Destructive Method (NDM) works.
- 7.8.4. It is recommended that any tunnel be located a minimum clear distance of $2.5 \times D$ away from any Railway Infrastructure, where D is the excavated tunnel diameter. For tunnels where the excavated diameter is less than 1m, the minimum clear distance shall be 2.5m. In all cases, the above submission requirements shall be met.
- 7.8.5. Geotechnical investigation shall be sufficient to define the horizontal and vertical alignment of the tunnel. The investigation shall ensure that difficult driving conditions such as mixed face conditions (interfaces between strong and weak or permeable and impermeable materials) are avoided where possible. Consideration shall also be given to identifying the optimal operational variables (e.g. RPM, axial feed rate, torque, flush and lubricant rate and specifications, face pressure etc.) for the desired technique.
- 7.8.6. Ground surface settlement shall be no more than 5.0mm, unless verified through study that greater settlements will not cause any impact upon Railway Infrastructure.
- 7.8.7. Ground surface settlement monitoring systems shall be installed extending outwards either side from the centreline of the pipe by a distance equal to the depth of the centreline of the pipe below ground surface. The minimum width of monitoring shall be 1m either side for pipe diameters less than 1.0m.
- 7.8.8. Benchmarks for monitoring ground surface settlement shall be a minimum of 50m from the nearest settlement point.
- 7.8.9. On commencement of construction, all operational variables shall be recorded (manually or automatically) to ensure compliance with the original expectations. These shall be recorded against measured chainage of the tunnel advance.
- 7.8.10. The above requirements do not include the requirements of any other authorities who may have additional requirements to those specified above.
- 7.8.11. Reference shall be made to international codes and standards such as those published by the Pipejacking Association (www.pipejacking.org) to assist in meeting the above requirements.



8. Risk Assessment

8.1. General

- 8.1.1. A hazard is something (e.g. an object, a property of a substance, a phenomenon or an activity) that can cause harm.
- 8.1.2. A risk is the likelihood (high or low) that harm could result from the hazard occurring, together with an indication of how severe the harm could be.
- 8.1.3. The Applicant shall undertake risk assessments to ensure that any potential hazards that may impact the Railway Infrastructure whether it is under construction, operation or planning are addressed. The Applicant shall identify all hazards arising from the proposed works, evaluate the corresponding risks and then outline the proposed mitigation measures to control them.
- 8.1.4. The Applicant must develop and implement systems, procedures and working practices that identify and minimise risk to the safety, operation or maintenance of the Railway, and that protect persons involved. This is a key risk control measure.
- 8.1.5. For permission to carry out Restricted Activities within the Railway Protection Zone, the Applicant must prepare the risk assessment report for submission to the Agency.

8.2. Process

- 8.2.1. Risk management involves the following processes;
 - › Thoroughly examining the work process, the machineries, equipment and material used.
 - › Identifying and analysing all possible hazards.
 - › Quantifying and evaluating the risks posed by these hazards to the Railway systems.
 - › Developing precautionary and contingency measures to eliminate and reduce the hazards and thus mitigate the risks.
 - › Implementing and applying the measures identified.
 - › Monitoring and reviewing the activities and taking necessary actions to mitigate any residual risks.
- 8.2.2. The Risk Assessment to be included in the NOC applications shall be based on the ALARP risk analysis approach, as outlined in EN 50126 'Railway applications–The

specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS) – Part1: Basic requirements and generic process’, where the probability or frequency of occurrence of an event or events leading to a hazard and the consequence of the hazard are estimated to determine the risk level.

- 8.2.3. The approach of ‘ALARP’ means that risks shall be reduced to ‘As Low as Reasonably Practicable’, and involves weighing the risk against the trouble, time and money needed to control it. Achieving ALARP involves four basic steps as shown in Figure 8.1.

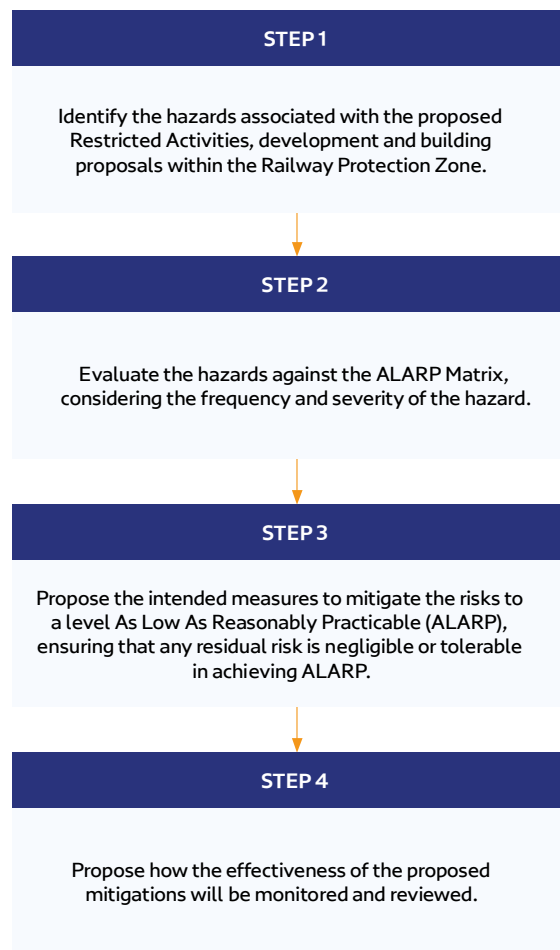


Figure 8.1: Steps to achieve ALARP

- 8.2.4. The steps in Figure 8.1 above can be summarised as;

- › Hazard Identification.
- › Risk Evaluation.
- › Risk Control.
- › Risk Review

- 8.2.5. Throughout the ALARP process, the Applicant shall record all findings in a formal Risk Register document.
- 8.2.6. The Risk Register is a living document that shall be continuously reviewed and updated throughout any project or activity life-cycle, to ensure that all accepted risks remain ALARP.
- 8.2.7. A Risk Register is provided for reference (refer Appendix D) to assist the Applicant in preparing the risk assessment report. The Applicant shall be responsible for all risks that arise as a result of the proposed activities.

8.3. Hazard Identification

- 8.3.1. The Applicant shall identify all possible hazards of the proposed Restricted Activities during the NOC stage.
- 8.3.2. It is important the Applicant recognises the sources or situations that can cause damage of Railway Infrastructure, affect the operation of the Railway and result in injuries or even fatalities to Railway passengers.
- 8.3.3. These can be due to the proposed Restricted Activities and the movement and operation of equipment/ plant used to carry out the activities. It is only by identifying the hazard that the risk associated with it can be controlled.
- 8.3.4. To effectively identify the hazards, the Applicant shall have available as much information as possible on the:
 - › Site layout and working environment.
 - › Work process or workflow of the activities.
 - › Existing and proposed site conditions affecting the working environment.
 - › Details of machineries, tools, and hazardous materials used.
 - › Relevant test records, inspection records and certificates.
 - › Competency and responsibilities of the operators, supervisors, project officers and safety officers.
 - › Relevant codes of practice, specifications and legislations.

8.4. Risk Evaluation

- 8.4.1. The Applicant shall determine the frequency of occurrence of the potential hazard and the expected severity of the hazard to evaluate the risk to the Railway system.
- 8.4.2. Table 8.1 defines the various frequency categories for hazards.

Table 8.1: Hazard Frequency Categories

CATEGORY	DESCRIPTION
FREQUENT	Likely to occur Frequently. The hazard will be continually experienced.
PROBABLE	Will occur several times. The hazard can be expected to occur often.
OCCASIONAL	Likely to occur several times. The hazard can be expected to occur several times.
REMOTE	Likely to occur sometime in the system life cycle. The hazard can be reasonably expected to occur.
IMPROBABLE	Unlikely to occur but possible. It can be assumed that the hazard may exceptionally occur.
INCREDIBLE	Extremely unlikely to occur. It can be assumed that the hazard may not occur.

8.4.3. Table 8.2 defines the severity categories and the consequences associated with each severity level.

Table 8.2: Hazard Severity Categories

CATASTROPHIC	Fatalities / multiple severe injuries / major damage to the environment and disruption.	Loss of a major system.
CRITICAL	Single fatality and/or severe injury and/or significant damage to the environment.	Loss of a major system.
MARGINAL	Minor injury and/or significant threat to the environment.	Severe system(s) damage.
INSIGNIFICANT	Possible minor injury.	Minor system damage.

8.4.4. Using the selected categories for frequency from Table 8.1 and severity from Table 8.2, an initial risk category can be identified using Figure 8.2.

8.4.5. Table 8.3 shows the actions required of the Applicant by the Agency based on the obtained risk category from Figure 8.2. Any unacceptable risk must be managed through changes in the materials, methods, equipment and people as necessary to bring the risk category down to an acceptable level.

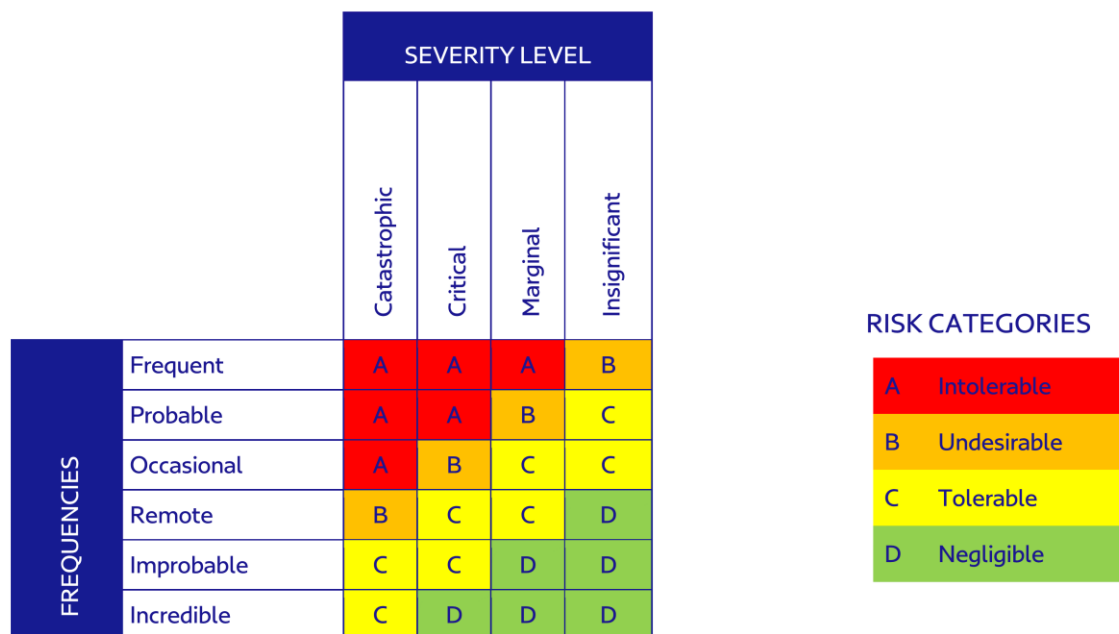


Figure 8.2: Risk Matrix

Table 8.3: Risk Category Actions

RISK CATEGORY	ACTION
INTOLERABLE	Must be eliminated
UNDESIRABLE	Shall only be accepted when risk reduction is impracticable and with the agreement of the Agency.
TOLERABLE	Acceptable with adequate Control Measures and the agreement of the Agency.
NEGLIGIBLE	Acceptable

8.5. Risk Control

- 8.5.1. The effort involved in managing a risk shall be commensurate with the magnitude of that risk.
- 8.5.2. The Applicant shall determine risk controls based on bringing the risk to an acceptable level. It is important the risk controls are practical and effective.
- 8.5.3. The Applicant shall use the hierarchy shown in Figure 8.3.
- 8.5.4. The Applicant shall seek to remove or eliminate the hazard at the source in the first instance. This could be achieved by selecting appropriate and suitable materials,

equipment, methods and/or people that will pose no risk to the Railway. If this is not possible, then other measures to reduce risks to an acceptable level must be considered.

- 8.5.5. The Applicant may substitute the hazard by using different materials, equipment, methods and/or people (e.g. replacing a hazardous chemical with a non-hazardous one, etc.).

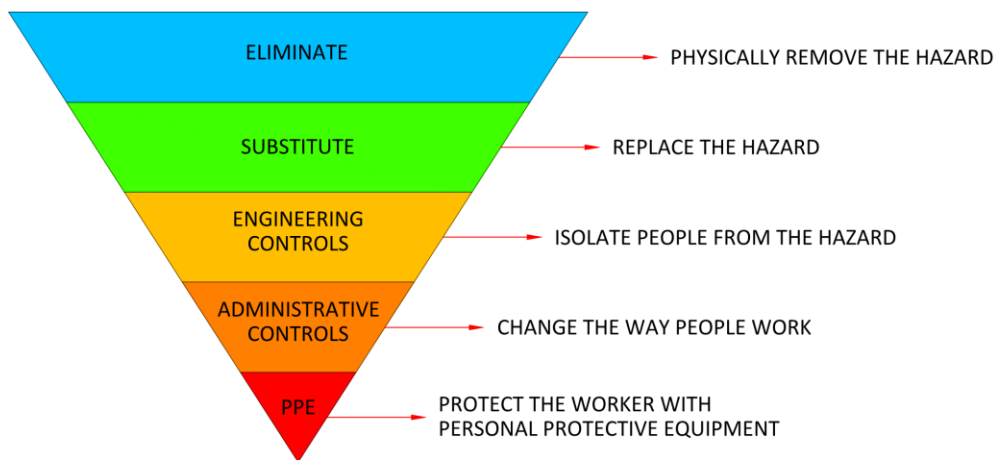


Figure 8.3: Hierarchy of Controls

- 8.5.6. The Applicant may add Engineering Controls to isolate people from the hazard. Examples of Engineering Controls include erecting physical barriers to restrict operational areas of equipment, installing protective structures to shield the Railway and passenger from the dangers, etc.
- 8.5.7. The Applicant shall only use Administrative Controls when other measures are not possible. Examples of administrative controls include implementing procedural checks, close site control and supervision at each stage of the Restricted Activity and on materials, equipment, methods and people used.
- 8.5.8. The Applicant shall only use Personal Protective Equipment (PPE) as a last resort. This is the least effective method of avoiding the risk associated with a particular hazard.
- 8.5.9. Restricted Activities shall not commence until the risk assessment report including the risk control measures are reviewed and approved by the Agency.

8.6. Risk Review

The Applicant shall demonstrate how the effectiveness of the risk mitigation measures will be assessed through regular health and safety audits of the site. Records shall be kept on site and be available by the Agency Inspection team as required.

9. Monitoring Requirements

9.1. General

- 9.1.1. This section provides general guidance in carrying out various monitoring activities required for the protection of the Railway Infrastructure during implementation of the approved Restricted Activity. The various types of monitoring instruments are discussed, followed by the requirements for calibration, installation, accuracy, protection and maintenance during operation and reporting of results.
- 9.1.2. Instrumentation and monitoring is an indispensable component of the risk control process particularly within the Railway Protection Zone to:
- › Verify design calculations and predictions.
 - › Maintain public safety.
 - › Assess the level of redundancy available.
 - › Ensure remedial measures are implemented in advance of ‘non-recoverable’ situations.
- 9.1.3. Examples of typical monitoring instruments are shown in Figure 9.1 and Table 9.1 below;

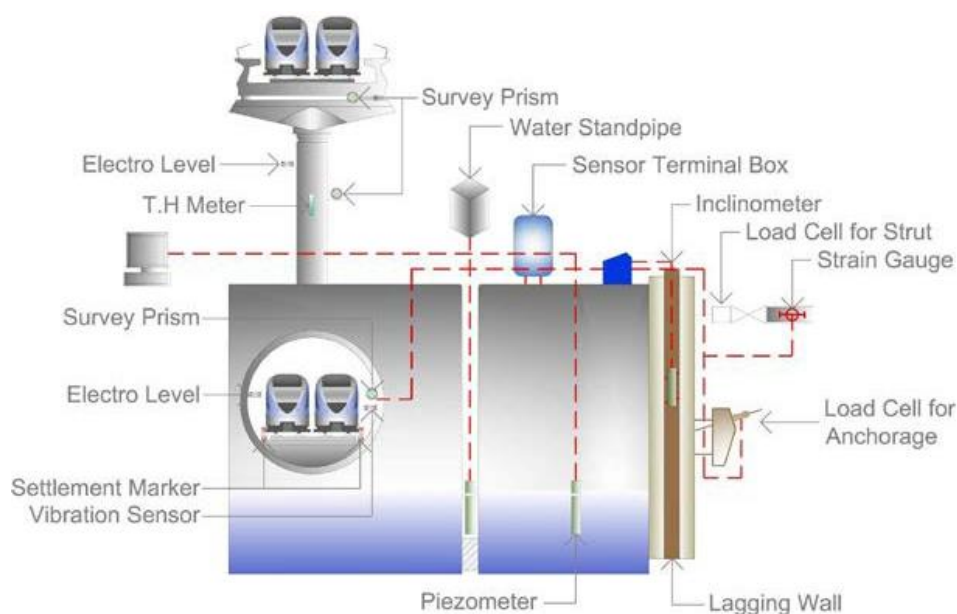


Figure 9.1: Typical Monitoring Scheme

Table 9.1: Typical Monitoring Instruments

PURPOSE	INSTRUMENTS
GROUND WATER MONITORING	Flowmeter
	Water standpipe
	Piezometer
	Electric conductivity meter
	Turbidity meter
GROUND MOVEMENT	Inclinometer (horizontal movement)
	Extensometer (vertical movement)
	Surveying methods
STRUCTURAL FORCES	Load cell
	Strain Gauge
STRUCTURAL AND TRACK MOVEMENT	Tiltmeter
	Surveying methods
	Crack meter
	Tape extensometer
	Electronic leveller
	Temperature Gauge
VIBRATION	Vibration sensor

- 9.1.4. The Applicant may propose different instruments to those specified in Table 9.1 subject to the approval of the RTA.
- 9.1.5. A summary of the different purposes of monitoring instruments for various structures is given in Table 9.2.

Table 9.2: Summary of Monitoring Locations, Instruments and Purposes

LOCATION	INSTRUMENT	MEASUREMENT	VISUAL OBSERVATION
Retaining wall (shoring)	Pressure cell	Earth pressure on back of wall.	Wall bending/deformation. Wall crack. Continuity. Groundwater ingress. Tension crack in ground.
	Water pressure cell Piezometer Standpipe	Pore water pressure. Groundwater level change (due to dewatering).	
	Electro-level Tiltmeter	Inclination/Tilt of structure.	
	Inclinometer	Horizontal displacement of structure with depth.	
	Surveying array	x,y,z coordinate of wall movement.	
Strut, Ground anchor	Load cell	Axial force in strut.	Strut connection. Bolt fastening.
	Strain gauge	Change in force/length of strut.	
Excavated ground, Surrounding ground	Piezometer Standpipe	Pore water pressure/Groundwater level.	Groundwater ingress. Road crack. Widening of gaps between street kerbs.
	Inclinometer	Profile of Horizontal Displacement with depth below ground level.	
	Extensometer	Vertical displacement of ground (heave/ settlement)	
	Surveying array	x,y,z coordinate of ground movement	
Railway structures in the vicinity	Tiltmeter Electro-level	Inclination/Tilt/distortion of Railway structure for both vertical (e.g. wall) and horizontal (e.g. tracks)	Cracks on structures Water infiltration Visual deformation of structure
	Crack gauge	Change in width of existing crack in Railway structure.	
	Strain gauge	Change in force in existing Railway structure	
	Surveying array	x,y,z coordinate of Railway structure movement	

9.1.6. The Rail Agency reserves the right to add any additional requirements considered necessary to safeguard the Railway.

9.2. Trigger Limits

- 9.2.1. The Applicant shall set limiting values on the parameter being measured by the instrument ('trigger limits').
- 9.2.2. The purpose of the trigger limits is to ensure that the performance of the proposed works in the field is maintained within expected values. In the event of a trigger limit being reached, appropriate contingency measures can be implemented.
- 9.2.3. Trigger limits are typically based on a 'traffic-light' system and represent the interface between green, amber and red response zones. The response zone is used to dictate what Control Measures are applicable in the event of each limit being reached. Table 9.3 outlines the typical responses for each limit.

Table 9.3: Trigger Limits

ZONE	RESPONSE
Green	Continue construction (limit is expected to be achieved)
Amber	Prepare to implement contingency measures, increase rate of monitoring if necessary
Red	Stop, reduce movements and implement contingency measures

- 9.2.4. The value chosen for each trigger limit shall be based on the results of the impact assessment undertaken for the proposed works. The trigger limits shall be set considering the following;
- › Predicted value of the parameter (result of the impact assessment).
 - › Likelihood of the predicted value being exceeded.
 - › Accuracy and stability of the instrument readings.
 - › Sufficient time within which to implement any contingency measures in the event of exceedance of a trigger limit without significant impact upon the Railway Infrastructure.
- 9.2.5. All the above shall be considered in the risk assessment along with a clear plan for implementation of emergency response and remedial actions to ensure the safety and integrity of the Railway Infrastructure.

9.3. Planning

- 9.3.1. The Applicant shall use detailed engineering analyses to predict the critical areas, impact and extent of the influence zone of the proposed works. The analysis can be used to inform the monitoring plan which will determine for each instrument;
- › Type.

- › Location.
 - › Frequency of monitoring.
 - › Trigger limits.
- 9.3.2.** When preparing the instrumentation and monitoring plan, the Applicant shall consider the following:
- › Ground conditions.
 - › Geometry of the proposed works.
 - › Magnitude and distribution of the stress changes and deformations resulting from the proposed works.
 - › Planned construction activities (and potential for disturbance of the instruments).
 - › Existing foundation of the Railway Infrastructure.
 - › Existing condition of the Railway Infrastructure.
- 9.3.3.** Some parts of the Railway Infrastructure may have already experienced displacement, settlement and distortion due to past construction activities. The Applicant shall consider the past history and current condition of the Railway Infrastructure in the monitoring scheme where possible.
- 9.3.4.** The Applicant shall ensure the monitoring plan contains sufficient redundancy in the provision of instruments to cater for possible damage and to permit meaningful comparisons between instruments.
- 9.3.5.** Pre-Condition Surveys shall be sufficiently detailed to identify all potential issues that may cause concern during the construction period and beyond. Typically Pre-Condition Surveys will involve observational survey (with photographs taken as evidence) and limited measurements where necessary. Advanced techniques may be used (e.g. laser scanning) however the use of such techniques must first be approved by the Agency to ensure the resolution and output quality of such techniques identify all issues of concern to the Agency.
- 9.3.6.** Where Pre-Condition Surveys identify areas of concern to the Agency, additional instruments may be required.
- 9.3.7.** Combustible materials shall not be used in the instruments or their fixtures to prevent fire hazard. This includes power and signal cables which shall be made of fire retardant, low smoke, halogen free materials. In-situ welding is not allowed and the anchoring system must be robust, designed for redundancy and for failure of any anchorage or bolt.
- 9.3.8.** The spacing of instruments shall be such that adverse changes in the ground conditions can be captured and suitable redundancy is available to capture the overall behaviour of the system. Reliance should not be placed on a single instrument as this does not allow for the risk of damage or disturbance to the instrument.

- 9.3.9. The extent of monitoring shall reflect the zone of influence of the proposed works and the sensitivity of the instrument to provide a reliable measurement.

9.4. Remote Monitoring Systems

- 9.4.1. Real time, remote monitoring systems have the capability to continuously acquire data readings. It is highly recommended that automatic systems be employed where possible (refer Figure 9.2). These systems also offer the possibility of;
- › Automatically increasing the frequency of data acquisition.
 - › Avoiding troublesome access requirements (both physically and procedurally).
 - › Automated alert systems (via SMS or email).
 - › Access to data real-time via Internet portals.
 - › More frequent monitoring and reporting and therefore better control and more rapid response.



Figure 9.2: Automatic Total Station Theodolite

- 9.4.2. Remote monitoring systems shall be manually checked at least once per month to verify the acquired data readings.

- 9.4.3. The software used in processing of data shall be in accordance with manufacturer's recommendations. The software shall be proven to be reliable and the Agency reserves the right to reject any proposed software that is deemed not acceptable.
- 9.4.4. For automatic monitoring, at least four monitoring cycles of results shall be provided for the entire monitoring zone within a period of 24 hours unless otherwise notified by the Agency.
- 9.4.5. For remote sensing of groundwater, data loggers can be connected to a telemetry system, which is connected to a GPS network that sends instant results. Data loggers are installed inside the pumping well or observation well.

9.5. Vibration Monitoring

- 9.5.1. Vibration generated by various construction activities can be measured using a vibration sensor, which usually displays and analyses the linear velocity of the vibrations in three orthogonal directions (x, y, z). The sensors can be raw sensing elements, packaged transducers, a sensor system or instrument, incorporating features such as totalising, local or remote display and data recording. Where the proposed construction activities are likely to generate intensive vibration for significant periods of time, the Contractor shall provide a full sensor system with totalising features including automatic data recording.
- 9.5.2. The overall system and particularly the transducer shall have an adequate sensitivity and range to cover the expected range of vibration frequency and velocity magnitudes.
- 9.5.3. When mounting vibration transducers, the aim shall be to reproduce faithfully the motion of the element or substrate without introducing additional response.
- 9.5.4. Vibration measurements made on or below the ground surface may be affected by the variation of the surface wave amplitude with depth. Structure foundations may then be exposed to a motion which is different from the one observed on the ground surface depending on the wavelengths, foundation depths, and geotechnical conditions.
- 9.5.5. To minimize coupling distortion, sensors mounted in the ground shall be buried to a depth at least three times the main dimension of the transducer/mounting unit.
- 9.5.6. Measurements shall be taken at the base of the structure of interest on the side of the structure facing the source of vibration. One of the horizontal vibration components shall be in the radial direction between the source and the structure in the case of ground measurements or oriented parallel with major axis of the structure when investigating structural response.

9.6. Calibration

- 9.6.1. The instruments to be installed at site shall have valid calibration certificates from recognised bodies and shall be tested before installation to verify the instrument provides reliable results. The calibration frequency of the instruments shall comply with the manufacturers' recommendations but no greater than 6 months.
- 9.6.2. The Applicant shall consider the use of 'control' instruments where background environmental influences may have a significant impact on instrument behaviour (e.g. temperature, vibration, etc.).

9.7. Installation

- 9.7.1. The Applicant shall submit details of all instruments to be installed on Railway Infrastructure to the Agency for approval before track access can be granted for the installation works.
- 9.7.2. The instruments shall be installed by an organisation that has the necessary experience, skills and knowledge in the field of instrumentation and monitoring and is prequalified for such works with the RTA and the Operator.
- 9.7.3. An installation plan shall be submitted to the Rail Agency outlining the following where required;
- › Instrumentation layout plan showing scale and chainages of instrument locations. Each instrument should be individually numbered so it can be uniquely identified.
 - › Cross-section through the Railway track, showing;
 - › Chainage and direction of view (e.g. north, south, etc.).
 - › Structure gauge profile (considering cant and horizontal throw).
 - › Clear distance from instrument to structure gauge envelope.
 - › Set out of instrument (vertical and horizontal with respect to rail).
 - › Fixing details, showing;
 - › 3D dimensions of instruments, brackets, bolts, cable fixing details.
 - › Specifications of instruments, cables, etc.
 - › Design calculations for all fixings.
- 9.7.4. The location of each instrument and the size of any protection boxes shall not interfere with any part of the Railway operations, nor shall it encroach beyond the structure gauge of the Railway.
- 9.7.5. Monitoring for tunnels shall be extended at least 20m beyond the zone of influence of the Restricted Activity. At least four points around each tunnel ring shall be monitored. Figure 9.3 shows an indicative monitoring scheme for tunnels.

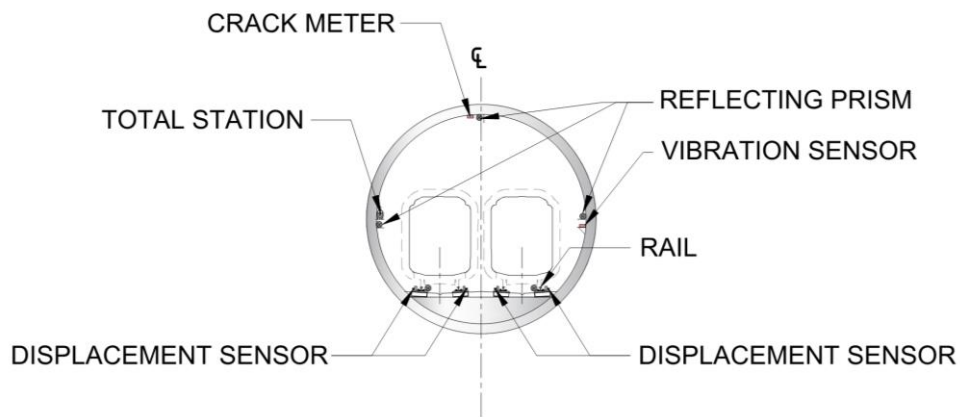


Figure 9.3: Indicative Tunnel Monitoring Scheme

- 9.7.6.** Wherever possible, the surveying prisms and protectors shall be located close to the rails to prevent tripping hazards. Prism protectors on the floor shall also be coated with luminous paint to enhance visibility (refer Figure 9.4).

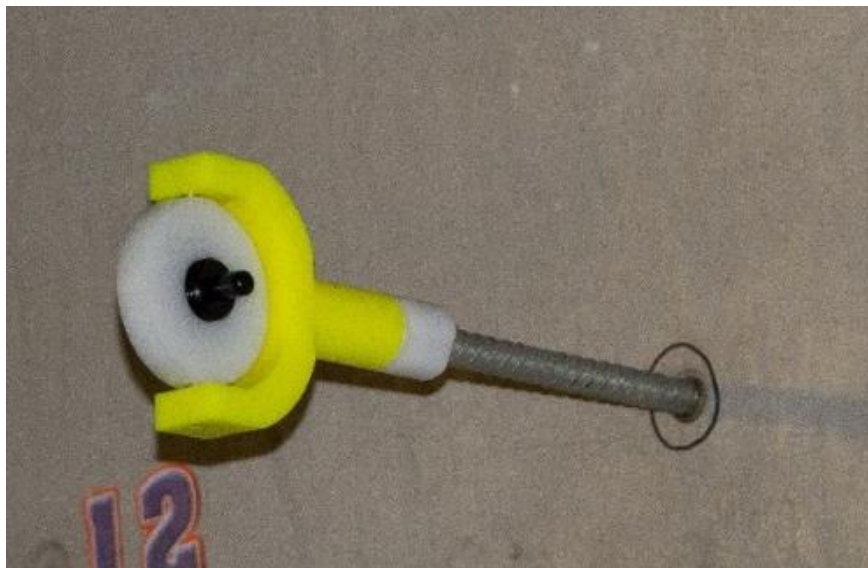


Figure 9.4: Reflective Prism (Reflective Coating)

- 9.7.7.** Where no drilling of the Railway structure is permitted, prisms shall be installed using heavy duty double sided tape (refer Figure 9.5).



Figure 9.5: Reflective Prism (Tape Fixing)

- 9.7.8. Consideration shall be given to the effect the fixing detail may have on the instrument behaviour and whether it will maintain the accuracy required.
- 9.7.9. Control and reference points shall be located outside the influence zone of the proposed works so that they do not impact on the accuracy of the monitoring results. At least two numbers of control points at opposite ends of site shall be provided. In addition, control points must be located on very stable structures which would not be affected by the proposed works.
- 9.7.10. Any changes to the approved plans or applications under review shall be notified to the Rail Agency before implementation.

9.8. Accuracy of Readings

- 9.8.1. To ensure the specified instrumentation is meaningful, the instrument accuracy must be sufficiently lower than the trigger limits specified. It is recommended that instruments shall have an accuracy of not greater than 20% of the lowest trigger level.
- 9.8.2. Where instruments cannot achieve the required accuracy above, the Applicant shall consider positioning instruments closer to the source of the disturbance. This may mean changing the type of instrument.
- 9.8.3. Notwithstanding the above the readings shall be consistent and stable and attain the level of accuracy as specified by the manufacturer. Instruments must be installed properly and maintained in good working condition.

- 9.8.4. The results shall be certified by a registered surveyor for submission to the Agency. The monitoring instrument and set up must consider the effects of Railway operation and changes in ambient conditions such as vibration, changes in air pressure and temperature, etc.

9.9. Initial Readings

- 9.9.1. Prior to any works starting, a suitable baseline period shall be established. This is to establish the baseline readings against which the proposed works will be checked. Note that the baseline conditions may vary (e.g. through fluctuations in temperature, pressure, instrument noise, etc) and it is vital to establish this in case any variation may be unfairly attributed to the work. The baseline monitoring period shall be generally be for a 4 week period unless notified by the Agency.
- 9.9.2. Initial readings must be stabilized to the satisfaction of the Rail Agency before construction works can commence.
- 9.9.3. Readings which are the most representative of the initial condition shall be taken as the initial readings.
- 9.9.4. For automatic monitoring of movements, the initial set of readings must include test results to demonstrate the monitoring system meets the required accuracy as stated in Section 9.8.
- 9.9.5. All instrument readings shall be able to consider the effects of Railway operations and changes in ambient conditions such as vibration, temperature and pressure.

9.10. Instrument Maintenance and Protection

- 9.10.1. The instruments shall be maintained in accordance with the manufacturers' recommendations and shall be kept away from moisture and other environmental influences where possible.
- 9.10.2. Instruments shall be protected and located such that they will not suffer damage from construction activities or from environmental influences (ref Figure 9.6).



Figure 9.6: Protection of Instruments

- 9.10.3. After installation, the Applicant must ensure that all instruments are properly protected with warning signs to prevent unauthorized access. Labels showing the name of the instrument, company, responsible engineer and a contact phone number shall be fixed on each instrument.
- 9.10.4. The battery in battery powered instruments shall be checked on a regular basis. The instruments shall also be checked on a daily basis and any malfunctioning instruments shall be replaced immediately.
- 9.10.5. The Applicant is responsible for ensuring the instruments are maintained and remain functional over the monitoring period. The Applicant shall immediately replace any non-functional or damaged instruments to the satisfaction of the Agency and readings correlated with the previous record where possible.
- 9.10.6. Where monitoring instruments need to be removed for periodic servicing and maintenance, the Applicant must submit a procedure in the monitoring proposal to demonstrate how the servicing will be carried out without affecting the monitoring results.

9.11. Reporting

- 9.11.1. The effects of construction works on the Railway Infrastructure, tracks and the ground shall be continuously monitored. The monitoring results shall be analysed to predict the likely trends and the Agency shall be notified immediately of any deviation from the predicted results and trends.
- 9.11.2. Readings shall be taken at the same time of the day throughout the monitoring period to minimise any temperature sensitive fluctuations. In any case, all instruments shall be protected from temperature fluctuations, have temperature correction features or allow for calculation based temperature corrections.
- 9.11.3. The monitoring readings shall be submitted to the Agency in a timely fashion. A report of the review and the monitoring results shall be submitted to the Agency within one week from the date of monitoring.
- 9.11.4. Depending on the nature of the construction works planned, the Agency may request for more frequent reporting. A periodic report shall typically include;
- › Computer generated outputs or manual records of monitoring data analysed and endorsed by the responsible engineer. The conclusions drawn from the data shall be included in the periodic reports.
 - › Comparison of monitoring data readings with trigger limit.
 - › Photographs of site activity within the RPZ. The date of the photograph should be clearly shown.
 - › Description of site works, especially within the RPZ.
 - › Results of any corrective action request issued by the Agency.
- 9.11.5. The Agency shall have the right to instruct changes to the proposed monitoring plan or any additional requirements deemed necessary to protect the Railway Infrastructure based on review of the results. Costs associated with the specific provisions requested by the Agency shall be borne by the Applicant.
- 9.11.6. Monitoring shall be performed in accordance with the approved plans. If any unexpected or excessive movements or ground behaviour are detected, the Applicant shall stop the works immediately, take appropriate measures and report to the Agency.
- 9.11.7. If it becomes apparent from the monitoring results that the monitored parameter is likely to pass into the red zone as shown in Table 9.3, the NOC holder shall alert the Agency and implement the contingency measures to control movements within the acceptable limits, all at the cost and expense of the NOC holder before the work is allowed to resume.

9.12. Completion of Monitoring

- 9.12.1. The monitoring period shall continue until all works that may affect the Railway Infrastructure have been completed and the monitoring readings shall be shown to have stabilised to the satisfaction of the Rail Agency and with no further change expected in the long term.
- 9.12.2. All areas within the Railway Protection Zone shall be reinstated to their original status on completion of the work.
- 9.12.3. The NOC holder shall submit their completion reports within seven working days from the completion date. The report shall include clear photographs showing the comparison of the site areas marked 'Before' and 'After'. The completion report shall also include a summary of the monitoring data, analysis and details of any left-in fixings if applicable.
- 9.12.4. Any left-in fixings shall be first approved by the Rail Agency or removed at the NOC holder's expense.

10. Inspection and Compliance

10.1. General

- 10.1.1. This Section provides requirements of site inspections by the Agency, enforcement options available in the event of non-compliance (with the Resolution, current By-Law, Code of Practice and NOC conditions) and Emergency Response Planning to be considered by the NOC Holder during implementation of the approved works.
- 10.1.2. The NOC holders shall be responsible for complying with all safety legislation published by other Government authorities in the Emirate of Dubai.
- 10.1.3. In case of any discrepancies in criteria or standards between this Code of Practice and other Government requirements, the most conservative criteria shall be adopted.

10.2. Site Inspections

- 10.2.1. The Agency, or any other party designated by the Agency, has the right to access the site for inspections at any time during the execution of Restricted Activities within the Railway Protection Zone. The inspections will be focused on any unapproved Restricted Activities or for approved Restricted Activities, any deviations from the NOC conditions. Any unapproved Restricted Activities or deviations from NOC conditions of approved Restricted Activities may be subject to immediate enforcement action and possible penalties.
- 10.2.2. The NOC holder is required to provide full support to the RTA Inspectors to ensure that they carry out their duties without hindrance.
- 10.2.3. The NOC holder shall ensure the following;
 - › All works carried out within the Railway Protection Zones are safe and that they do not infringe the requirements of the Resolution, current By-Law, this CoP or the NOC conditions.
 - › All hazards are included in the Risk Register and adequate precautionary and safety measures are taken by the NOC Holder, plant and machine operators to ensure the associated risks with the hazards are ALARP.

- › Safety measures implemented on site such as provision of physical barriers or demarcation to prevent encroachment of crane or similar plant are maintained and protected from inadvertent removal or damage.
- › Record of test certificates of all cranes, lifting gears and appliances issued by Dubai Municipality accredited bodies are maintained and available for inspection on site.
- › Register of all the names of site lifting supervisors, crane operators and the works and activities in which they are responsible is up to date. The register and set of the certificates of competency of these personnel shall be maintained at site and shall be available for inspection by the Agency's staff.
- › Safety officer, lifting supervisors and crane operators conduct daily checks of all mechanical plant and equipment including any lifting gears and appliances to confirm that they are in good working condition.
- › Site agents, Supervisors, foremen, crane operators and lifting supervisors are briefed and well versed with the requirements and conditions of the Agency for works in the vicinity of the Railway Infrastructure.
- › Any operation which is likely to endanger Railway operation or damage Railway Infrastructure such as unsafe lifting operation, etc. are immediately stopped and reported to the Agency.
- › Working platforms for supporting cranes, piling machines or any other mechanical plant are stable before and during operation. Should changes in the site conditions potentially affect the safe operation of these plant, the NOC Holder shall assess the situation and certify whether the working platforms are safe before allowing the operation of the crane, piling machines, etc. to continue.
- › If required by the RTA, a site diary is maintained that states the details of activities carried out within the Railway Protection Zone. The diary shall include the following:
 - › Description of site activities.
 - › Location, orientation and operational duration of each crane, piling machine and other mechanical plant together with the name of the equipment operator.
 - › Records of site conditions, certification of the stability of the working platform, etc.
 - › Records of safety checks and endorsements on cranes and mechanical plants and equipment.
 - › Records of defects of any crane and/or other mechanical equipment and measures taken to address the defects.
 - › Records of the incidences whereby the contractor has violated the requirements and conditions imposed by the Agency and the instructions issued by the Agency.

10.2.4. Although the NOC holder retains responsibility for safe execution of his works and for providing adequate supervision, the Agency may require an extra level of supervision to address any specific concerns to the Agency.

10.2.5. The NOC holder shall include risks applicable to the Railway in site inductions and site briefings. Records of training and briefings shall be retained at the NOC holder's site offices for inspection.

- 10.2.6. The Agency reserves the right to require the immediate removal from site of any person who in the opinion of the Agency is not in a fit condition to carry out their duties, or is liable to endanger their own health and safety or that of others. Such persons will not be permitted further access to the work site without the agreement of the Agency.
- 10.2.7. The Agency will carry out pre-arranged or unannounced safety inspections from time to time. These may cover lifting operations, piling, excavation, scaffolding or any other Restricted Activity. Where appropriate, registers and certificates relevant to the works are to be made available for inspection by the Agency Inspectors.

10.3. Enforcement Action and Fines

- 10.3.1. The Agency, through its Rail Right of Way Department has the authority to stop any work not authorised under the NOC process. The Agency may impose fines in accordance with the applicable Resolution and current By- Law.
- 10.3.2. The Inspector may also serve an Improvement Notice or a Prohibition Notice to any Person in any of the following cases:
- › Breach of any provision of the Regulation or its current implementing By-law.
 - › Any activity near the Railway Infrastructure or Railway Vehicles within the Railway Protection Zone that could lead to risks that endanger safety.
 - › Difficulty in seizing or removing prohibited materials.
- 10.3.3. The two different types of enforcement notice and the basis upon which each notice is issued are summarised in Table 10.1 below.

Table 10.1: Types of Enforcement Notice

ENFORCEMENT NOTICE	BASIS
Improvement Notice	When non-compliance with Regulation no.1/2017 or this Code of Practice is observed and there is a <u>low</u> risk to the Railway Infrastructure
Prohibition Notice	When non-compliance with Regulation no.1/2017 or this Code of Practice is observed and there is a <u>high</u> risk to the Railway Infrastructure

- 10.3.4. An infringement notice or fine may be issued for certain offences against the Resolutions and/or the current By-Law. The schedules of fines (as of April 2017) are shown in Table 10.2 and Table 10.3. The Applicant should refer to the latest Resolutions to ensure that the fines as described are still current.

Table 10.2: Violations and Fines (for Railways)

S.N.	CLAUSE	FINE (IN AED)	
1	A Person conducting or attempting to conduct any activities within the Critical Zone without first obtaining a No-objection Certificate.	100,000.00	
2	A Person conducting or attempting to conduct any activities outside of the Critical Zone, but within the Protection Zone, without first obtaining a No-objection Certificate	50,000.00	
3	Failure to comply with the terms of a No-objection Certificate	20,000.00	
4	Causing an Accident that results in damage to Infrastructure	50,000.00	
5	Committing or allowing others to commit any act that may cause damage to, or compromise the safety of, infrastructure.	10,000.00	
6	Failure to notify the Agency of an Accident	100,000.00	
7	Preventing or obstructing an Agency inspector or any other Person authorised by the RTA from performing his duties in any way whatsoever.	50,000.00	
8	Failure to comply with any legal notice issued by the Agency within the timeframe prescribed herein	Notice of Prohibition	100,000.00
		Notice of Remedy	20,000.00
9	Failure to remedy a violation within the timeframe prescribed by the Agency	500,000.00	
10	Constructing or developing infrastructure or performing any works related to Railway Systems without obtaining a Compliance Certificate from the Agency.	500,000.00	
11	Conducting or attempting to conduct any activity in violation of the Compliance Certificate.	300,000.00	
12	Suspending infrastructure construction works or any other works related to Railway Systems without obtaining a No-objection Certificate	300,000.00	
13	Exceeding the minimum permitted limits of Noise or Vibrations	20,000.00	

Table 10.3: Violations and Fines (for Tramways)

S.N.	CLAUSE	FINE (IN AED)
1	Throwing or causing to throw waste on the Railway Right of Way	500
2	Failure to carry a valid Tram driving Permit or training permit when driving the Tram or training to drive it	1,000
3	Crossing the Railway track anywhere other than the designated areas	1,000
4	Unauthorised access into a Prohibited Zone	1,000
5	Driving the Tram without obtaining a Tram driving Permit or with an expired Permit	2,000
6	Driving the Tram in violation of paragraphs (3) to (6) of Article (14) of this Resolution	2,000
7	Failure by the trainer to meet the Tram driving training requirements prescribed by the RTA	2,000
8	Taking or attempting to take an action by any person which may interfere with the operation of the Tram or affect its safety or the safety of its Infrastructure	2,000
9	Unauthorised interception by any person of the Tram on the Railway Right of Way	3,000
10	Failure by the Owner, Contractor, or Operator to meet the Tram driving requirements in violation of the security and safety requirements stipulated in this Resolution and the resolutions issued under it	500,000
11	Failure by the Owner, Contractor, or Operator to meet the insurance requirements stipulated in this Resolution and the resolutions issued under it	500,000

10.4. Contingency Plan and Emergency Procedure

10.4.1. An emergency situation may arise due to various incidents at sites such as:

- › Monitoring results move into the red zone as per Table 9.3.
- › Injury to a Railway worker, passenger or anyone on the operational Railway.
- › Damage to Railway Infrastructure.
- › Accidents (e.g. construction material falls onto the viaduct, crane topples onto the viaduct, etc).
- › Water ingress into the station premises, etc.
- › Possession overrun.

- 10.4.2. Any of the above accidents or incidents must be reported at the earliest opportunity to the Agency and shall be followed up with the incident report without delay.
- 10.4.3. Where there might be a need to stop Railway operations in an emergency and/or arrange a possession this will be done by the Rail operator representative for that work. An emergency contact notice shall be displayed on the worksite. Site staff shall be made fully conversant with this procedure as part of the site induction.

Emergency Procedure Report

- 10.4.1. The NOC Holder shall prepare a contingency plan/emergency procedure as part of the Construction NOC process stating the immediate actions to be taken in the event of an emergency to safeguard the integrity of the Railway Infrastructure.
- 10.4.2. An emergency procedure report shall include the following items:
- › Descriptions of the project and proposed works or activities to be carried out in the Railway Protection Zone.
 - › List of possible hazard/ emergency situations that may arise due to the proposed works or activities.
 - › Governing criteria for initiating an emergency procedure.
 - › Step-by-step procedure or flow chart showing the actions to be taken by the project team in the event of an emergency.
 - › Contact list stating the names and contact numbers of all key personnel including the project manager, the site supervisors, and the instrumentation specialist. A flow chart for the emergency reporting shall also be included.
 - › Follow-up actions to be taken after the implementation of Control Measures at site.

10.5. Incident / Accident Management

- 10.5.1. The Agency and the Operator shall be notified immediately when any Railway safety concerns are observed or if any incident or accident takes place which affects or could affect the safety of people or the Railway Infrastructure.
- 10.5.2. Operator's control room can be contacted any time by:
- › Using the emergency help point at any Railway stop.
 - › Contacting local representatives.

THE AGENCY SHALL BE NOTIFIED, IMMEDIATELY AFTER THE OPERATOR, ON
800 90 90 OR 04-6051515

- 10.5.3. It is the NOC Holder's responsibility to report to the relevant Government authorities and agencies any incidents or accidents resulting in personal injuries, death or damage to properties which do not belong to the Agency.
- 10.5.4. The NOC Holder shall submit a formal incident report within 48 hours from the date of an incident or an accident, summarising the nature of the incident, cause, its effect and the recovery measures taken.
- 10.5.5. All works must be stopped until the Operator and the Agency have given approval for works to resume.

10.6. Completion of Work

- 10.6.1. Condition surveys of the Railway Infrastructure shall be carried out upon completion of the proposed works or at intermediate stages as directed by the Agency. The survey will identify any defects or damage to the Railway Infrastructure caused by the works as well as the overall condition of the Railway Infrastructure. Any defects found shall be highlighted and compared with the findings of the Pre-Condition Survey.
- 10.6.2. The NOC Holder shall first submit a proposal for any rectification works to the Rail Agency for their approval prior to commencement of any remediation work.
- 10.6.3. Remediation of defects arising from the development shall be completed to the satisfaction of the Agency. The NOC holder shall bear all direct or indirect costs arising from the rectification works.
- 10.6.4. On completion of all remedial work, the NOC Holder shall submit a report on the completed works using clear photographs to compare the completed remedial work against the original defect as evidence of the rectification work carried out.
- 10.6.5. A final completion inspection may be conducted by the Agency or any other party designated by the Agency to confirm the status of completion and acceptance of any remedial works.



Marina Towers
To Dubai Marina

للمارينا
ن دوبي



11.Enquiries

All technical enquiries or comments on this Railway Protection Code of Practice shall be sent in writing to:

Rail Right of Way Department
Office Rail Agency
RTA Main Headquarters
Marrakech Road
P.O. Box 118899
Dubai, U.A.E



Marina Towers
To Al Sufouh

Appendix A – Frequently Asked Questions (FAQ)

A.1 How to Apply for an e-NOC?

Applications for e-NOCs can be made via the online system.

<https://noc.rta.ae/RTAeNOC/Webpages/common/login/login>

Please refer to the Code of Practice and understand the requirements based on the NOC type (refer to Section 5 of the Code for the NOC types). Consult RTA RROW for further clarifications if necessary.

A.2 What are the NOC Application Requirements?

The application requirements are dependent upon the NOC type.

Please refer to Section 5 of the Code of Practice. The Applicant may also consult RTA RROW for further clarifications if necessary.

A.3 When should the NOC Application be Submitted?

Processing NOC applications may take some time. This depends on the type of the NOC and the nature of the proposed works.

The NOC Applicant is encouraged to submit the NOC application at the earliest possible time so long as the requirements as outlined in Section 5 for each type of NOC are met.

A.4 How long will it take for the NOC Application to receive feedback from the RTA?

Based on the type of the NOC and the nature of the proposed works, it is expected to receive the first feedback from RTA within the predefined KPI by RTA. Further, as part of the NOC process, the Applicant shall agree with the Agency a schedule of submissions.

A.5 How are RTA Comments conveyed to the NOC Applicant?

This can be done via the e-NOC portal or during a meeting to be held between the RTA and the Applicant. For this purpose, the Applicant is encouraged to check their application in the e-NOC portal on a daily basis. Also, they can follow up on the status of the application with the RTA engineers via emails.

A.6 What is the difference between a NOC and an e-NOC?

A No Objection Certificate (NOC) is a document issued by the Agency, authorizing an organization to perform activities within the Rail Right of Way.

An e-NOC is the electronic NOC application that can be submitted via the online system

<https://noc.rta.ae/RTAeNOC/Webpages/common/login/login.aspx>

A.7 What is the maximum size of the document attached with the e-NOC Application?

This can be changed based on the e-NOC system upgrade. Please refer to the e-NOC portal

<https://noc.rta.ae/RTAeNOC/Webpages/common/login/login.aspx>

Maximum size limit as of December 2016 is 40MB.

A.8 For Design NOC Application, when is it required to submit Design Verification by Third Party?

This depends on the risk to the safety, operation and maintenance of the Railway Infrastructure as determined by the RTA following their review of the NOC application. Please refer to Table 5.2.

A.9 For Third Party Peer Review associated with the Design NOC Application, are there any specific requirements for the selected consultant who is required to carry out the review?

The review consultant shall be approved by DM and RTA for the proposed works. The same shall be specified in the consultant professional license. It is highly recommended to discuss with RTA in advance to agree on the review consultant.

A.10 For the Construction NOC Application which includes performing Restricted Activities within the Railway Protection Zone under supervision of the project consultant, what is the role of the consultant in facilitating the NOC Approval by the RTA?

The documents submitted in the Construction NOC application for the proposed works shall be approved by the project consultant and attached with the NOC application along with a letter of approval for the same provided by the consultant and client.

A.11 For erection of scaffolding system or temporary supporting gantry structure close to the Railway, is the NOC Applicant required to submit Design Calculations for the proposed supporting systems?.

This depends on the risk to the safety, operation and maintenance of the Railway Infrastructure. Please refer to Table 5.2.



Appendix B – List of Potential Stakeholders

B.1 General

- B.1.1 The Applicant shall ensure that all stakeholders are consulted where they are affected (or potentially affected) by the Applicants proposed works.
- B.1.2 A list of potential stakeholders is provided in Table B.1 for guidance only. Additional stakeholders may be affected by the Applicants proposed works and it remains the Applicants responsibility to ensure all relevant stakeholders are consulted.
- B.1.3 Any NOC issued by the Agency may be conditional upon receiving approval from the relevant stakeholders.

Table B.1: List of Potential Stakeholders

TYPE	STAKEHOLDER
Road and Transport Authority (RTA)	
Rail Agency	RTA Strategic Planning Department
	RTA Rail Inspection Section
	RTA Rail Maintenance Department
	RTA Rail Operations Department
	RTA Rail Planning and Projects Department
Public Transport Agency	PTA Planning and Business
	PTA Marine Projects
Licensed Railway Operator	Railway Operator (Metro and/or Tram)
Licensed Railway Maintenance Company	Railway Maintenance Company (Metro and/or Tram)
Traffic & Roads Agency	RTA Roads ROW Department
	Roads and Facilities Maintenance
	ITS Department
	Parking Department

TYPE	STAKEHOLDER
Dubai Municipality	
	DM Planning Department
	Drainage & Irrigation Department
	Public Parks and Horticulture Department
	Environmental Planning Department
Other Government	
	Dubai Airports
	Dubai Civil Defence (DCD)
	Dubai Technology and Media Free Zone (DTMFZ)
	Military
	Ports, Customs and Free Zone Corporation (PCFC) Trakhees
	Jebel Ali Free Zone Authority (JAFZA)
Local Utility Companies	
	Dubai Electricity and Water Authority (DEWA)
	Etisalat
	Du
	Tabreed
	Empower
Other	
	Neighbouring Residents
	Neighbouring Contractors

Appendix C – Request for Engineering Information (RFI) Form

☐ Internal

☐ External

Registration
Date

: / /

Requester's Details			
Name	:		
Job Title	:		
Company Name	:		
Department	:		
Section	:		
Contact Number	:	Extension :	Mobile :
Email	:		
Company Address	:		

Justification for Request	
Reason	:
Info will be used for	:
Project Name (Optional)	:
Project Number (Optional)	:

Required Info Attributes			
Site/ Location/ Structure	:		
Type of Info	:	<input type="checkbox"/> Drawings	<input type="checkbox"/> Documents <input type="checkbox"/> Engineering Data
Discipline	:	<input type="checkbox"/> Architectural	<input type="checkbox"/> Building Services <input type="checkbox"/> Civil and Structural
		<input type="checkbox"/> Electrical Network	<input type="checkbox"/> Track work <input type="checkbox"/> Rail Operational Systems
		<input type="checkbox"/> Rolling Stock	<input type="checkbox"/> Signalling <input type="checkbox"/> Telecommunications
		<input type="checkbox"/> Automatic Fare Collection	<input type="checkbox"/> Engineering <input type="checkbox"/> Utility Services
		<input type="checkbox"/> Other:.....	
Details	:	<div></div> <div></div> <div></div> <div></div> <div></div>	

Note:

1. Separate RFI should be submitted for each Location or Discipline.
2. Data collection Media (Flash drive of minimum 8GB) should be provided along with the submission of this application.

The latest version of this form should be obtained from the Rail Engineering & Information Section (email: RFI_RES@rta.ae).

Appendix D – Risk Register (Template)

D.1 Work Details

PROJECT NAME		LOCATION	
COMPANY/OFFICE		DATE	
WORK DESCRIPTION			

D.2 Type of Restricted Activity

SA1: Storage of goods	SA4: Dredging of sea-beds and canal-beds	SA7: Demolition	SA10: Installation or replacement of conduits for any utilities
SA2: Movement or operation of cranes, hoists, other lifting equipment and any machinery	SA5: Construction of underground passageways	SA8: Use of explosives and fireworks and the lighting of fires	SA11: Other activities to be controlled
SA3: Installation of boreholes and wells	SA6: Excavation of trenches and earth movement	SA9: Erection of scaffolding and other temporary structures	

D.3 Assessor Details

ASSESSMENT COMPLETED BY	POSITION	CONTACT NUMBER	EMAIL	SIGNATURE

D.4 Risk Matrix

		SEVERITY LEVEL			
		Catastrophic	Critical	Marginal	Insignificant
FREQUENCIES	Frequent	A	A	A	B
	Probable	A	A	B	C
	Occasional	A	B	C	C
	Remote	B	C	C	D
	Improbable	C	C	D	D
	Incredible	C	D	D	D

RISK CATEGORIES	
A	Intolerable
B	Undesirable
C	Tolerable
D	Negligible

D.5 Risk Categories

RISK CATEGORIES	RISK LEVEL - ACTION REQUIRED
A Intolerable	Very high risk identified - Revise the Control Measures in order to mitigate the risk
B Undesirable	High risk identified - Develop/determine further controls
C Tolerable	Medium risk identified - Further controls may be required
D Negligible	Low risk identified - Control Measures to be adopted and monitored

D.6 Frequency of Occurrence of Hazardous Events

CATEGORY	DESCRIPTION
Frequent	Likely to occur Frequently. The hazard will be continually experienced.
Probable	Will occur several times. The hazard can be expected to occur often.
Occasional	Likely to occur several times.
Remote	Likely to occur sometime in the system life cycle. The hazard can be reasonably expected to occur.
Improbable	Unlikely to occur but possible. It can be assumed that the hazard may exceptionally occur.
Incredible	Extremely unlikely to occur. It can be assumed that the hazard may not occur.

D.7 Hazard Severity Level

CATEGORY	DESCRIPTION	CONSEQUENCES TO SERVICE
Catastrophic	Fatalities and/or multiple severe injuries and/or major damage to the environment.	
Critical	Single fatality and/or severe injury and/or significant damage to the environment.	Loss of a major system
Marginal	Minor injury and/or significant threat to the environment.	Severe system(s) damage
Insignificant	Possible minor injury	Minor system damage

D.8 Risk Register

All risks remain with the Applicant and should be identified as part of the formal Risk Assessment process and included in the template below.

RISK ASSESSMENT										
	HAZARD IDENTIFIED	RISK DESCRIPTION	CONSEQUENCES / IMPLICATIONS	INITIAL		INITIAL	MITIGATIONS	FINAL		FINAL SCORE
				L	S			L	S	
1										
2										
3										
4										
5										
6										

APPLICANT SIGNATURE	APPLICANT STAMP	DATE

Appendix E – NOC Flowcharts

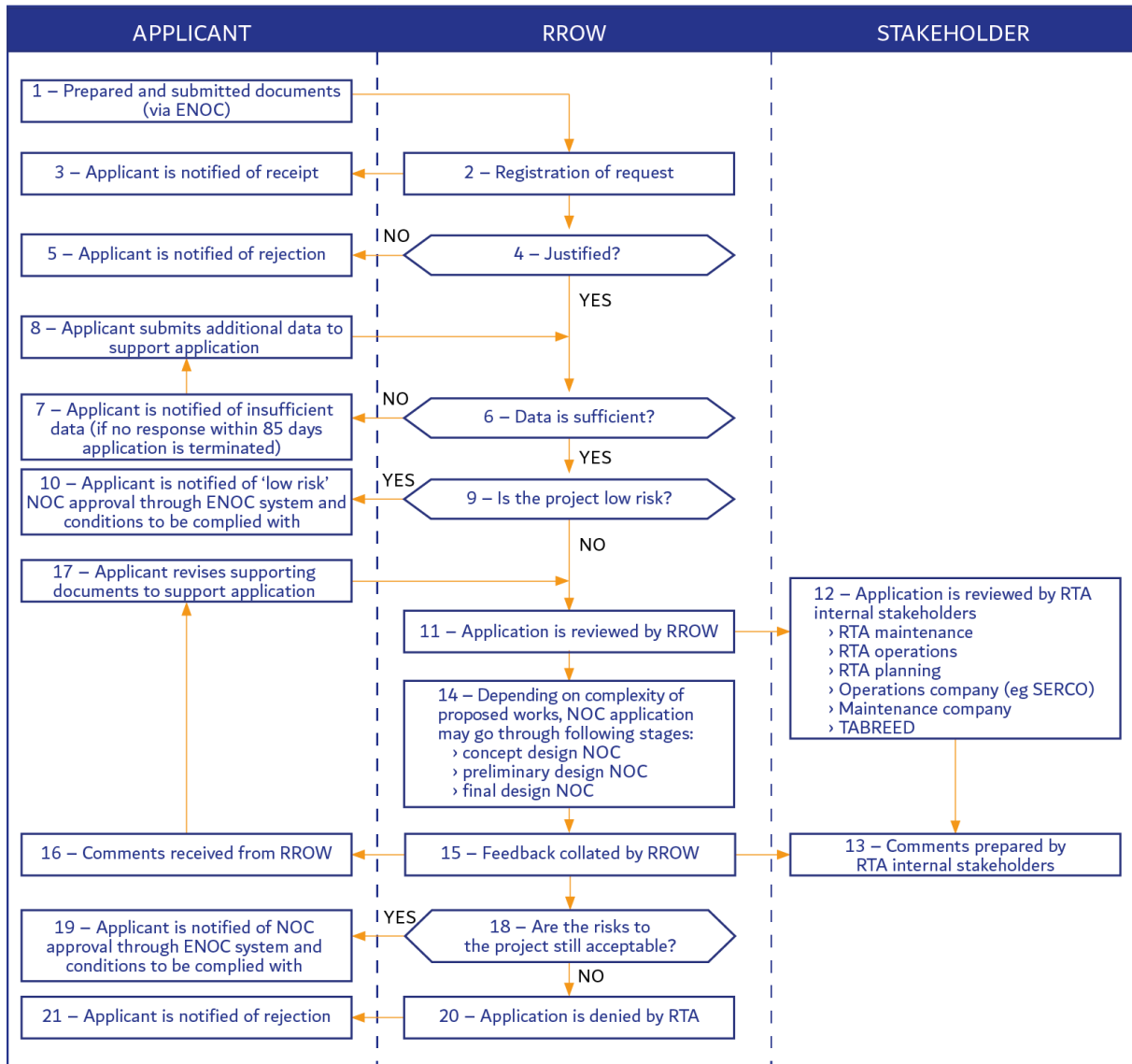


Figure E.1: Design NOC Flowchart

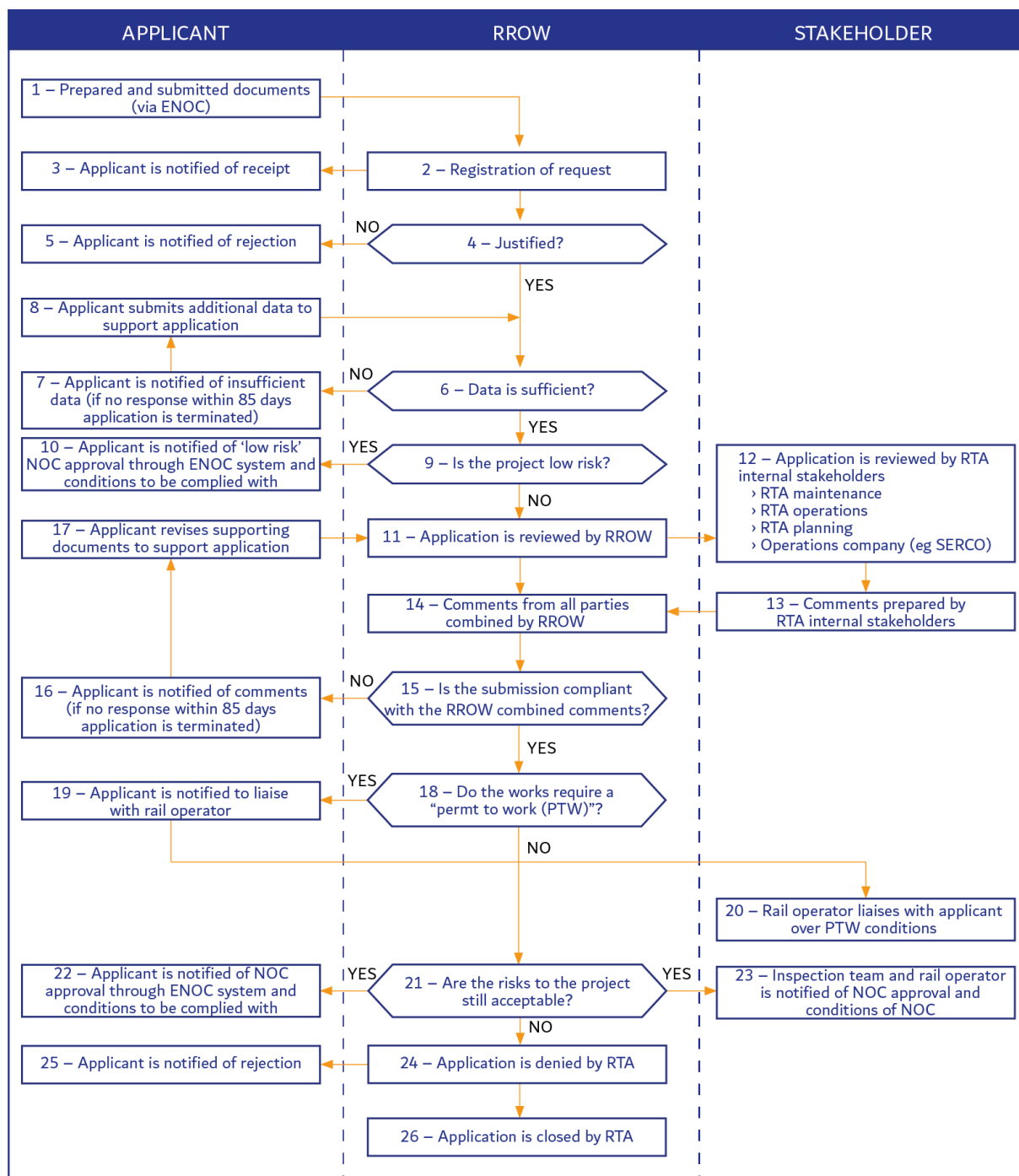


Figure E.2: Construction NOC Flowchart

Appendix F – Method Statement Checklist

F.1 Work Method Statement for Restricted Activity within Railway Protection Zone

This document provides a checklist for the proposed Method Statement to execute the Restricted Activity within the Railway Protection Zone as defined in the Railway Protection Code of Practice and submitted as part of the application for No Objection Certificate to (NOC) to Rail Right of Way Department, Rail Agency, RTA.

Table F.1: List of Restricted Activities

SITE ACTIVITY	DESCRIPTION	
SA1	Storage of goods	<input type="checkbox"/>
SA2	Movement or operation of cranes, hoists, other lifting equipment and any machinery	<input type="checkbox"/>
SA3	Installation of boreholes and wells	<input type="checkbox"/>
SA4	Dredging of sea-beds and canal-beds	<input type="checkbox"/>
SA5	Construction of underground passageways	<input type="checkbox"/>
SA6	Excavation of trenches, earth movement and NDRC	<input type="checkbox"/>
SA7	Demolition	<input type="checkbox"/>
SA8	Use of explosives and fireworks and the lighting of fires	<input type="checkbox"/>
SA9	Erection of scaffolding and other temporary structures	<input type="checkbox"/>
SA10	Installation or replacement of conduits for any utilities	<input type="checkbox"/>
SA11	Other activities to be controlled	<input type="checkbox"/>

1. Administration

- ☐ Is the cover page completed and signed off?
- ☐ Are the pages numbered?
- ☐ Is the document number and revision correct?
- ☐ Is the review signed off by manager/QA manager/ H&S manager?
- ☐ Is the referenced documentation in the Method Statement provided?
- ☐ Does the Method Statement demonstrate conformance to UAE H&S legislation?

2. Scope of Work

- ☐ Is the work to be undertaken clearly defined?
- ☐ Is the location of work clearly shown?
- ☐ Are the work limits, site boundaries, time limits, access to site shown?
- ☐ Is the completion criteria identified?

3. Risks and Hazards

- ☐ Are all risks identified?
- ☐ Are the controls and safeguards to be effected identified?
- ☐ Have all buried and other services been checked?
- ☐ Are the traffic management arrangements identified?

4. Railway and Public Interface Arrangements

- ☐ Have the necessary Railway Protection Zone (RPZ)/possession arrangements been made?
- ☐ Are the protected/safe areas identified on site?
- ☐ Are any Permits To Work (PTWs) approved and in place?
- ☐ Are the passenger interfaces at stations clearly identified and protected?
- ☐ Have any arrangements for temporary speed restrictions been identified?
- ☐ Are the locations of temporary fencing adjacent to Railway identified?
- ☐ Have the safeguards for machines near operational Railway been identified?
- ☐ Are measures in place to ensure security of material from vandalism?

5. Protection of Railway Infrastructure

- ☐ Have housekeeping measures to avoid windblown debris been identified?
- ☐ Have buried and other services been considered and checked (including use of approved service locating tools and methods)?
- ☐ Has any Infrastructure susceptible to damage been identified?
- ☐ Have drawings been provided showing location of services?
- ☐ Have measures for protection of the track been identified?
- ☐ Have any restrictions on plant movement been identified?
- ☐ Have any demolition processes been clearly described?
- ☐ Have any proposed hot work been identified?
- ☐ Have any additional fire precautions required been identified?
- ☐ Have any measures to prevent disturbance of the track been identified?

6. Briefing Arrangements

To ensure the method statement is followed on site, it is important the communication amongst all employees and subcontractors is clear. The following should be clear in the method statement;

- ☐ Who prepares the method statement?
- ☐ Who is briefed?
- ☐ How is briefing recorded?
- ☐ How is understanding confirmed?
- ☐ What are the emergency phone numbers?

7. Method of Work

This section must define the specifics of the method of work, step by step to a level of detail that helps the client understand what is actually planned for the project and how the works will be carried out. The method of work must relate to the risk assessment.

- ☐ Is the order of work stated?
- ☐ Are hold points clearly defined?
- ☐ Is there a Bar Chart showing sequence of separate tasks?
- ☐ Are drawings and sketches illustrating the work sequence provided?
- ☐ Are access and egress arrangements, including the need for ladders/scaffolds identified?
- ☐ Have requirements for delivery and disposal of materials been identified?
- ☐ Have any temporary structures been identified?
- ☐ Has the method of authorising start of work been identified?
- ☐ Are measures for ensuring compliance with the method statement shown?

8. Health, Safety and Environment (HSE)

This section must detail the HSE nominated representatives and their roles that will be in effect for the project and who will be responsible for their compliance.

NAME	ROLE	EMAIL ADDRESS

8.1 Workgroup

This section must describe roles & responsibilities within the work group.

ROLE	STAFF REQUIRED	ADDITIONAL PROFICIENCY / COMPETANCE

Are contact phone numbers (including outside normal working hours) shown for the following?

- ☐ Key Contractor personnel including project manager
- ☐ RTA Operations
- ☐ RTA Rail
- ☐ RTA Roads
- ☐ Subcontractors
- ☐ Dubai Municipality (or other local authority)
- ☐ Occupiers of adjacent properties/works

9. Emergency Procedures

This section must provide comprehensive details of all emergency arrangements for the project. Drawings, diagrams will be provided where necessary.

- ☐ Is the site emergency plan identified?
- ☐ Is an accident reporting and investigation plan provided?
- ☐ Are contingency plans/procedures stated?

10. Personnel

- ☐ Are the contractors and subcontractors identified?
- ☐ Are supervision arrangements and the name of the Person In Charge (PIC) shown?
- ☐ Are competencies and training requirements outlined and met?
- ☐ Have site access arrangements been made e.g. Permit to Work (PTW)?
- ☐ Are working hours stated?

- ☐ Are shift handover arrangements identified?
- ☐ Are welfare and first aid provisions stated?
- ☐ Have health hazards been assessed and Control Measures identified?
- ☐ Are PPE requirements for each work activity identified?

11. Products

This section must describe products/materials/substances to be used in the work. Material Safety Data Sheets must be provided as an addendum to the Method Statement.

12. Tools and Equipment

This section must describe the tools and equipment that will be required to carry out the works including any competencies that may be relevant; (e.g. scaffolding erection/dismantling, use of tools 120v or 240v, etc)

- ☐ Has all plant and equipment been specified?
- ☐ Are inspection and examination certificates available?
- ☐ Has temporary lighting requirements been identified?
- ☐ Have cranes/ lifting equipment been identified and are access routes clear?
- ☐ Has the risk of plant falling within the Critical Zone boundary been checked?
- ☐ Are arrangements for standby plant identified?

13. Environmental Aspects and Impacts

This section must describe the environmental aspects and impacts of the work and how they will be controlled and managed during the duration of work, (e.g. but not limited to waste, noise and vibration, spills, use of resources, etc).

Have environmental protection measures been identified for;

- ☐ Waste and pollution?
- ☐ Noise, dust, smoke, vapour?
- ☐ Dewatering arrangements and disposal of water?
- ☐ Fuels, oils etc. storage and containment?
- ☐ Hazardous substances, (including spill procedures)?

14. Documentation

This section must define the related documentation e.g. Work Instruction/Procedure/O&M Manual, Drawings/ Plans, Technical Data, Specifications, previous NOC, PTW which are related to the works.

15. Arrival on Site

This section must define the first steps to be carried out on “arrival to site”, i.e. marking out, dimensions and levels, safety briefings, barriers, Traffic Management, etc.

16. Handback Arrangements

This section must define how the completion of work will be identified, who and what departments will be notified/informed for final inspection. This must include reference to Hand Back Procedure and where required Hand back certificate.

APPLICANT SIGNATURE	APPLICANT STAMP	DATE

Appendix G – Guidelines for Impact Assessment for Restricted Activities

G.1 General

- G.1.1 This section outlines the minimum requirements that shall be followed when assessing the impact of Restricted Activities within the Railway Protection Zone.
- G.1.2 The Applicant may propose alternatives to the requirements outlined in this Section as stated under Section 6.3.
- G.1.3 Notwithstanding the provisions in this section, the Agency reserves the right to impose any additional requirements that the Agency considers necessary for safeguarding the Railway Infrastructure.

G.2 Geotechnical Investigation

- G.2.1 The Applicant shall apply for a NOC before carrying out any geotechnical investigation within the Railway Protection Zone.
- G.2.2 Where required, geotechnical investigations shall be specified to evaluate the following:
 - › Type of soil/rock materials and the subsurface stratigraphy.
 - › Groundwater table and likely variation with time.
 - › Hydrogeological conditions and properties.
 - › Grain size distribution and density of granular materials.
 - › Strength and stiffness properties.
 - › Any existing site obstructions.
 - › Seismic risk.
 - › Occurrence of contaminated and/or aggressive ground conditions.
- G.2.3 The Applicant is advised to contact a specialist geotechnical engineer prior to conducting investigations to ensure the investigation is properly specified to obtain the correct information needed to assess the impact of the proposed works to the Agency's requirements.
- G.2.4 In the event the Agency believes the site investigation is limited in terms of its extent and/or quality in relation to the risk posed by the proposed works to the Railway Infrastructure, the Agency may require additional investigations be carried out and/or greater conservatism to be used in the derivation of the design geotechnical parameters.

- G.2.5 The locations of the investigation points and depths shall be such that the geotechnical properties of the zone of influence of the proposed works can be reliably established. Reference may be made to BS EN 1997-2:2007 (and its latest amendments) for the recommended minimum numbers of investigation points.
- G.2.6 The number of geotechnical tests (in-situ and laboratory) required is dependent upon the homogeneity of the ground, experience within the ground conditions and complexity of the proposed works. Reference may be made to BS EN 1997-2:2007 (and its latest amendments) for the recommended numbers of tests.
- G.2.7 As a minimum the drilling method, diameter, proposed depth, inclination and coordinates of the borehole will be required before approval is given.
- G.2.8 Care shall be taken that soil investigation tests are not adversely affected by the drilling processes (e.g. contamination of the borehole walls with drilling mud, permeability tests could be affected by smearing of fine particles during drilling, disturbance to borehole walls may affect down hole testing, etc).
- G.2.9 The Applicant should consider the use of any investigation boreholes as potential monitoring locations during the construction period (e.g. using boreholes as monitoring standpipes for groundwater).
- G.2.10 Upon completion of drilling and testing, the ground shall be reinstated through the use of a standard cement-bentonite grout mixture to seal the boreholes.
- G.2.11 Reference should be made to the risk and control measures outlined in SA3 in Section 4.

G.3 Imposed Load Limits for Underground Railway Infrastructure

- G.3.1 The design and construction of any works in the Railway Protection Zone shall satisfy the allowable limits for imposed loads on the Railway Infrastructure as given in Table G.1.

Table G.1: Allowable Imposed Loads Applied at Existing Ground Surface

CATEGORY	IMPOSED LOAD (kPa)
Bored Tunnel	20kPa
Underground stations (outside of road)	5kPa
Underground stations (beneath road)	15kPa
Cut and Cover Tunnel	15kPa

- G.3.2 Unsymmetrical loads of equivalent magnitudes to those stated in Table G.1 may be more onerous than uniformly applied loads due to the distortions created through unbalanced load conditions and should also be considered. The RTA reserves the right to request additional analysis to verify load conditions where applicable.
- G.3.3 For any works involving construction directly above underground stations and cut and cover tunnels, the Applicant shall apply for an information NOC to obtain and verify the as-built loading plan for the underground station/cut and cover tunnel.
- G.3.4 The loads in Table G.1 do not apply for conditions of unloading (excavations). The Agency may require specific study of any excavations depending upon the lateral extent and depth of the proposed excavation, the proximity of excavation to the Railway Infrastructure and the type of Railway Infrastructure.

G.4 Imposed Movement Limits

- G.4.1 The design and construction of any works in the Railway Protection Zone shall satisfy the movement limits on the Railway Infrastructure as given in Table G.2 unless otherwise advised by the Agency.

Table G.2: Allowable Limits for Movement for Railway Infrastructure.

CATEGORY	TOTAL MOVEMENT IN ANY DIRECTION	DIFFERENTIAL MOVEMENT IN ANY PLANE
All structures	3 mm	1:1000

- G.4.2 The allowable movement limits for the above ground Railway Infrastructure structures, such as viaducts, may be dependent on the allowable capacity of the bearings and the structural system of the Railway Infrastructure.
- G.4.3 The Applicant shall appoint an engineer to carry out an inspection of all bridge bearings that are within the influence zone of the proposed works and assess the capacity of these bearings to tolerate further movements. The inspection report prepared and endorsed by the engineer shall be submitted to the Agency.
- G.4.4 Any other constraints that form an integral part of the Railway Infrastructure must also be checked before adopting the allowable values in Table G.2.
- G.4.5 Notwithstanding the above limits, movements of the Railway Infrastructure will generate corresponding forces within the supporting Railway Infrastructure. The Applicant shall verify to the Agency's satisfaction that the change in forces within the Railway Infrastructure can be tolerated.

G.5 Vibration Limits

- G.5.1 The NOC holder shall consider the impact of vibration generated from the works on the structural and operational systems and on the comfort of the passengers using the Railway Infrastructure.
- G.5.2 Vibration can present a risk to operation through disruption of equipment or through movement of ground or structures (ground displacement, settlement or heave).
- G.5.3 The Applicant shall consider vibration levels at the nearest Railway structure arising from construction processes associated with foundations, dewatering, excavations and shoring within the Railway Protection Zone.
- G.5.4 The risk of vibration induced damage is dependent upon the magnitude, frequency and duration of the likely vibrations.
- G.5.5 The Peak Particle Velocity (PPV) is used to determine the potential for impact of vibration. Here the PPV is taken as the vector sum of the vertical and horizontal (longitudinal and transverse) components of vibration.
- G.5.6 Table G.3 outlines the allowable limits for vibration. Different PPV limits are set depending on whether the vibrations are ‘transient’ (single-impact) or continuous.

Table G.3: Allowable Limits for Vibration

TYPE OF VIBRATION	LIMITING PPV
Transient vibration	10mm/s
Continuous vibration	5mm/s

- G.5.7 The limits outlined in Table G.3 are only valid for frequencies greater than 4 Hz. Where the anticipated works may generate vibration at frequencies less than 4Hz, special study is required as the induced strains are more significant for displacements at lower frequencies. The dominant frequency to use for the assessment is that associated with the greatest amplitude pulse.
- G.5.8 Examples of sources of transient (single impact) vibrations are impact pile drivers, blasting, and other sources of impact such as dropping of heavy loads.
- G.5.9 Example of continuous vibrations are excavation equipment, compaction equipment, construction traffic, vibratory pile drivers, and bored piling plant.
- G.5.10 The Applicant shall follow the requirements of the RTA Noise and Vibrations Guidelines for any works adjacent to Railways.
- G.5.11 The Applicant shall consider the potential for vibration induced settlement around Railway Infrastructure particularly in weak soils.
- G.5.12 If the Agency believes that continuing vibration will or is reasonably likely to have an adverse impact on RTA property then they have the right to suspend the works.

Appendix H – Dewatering Requirements

H.1 General

- H.1.1 The designer of the dewatering system ('Dewatering Designer') shall be responsible for the aspects of the dewatering program outlined in this Section.
- H.1.2 The Dewatering Designer shall carefully consider the location, geometry, type of excavation, type of soil to be excavated, rate of excavation and the duration of dewatering in the design of the dewatering system. Some recommendations for geotechnical investigations are given in Appendix G.
- H.1.3 The Dewatering Designer shall ensure that the proposed method is appropriate for the hydrogeological environment and that sufficient flexibility exists within the system to account for any variations encountered during construction.
- H.1.4 The requirements discussed in this section are intended to serve as guidelines and it is not intended to be used solely as a dewatering system design document.
- H.1.5 The design and monitoring of the dewatering system shall be approved and reviewed by an entity licensed for similar activities in Dubai. For critical projects, the Agency may require an independent review to be carried out by an independent third party.
- H.1.6 Permanent dewatering of any proposed structure will not be accepted.

H.2 Dewatering Effects, Risks and Potential Impacts

- H.2.1 The dewatering design shall consider the following;
- › Settlement caused by groundwater drawdown.
 - › Changes in ground water pressure.
 - › Base instability.
 - › Collapse of subsurface cavities or voids.
 - › Transport of contaminated groundwater.
 - › Dissolution of soluble materials (e.g. gypsum).
 - › Higher groundwater inflows.

Settlement caused by Groundwater Drawdown

- H.2.2 Groundwater drawdown will reduce pore pressures and increase the effective stress in the soil. The increase in effective stress will cause the soil to settle.

- H.2.3 Dewatering of compressible materials can cause significant settlements and the impact of these upon the Railway Infrastructure shall be carefully considered.
- H.2.4 A dewatering assessment shall identify the cone of depression associated with the dewatering operations and the likely drawdown anticipated at the point of interest. Particular care shall be given to differential settlements which will be significant where the groundwater drawdown curves are steep.
- H.2.5 The Dewatering Designer shall demonstrate that any settlements from groundwater drawdown are within acceptable levels.

Changes in Groundwater Pressure

- H.2.6 Dewatering operations will change the groundwater pressures which may have impacts upon existing underground Railway Infrastructure as it may act as an underwater obstruction to ground water flow.
- H.2.7 Beneath a static horizontal water table, an underground structure will experience the same pore pressure on both sides (hydrostatic). If dewatering operations are commenced on one side of the structure, the side of the underground structure closest to the dewatering operation will experience a reduction in pore pressure. The difference in groundwater pressures between each side may generate significant structural forces within the underground structure.
- H.2.8 The Dewatering Designer shall demonstrate that the likely change in pore water pressures caused by dewatering will not significantly affect buried Railway Infrastructure.

Base Instability

- H.2.9 There are four types of hydraulic failure (as defined in Eurocode 7 BS EN 1997-1);
- › Failure by uplift (buoyancy).
 - › Failure by heave.
 - › Failure by internal erosion.
 - › Failure by piping.
- H.2.10 Failure by uplift (buoyancy) occurs when pore-water pressure under a structure (or low permeability ground layer) becomes larger than the mean overburden pressure (e.g. due to removal of overburden by excavation, or rise in groundwater table).
- H.2.11 Failure by heave occurs when upwards seepage forces act against the weight of the soil, reducing the vertical effective stress to zero. The vertical water flow will carry away soil particles causing failure (boiling).

- H.2.12 Failure by internal erosion is produced by the transport of soil particles through groundwater flow within a soil stratum, at the interface of soil strata, or at the interface between the soil and a structure. This may finally result in regressive erosion, leading to collapse.
- H.2.13 Failure by piping is a particular form of failure, where erosion begins at the surface, then regresses until a pipe-shaped discharge tunnel is formed in the soil mass or between the soil and a foundation or at the interface between cohesive and non-cohesive soil strata.
- H.2.14 The Dewatering Designer shall demonstrate that the above four failure types have adequate factors of safety to prevent the occurrence of failure of excavations and/or generation of sinkholes outside the excavation.

Collapse of Cavities or Voids

- H.2.15 Where the site investigation reveals the presence of cavities the Dewatering Designer shall consider the potential for settlement generated by collapse of existing cavities caused by groundwater drawdown.

Dissolution of Soil-Cementing Salts and Evaporate Rocks

- H.2.16 The Dewatering Designer shall consider the potential for dewatering operations to induce dissolution of soil-cementing agents or evaporate rocks. Where the risk is significant, the Dewatering Designer shall ensure that flow rates are monitored and electrical conductivity of extracted water is monitored to ensure that the risk is managed.

Higher Groundwater Inflows

- H.2.17 The Dewatering Designer shall consider the potential for higher than expected inflows (e.g. due to rainfall events or the effects of neighbouring activities such as cessation of dewatering activities at neighbouring sites). The Dewatering Designer shall conduct a visual survey of surrounding sites before dewatering operations commence, noting any existing dewatering operations. The Dewatering Designer shall liaise with any neighbouring contractors to understand their planned dewatering sequence and duration. The risk assessment shall identify the potential for increasing dewatering requirements over the project duration and size the pumping systems to allow for additional capacity where required.

H.3 Construction Dewatering and Groundwater Control Methods

- H.3.1 There are essentially two types of groundwater control methods for excavations; those that remove groundwater by pumping and those that exclude it from entering the excavation. In many cases, both methods will be used together.

- H.3.2 For both types of groundwater control method, the Dewatering Designer shall follow the following guidelines for each technique. Other alternative techniques may be proposed by the Dewatering Designer subject to the approval of the Agency.
- H.3.3 The key principles to minimise the impact of groundwater upon Railway Infrastructure are as follows;
- › Ensure groundwater drawdowns are limited to avoid potential settlement of Railway Infrastructure.
 - › Ensure that fines are not drawn through the groundwater pumping system which may subsequently cause erosion and instability around any excavation.
 - › Ensure groundwater pressures are balanced and/or not significantly altered about any underground Railway Infrastructure.
 - › Ensure stability of any excavation is not compromised due to groundwater pressures or inflows.
- H.3.4 The Dewatering Designer is required to clearly demonstrate in their submission how the above key principles will be achieved during construction of the proposed works.
- H.3.5 The Dewatering Designer shall ensure flexibility is maintained in the chosen dewatering scheme to allow for additional dewatering measures to be added should encountered conditions vary unexpectedly during construction.
- H.3.6 The water quality and the impact of water disposal shall be considered for any dewatering scheme. Provision of settlement tanks and water treatment facilities shall be provided where required.
- H.3.7 There are many different types of groundwater pumping methods. The most common in the region are trenching and sump pumping, wellpoints and deepwells. The selection of each method will depend on the cost, time and spatial constraints associated with each project as well as the soil conditions anticipated on site. Figure H.1 shows the typical range of applicability of groundwater pumping techniques as a function of groundwater drawdown and soil permeability.

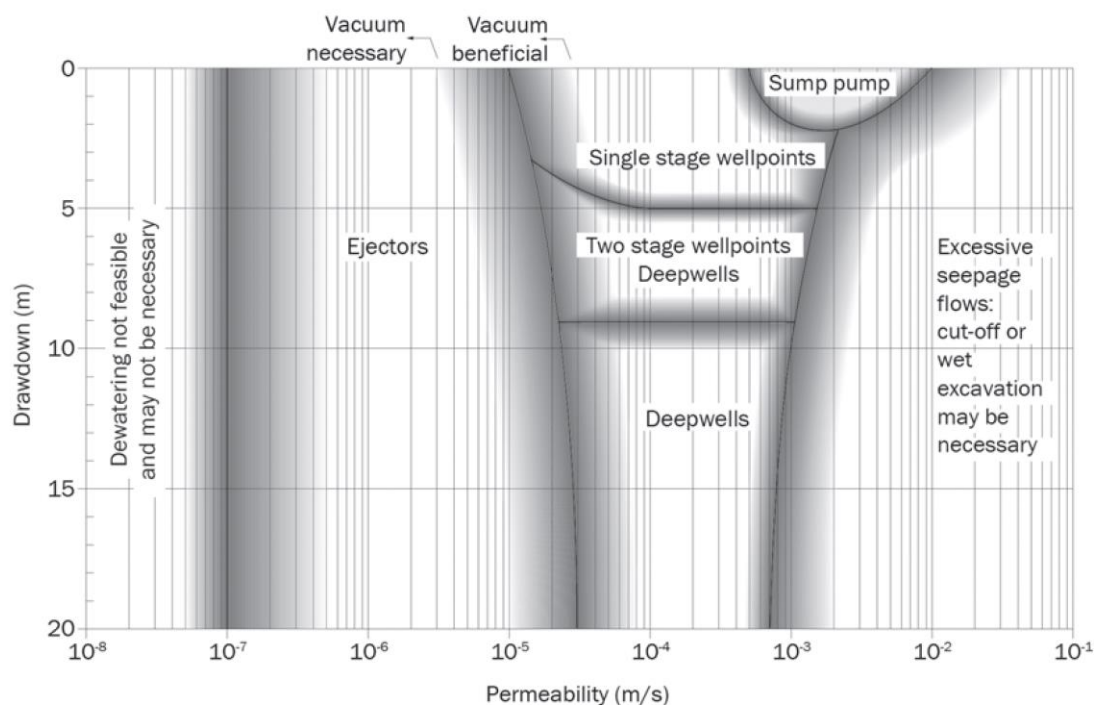


Figure H.1: Range of Application of Dewatering Techniques (from Preene, M. et al., 2016).

Sump Pumping

H.3.8 Sump pumping involves collection of ground water at low levels in relation to the excavated level. Typical sump pump arrangements are shown in Figure H.2.

- › Sump pumping shall be used with extreme care. As the groundwater level is very shallow compared to the level of excavation, the excavation shall be checked to ensure the stability is not compromised by the relatively short distance between the excavation level and the water table.
- › The Dewatering Designer shall ensure an adequate filter is in place at the sump boundary with the natural material to minimise migration of fines into the sump. The sump shall be adequately sized to accommodate the inflow accounting for the influence of the filter materials and extra capacity for higher than expected inflows.
- › Filters shall accord with the filter criteria outlined in Table H.1 below and use slotted screens, graded gravel packs and non-woven geotextiles as necessary.

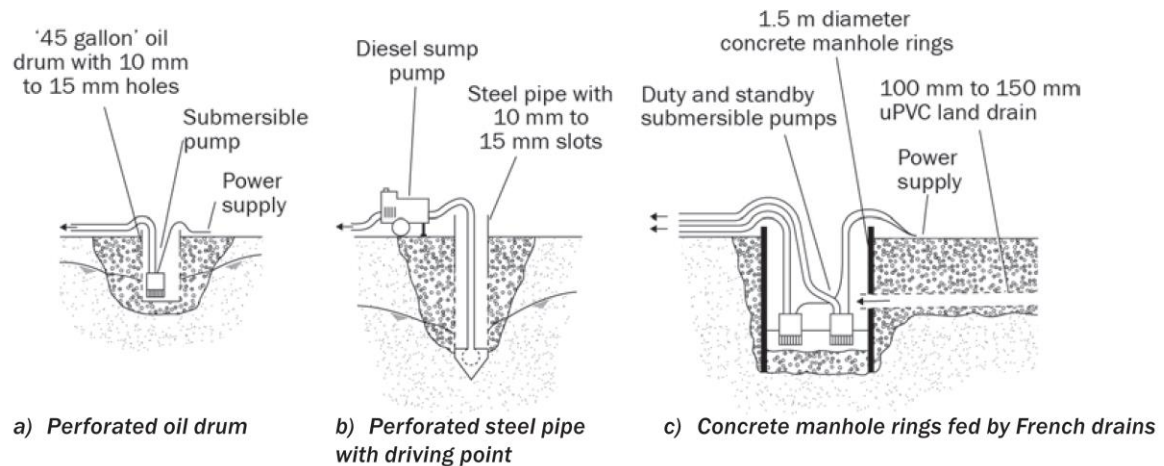


Figure H.2: Typical Sump Arrangements (from Preene, M. et al., 2016.)

- › The Dewatering Designer shall also consider the impact of contamination such as cement, bentonite and spills from construction plant entering the trenches and sumps. Even though a settlement tank is located before the discharge point, additional treatment may be required.
- › Where sump pumping is proposed, the Dewatering Designer shall clearly demonstrate;
 - › Why sump pumping is suitable for the site.
 - › How trenches and sump pumping will be coordinated during staged excavation.
 - › What mitigation measures are proposed to limit the removal of fine materials during sump pumping.
 - › How contaminated materials will be treated prior to disposal.

Wellpoints

H.3.9 A wellpoint dewatering system consists of an array of individual wellpoints connected to a common headermain, which is put under vacuum by a vacuum pump. The wellpoints interact with each other to draw the groundwater down to a predefined depth and area. Due to the hydraulic restrictions of the amount of lift which can be generated by suction, wellpoints are typically limited to achieving approximately 3.5 to 4m of drawdown in sand and gravels, albeit multistage wellpointing may be used for deeper excavations.

H.3.10 Figure H.3 identifies the main components of a typical wellpoint dewatering system.

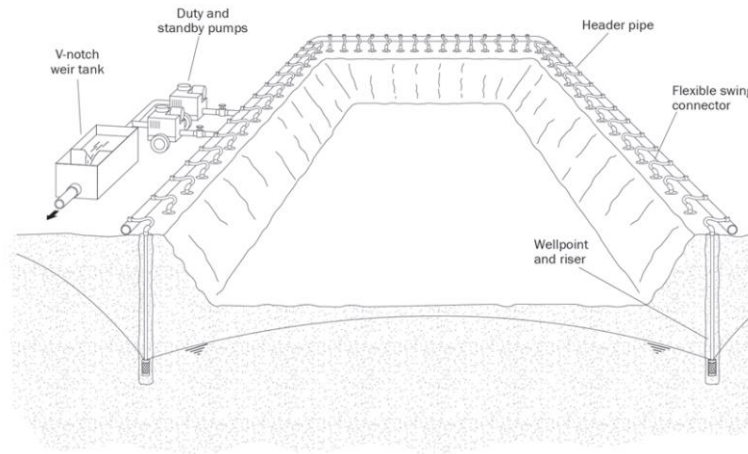


Figure H.3: Typical Components of a Wellpoint Dewatering System (from Preene, M. et al.,2016)

- H.3.11 The Dewatering Designer shall consider measures to isolate various sections of the wellpoint system where necessary. Valves are recommended every 130m and at critical locations (e.g. bends, pipe connections, etc.)
- H.3.12 Where well-pointing is proposed, the Dewatering Designer shall clearly demonstrate;
- › Why well-pointing is suitable for the site.
 - › How the well-pointing system will be protected from plant and construction activities whilst allowing for continual access during installation and construction.
 - › What provision is made for stand-by pumps in the event of servicing or unexpected inflows?
 - › What mitigation measures are proposed to limit the removal of fine materials during well-pointing.

DeepWells

- H.3.13 A deepwell dewatering system consists of an array of individual deepwells pumped by electrical submersible pumps. The deepwells interact with each other to draw the groundwater down to a predefined depth and area.
- H.3.14 Figure H.4 shows typical components of a deepwell dewatering system

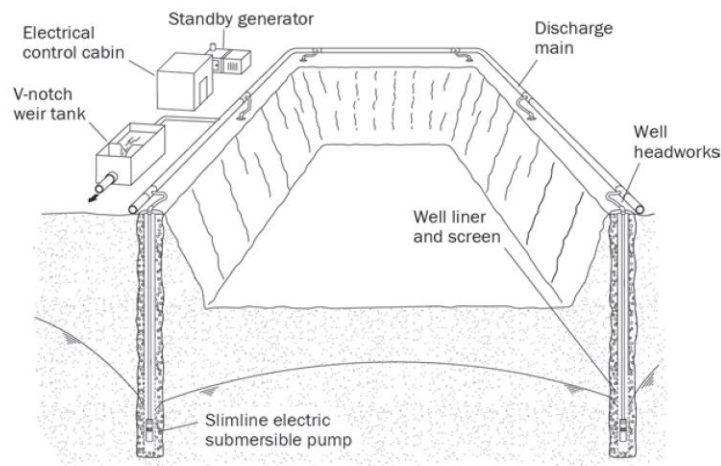


Figure H.4: Typical Components of a Deepwell Dewatering System (from Preene, M. et al., 2016.)

- H.3.15 For deep well systems, the Dewatering Designer shall confirm,
- › The proposed well depth and the screen length.
 - › The borehole and well screen diameters.
 - › The proposed filter details.
- H.3.16 The Dewatering Designer shall demonstrate the well diameter is sufficient to allow the submersible pump to be accommodated allowing for the well screen thickness, filter media thickness and tolerance on the well verticality.
- H.3.17 The Dewatering Designer shall size the pumps to allow for flows higher than the steady state flow to allow for the higher pumping capacities expected at the start of the dewatering and also to accommodate any unexpected inflows (e.g. due to rainfall or cessation of neighbouring dewatering operations).
- H.3.18 Well screens shall be sufficiently robust to withstand collapse pressures from the soil and groundwater loadings.
- H.3.19 The filter shall;
- › Have greater than 50mm and less than 150mm annular thickness.
 - › Ensure the void between the well casing and natural soil is filled to prevent borehole collapse.
 - › Be sufficiently coarse to allow water to enter the well easily.
 - › Be sufficiently fine to prevent removal of fine particles.
 - › Ensure non-segregation during placement.
- H.3.20 The recommended filter criteria is given in Table H.1 below (where D is particle diameter);

Table H.1: Recommended Filter Criteria

Basis	Filter criteria
Lower Limit	$D_{15}(\text{filter}) > 4 \times D_{15}(\text{natural soil})$
Upper Limit	$D_{15}(\text{filter}) \leq 5 \times D_{85}(\text{natural soil})$
Uniformity Coefficient	$D_{60}(\text{filter})/D_{10}(\text{filter}) < 3$

- H.3.21 The filter media shall be sufficiently durable to avoid dissolution and crushing. Ideally, particles shall be rounded to promote permeability.
- H.3.22 The well screen slot sizes shall be approximately $D_{10}(\text{filter})$ with aperture opening of 5–20% of the total area of the well screen.
- H.3.23 The Dewatering Designer shall ensure that during installation of the filter media, the annulus is overfilled by 0.5 to 1m above the well screen to allow for settlement of the filter media.
- H.3.24 Standby equipment shall be required to operate during breakdown or maintenance periods. All standby equipment shall be periodically operated to ensure that it is ready to function in the event of a breakdown of the regular equipment. Measures shall be in place to indicate whether the pumping unit is operational or not (e.g. signal lights or warning buzzers). If control of the groundwater is critical to safety of the excavation or foundation, appropriate operating personnel shall be on duty at all times.

H.4 Dewatering Design

- H.4.1 The design of groundwater control systems requires a combination of modelling, analysis and judgement.
- H.4.2 The key input to any dewatering analysis is the soil permeability with depth profile and the geological model. The permeability value of each soil layer shall be determined by at least one of the following methods (in order of preference);
- › Full scale pumping test.
 - › Small scale in-situ test (e.g. packer test, falling-head or constant-head tests).
 - › Empirical relationships with soil classification testing.
- H.4.3 Note that a full-scale pumping test can be a significant dewatering operation and therefore it shall be subject to the same requirements as outlined in this Code of Practice. The Applicant shall demonstrate that the impact of the pumping test upon adjacent Railway Infrastructure is acceptable.
- H.4.4 In any case the derived permeability values shall be subjected to a sensitivity study in any analysis to ensure the most moderately conservative value is taken.

- H.4.5 If the geotechnical investigations identify weak soils that may be subject to significant settlement from groundwater drawdown, a general survey of the foundation within the radius of the influence area shall be undertaken and a detailed analysis shall be performed.
- H.4.6 It is expected that the modelling and analysis phase shall involve analytical methods, flow net analysis and/or numerical modelling. The Dewatering Designer shall carefully consider the following when using these methods;
- › Soil layer thickness and hydraulic properties.
 - › Zone of influence.
 - › Model boundaries (including no-flow and recharge boundaries).
 - › Initial groundwater level.
 - › Underground obstructions (e.g. basements, tunnels).
 - › Modelling method assumptions (esp. for analytical methods).
- H.4.7 The RTA may advise the preferred method of analysis depending on the significance of the project, the geometry, location, shoring system, and any other factors which the RTA might consider significant.
- H.4.8 The Dewatering Designer shall demonstrate that the design is sufficiently flexible and robust to allow for variations in the discharge flow rates and drawdown distributions derived from the model. This shall be accomplished in part through sensitivity study of the various parameters used in the analysis.
- H.4.9 As most calculations are carried out under steady-state conditions, the contractor shall consider the impact of transient conditions and the potential for onerous temporary conditions to occur.
- H.4.10 The Dewatering Designer shall consider the temporary or long-term impacts from nearby dewatering operations from other sites. The effects of such temporary impacts (e.g. reduction in well capacity) and the potential for these to change during the works shall be considered by the Dewatering Designer in the analysis.

H.5 Dewatering Operational Risks

- H.5.1 The Dewatering Designer shall consider the following risks when developing the dewatering system and demonstrate the contingency and risk management plans in place to handle the following events;
- › Impacts posed by maintenance operations.
 - › Loss of power or other technical pump failure.
 - › Clogging of well screens.
 - › Inundation of water flows higher than anticipated (e.g. flooding, rainfall or the shutdown of other dewatering systems in the vicinity of the project).

- › Broken or damaged secondary component (e.g. pipe) in the dewatering system.
 - › High sediment inflows.
- H.5.2 A second discharge shall be afforded for critical projects in the case where the first discharge point is compromised.
- H.5.3 A qualified electrician shall be involved in the design and construction of the dewatering system and adequate safety measures are implemented and maintained to prevent the event of an electrical hazard.

H.6 Operation and Monitoring

- H.6.1 The Dewatering Designer shall ensure that the groundwater table is maintained sufficiently below the excavation level to both perform the work and yet minimize the impact upon the Railway Infrastructure.
- H.6.2 Unless otherwise notified by the RTA, the following minimum requirements shall be followed for monitoring of dewatering works;
- › At least one piezometer in the centre of the project.
 - › At least one piezometer between the maximum distance between adjacent wells to verify drawdown (this may be the same as the above).
 - › One piezometer external to the shoring system per 25m running length of the sides facing RTA Infrastructure.
- H.6.3 If recharge of the aquifer near the dewatering system is required to prevent settlement of adjacent structures, control piezometers shall be also be installed.
- H.6.4 In any case, the selection of monitoring wells shall be based on the dewatering calculations and analysis including the depth of excavation to be dewatered and its location adjacent to the Railway Infrastructure.
- H.6.4 Recommended details for piezometer installation are shown in Figures H.5 and H.6.

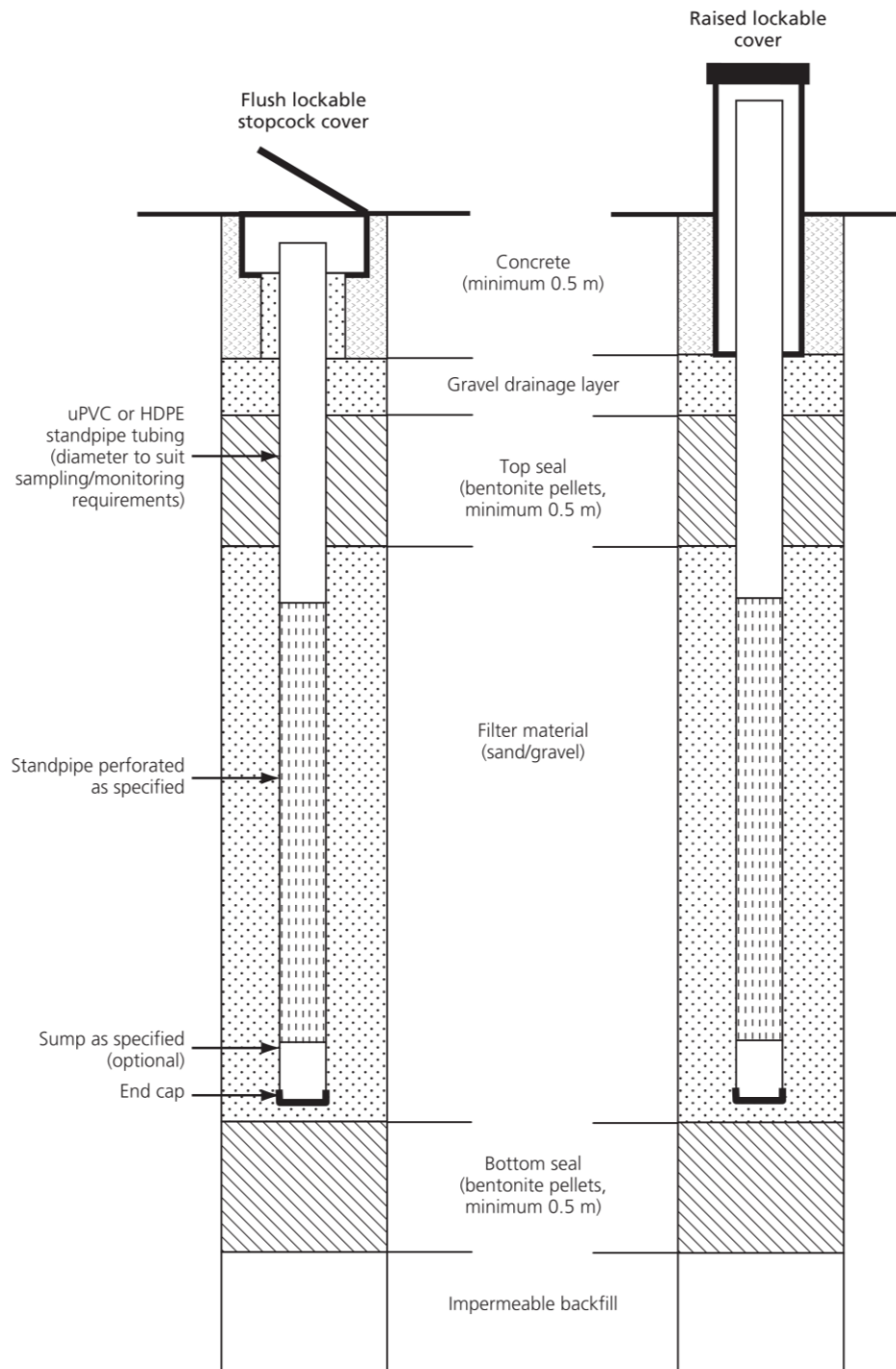


Figure H.5: Schematic Standpipe (from SISG, 2012)

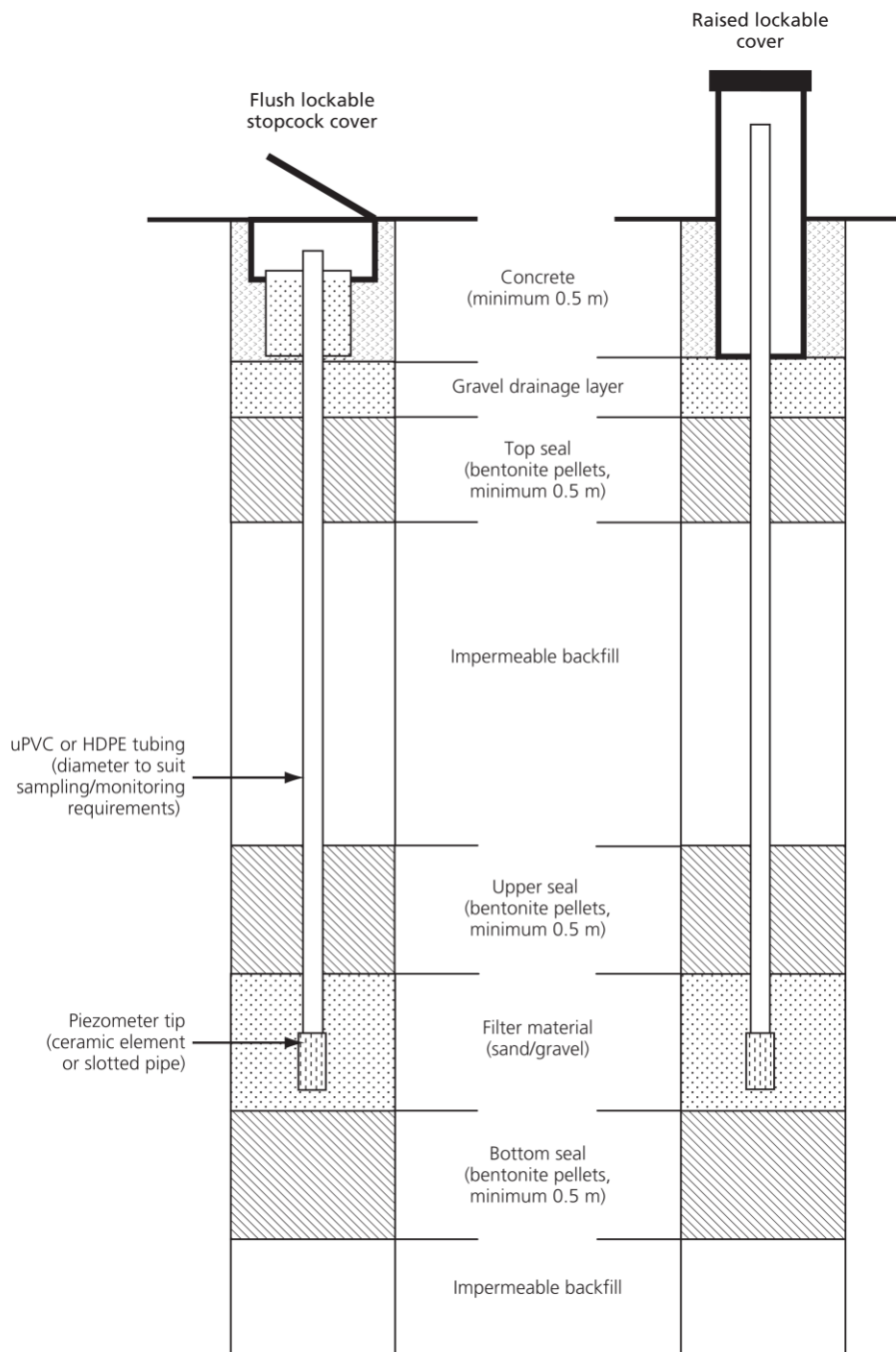


Figure H.6: Schematic Standpipe Piezometer (from SISG, 2012)

H.6.5 A graph of groundwater drawdown (Y-axis) with time (X-axis) shall be plotted for each piezometer. Each piezometer shall be plotted on the same graph. The total pumped flow

rate shall be plotted on the same figure (on a secondary Y axis). The drawdown rate in each piezometer shall not exceed 0.5m/day.

H.6.6 The Dewatering Designer shall monitor changes in groundwater flow during dewatering as sudden changes may reveal potential issues and incorrect assumptions in the dewatering model.

H.6.7 The following parameters shall be measured as shown in Table H.2.

Table H.2: Monitoring Parameters for Dewatering

PARAMETER	LIMIT	MONITORING FREQUENCY	SAMPLING POINT
Groundwater drawdown	As per trigger limit in risk assessment	Daily	Standpipe/ piezometer
Discharge rate	As per design calculation	Daily	Pump
Turbidity	50 Nephelometric Turbidity Units (NTU)	Daily	Settlement tank
Total Suspended Solids	50mg/L	Daily	Settlement tank

H.6.8 All monitoring well installations shall be completed in accordance with international approved standards. All monitoring wells shall be designed such that they prevent water from entering from the top of the pipe during construction.

H.7 Discharge of Groundwater

H.7.1 The following characteristics of the water produced from the dewatering operations shall be considered as part of the dewatering system design to ascertain its acceptability to discharge:

- › Origin of ground water.
- › Chemical characteristics of the groundwater.
- › Groundwater quantities.
- › Duration of the dewatering project.
- › Total estimated discharge rates.

H.7.2 To operate a dewatering system and discharge the abstracted groundwater, Dewatering Permits are required from the Dubai Municipality.

H.7.3 Furthermore, if the dewatering discharge pipelines route runs along the vicinity of Railway Infrastructure, NOCs are also required from the RTA.

H.8 References

H.8.1 In addition to the recommendations in this Section, the following references are provided to assist the Applicants in developing the dewatering aspects of their projects;

- › Abu Dhabi City Municipality. 2014. Dewatering Guidelines. Project No. 13-5015.
- › Cashman, P.M. & Preene, M. 2013. Groundwater Lowering in Construction – A practical guide to dewatering. 2nd edition. CRC Press.
- › Preene, M, Roberts, T.O.L, & Powrie, W. 2016. Groundwater control – design and practice. 2nd edition Construction Industry Research and Information Association, CIRIA Report C750, London.)
- › Site Investigation Steering Group (SISG), 2012, Specification for Ground Investigation, ICE Publishing.



Appendix I – Requirements for Tunnelling using NDRC and NDM Techniques

I.1 General

I.1.1 The following items are required by the Agency when carrying out Tunnelling using Non-Destructive Road Crossings (NDRC) and Non-Destructive Methods (NDM) within the Railway Protection Zone.

- › Copy of E-NOC application (for manual applications).
- › Key Plan showing exact location of proposed NDRC with co-ordinate points.
- › Copy of RTA Approved route NOC, along with the route layout drawings.
- › Cross section of Right of Way showing clearly the vertical alignment of the proposed crossing line with existing services, including typical cross-section and proposed section as per actual site conditions.
- › Site borehole reports (for Dual Carriage Roads, Right of Way (ROW) above 30.50 m/or as and when required by RTA) shall be carried out by authorized laboratory and be approved by the Consultant. Locations of boreholes to be at thrust and reception pits and depth of water table to be mentioned in the borehole logs. The boreholes shall be sunk at least 2.0 meters below the level of proposed works or at least 50 percent deeper than the proposed works, whichever is deeper.
- › The minimum depth of tunnel (i.e., top of Duct/ Pipe/ Sleeve) must be 2D (where D is the external diameter of the Duct/Pipe/ Sleeve) but not less than 2.5 meters from the Finished Road Level (FRL).
- › The contractor shall submit unconditional Bank Guarantee from an approved bank in Dubai. The amount of this guarantee shall be in accordance with the relevant clause of System No.4/2009. (Roads Maintenance Dept.).
- › Method statement must be provided.
- › Monitoring of existing road surface (Pre-drive level) should be carried out 20 m each side of the tunnel centreline at 2.0m intervals. The same should be approved by ROW Departments of RTA.
- › Proposed NDM work crossing Dual Carriage Roads should be designed and supervised by RTA approved Consultants for NDM works. The settlement calculations / design for all types of NDM methods should be as prescribed in the latest standards as advised by RTA ROW Department.
- › A letter from the Consultant confirming the method statement is acceptable and settlement calculation checked and verified that long-term settlement is within the allowable limits of 5 mm (for dual carriage way).
- › NDM works shall be carried out by RTA Approved Contractors for NDM works.

- › Traffic diversion plan in case of settlement /collapse of road during NDRC process (for dual carriage way). Traffic diversion approval from traffic services section (ROW department) as backup plan in case of emergency.
- › Approved road contractor letter confirming that he will be ready to do the emergency reinstatement if the road settles/collapse during the NDM process.
- › Letter from Contractor confirming that there is no leakage of existing services within 100.0m radius from NDM location and no settlement or damages to the existing asphalt and RTA road furniture.
- › Site organization sheet of consultant and NDM contractor including names and contact numbers.
- › Programme of work.
- › Soft copy in DLTM system Micro-Station version 7/8, clearly showing the layout / location with co-ordinate points and cross-section and profile (for Manual submission).
- › Thrust and reception Pits to be 5.0m (min.) away from the existing Asphalt edge.
- › Site photographs showing the location of the proposed NDRC.
- › Each location of NDRC shall be applied separately.

I.2 NDRC Post Construction Requirements

- I.2.1 The surveying of existing road surface immediately after completion of work (Post drive level) and after 6 months or as and when required by RTA to monitor the settlement of the road, the same should be carried out in coordination with Inspection Section of RTA.
- I.2.2 The work done must be subjected to one year maintenance and 10 years decennial liability as per RTA Regulation.

The RTA extends its appreciation to Petros N. Zouzoulas for the use of his colour photographs of the Dubai Metro and Dubai Tram in this Code of Practice.