Industry reference guideline

Undertaking Piling and Foundation Work Safely within the Rail Corridor in Victoria

Table of Contents

This Industry reference guideline: Undertaking Piling and Foundation Work Safely within the Rail Corridor in Victoria is hosted by Metro Trains Melbourne and is available for use by Principal Contractors, Piling and Foundation Contractors and other parties when planning for and performing piling and foundation works in the rail corridor.

The guideline was developed by an industry working group comprising:

Piling and Foundation Specialists Federation

Keller Pty Ltd

Wagstaff Piling Pty Ltd

Acciona Geotech Group Services Pty Ltd

McConnell Dowell Corporation Limited

John Holland Pty Ltd

CPB Contractors Pty Ltd

Lendlease Engineering Pty Ltd

Laing O'Rourke Australia Pty Ltd

Metro Trains Melbourne Pty Ltd

Level Crossing Removal Project

Rail Projects Victoria

Application of the Guideline and Mandatory Requirements.

Each individual Rail Transport Operator (RTO) will specify their requirements at the time of granting access to a contractor or other party required to perform works anywhere within a RTO lease boundary. Each contractor or other party must comply with all RTO rail safety, rail access and other procedures / special requirements imposed as a condition of granting access to any area within the lease boundary at all times when performing the works. The RTO may refer to this document when granting access and require that it be applied to piling and foundation works performed anywhere within their lease boundaries as a condition of access. With regard to piling and foundation works occurring within the Metro Trains Melbourne Pty Ltd lease boundary, this guideline applies at all times. All mandatory requirements within the guideline must be adhered to by the piling and foundation contractor performing the works and the remaining guidance within this document must be reviewed by the piling and foundation contractor and applied to the works so far as is reasonably practicable.

The Piling and Foundation Specialists Foundation website hosts two documents related to this guideline (both in word format and as editable graphics files) that can be downloaded and customised by piling and foundation contractors for use by piling crews in the field:

- A tabulation of the hazards identified within this guideline and proposed controls and,
- A set of flip cards that can be provided to piling and foundation crews to assist with application of the guideline in the field.

Glossary

Absolute Occupation	A method of protection that closes a defined portion of track for a specified period.
Authorised Electrical Operator	A person authorised to carry out switching, isolation, earthing and short circuiting and issue and cancel permits and certificates on electrical apparatus (i.e. any electrical equipment above or below ground, the conductors of which are live or can be made live or energised).
CFA	Continuous Flight Auger is a method of piling that involves the use of a hollow stem auger with continuous flights. Concrete is placed into the pile hole as the auger is withdrawn from the hole.
Competent person	A person who by their training, qualification or experience has the knowledge and skills to carry out the task.
CSR	Combined Services Route.
Danger Zone	All space within 3 metres horizontally from the nearest rail and any distance above or below this zone including on track.
EAP	Electrical Access Permit a form of authorisation which allows access to work on isolated and earthed and short circuited high voltage apparatus.
ELECTROL	Electrical System Control Centre from which all electrical operations of the train high voltage electricity power supplies are controlled.
Employees	All direct employees, any contractors and the contractors' employees.
EWP	Elevating Work Platform.
METROL	Metropolitan Railway Train Control Centre (Melbourne Trains).
MTM	Metro Trains Melbourne.
OHLE	Overhead Line Equipment.
OHS	Occupational Health and Safety.
OSO	Overhead Safety Observer.
PFSF	Piling and Foundation Specialists Federation.
PPE	Personal Protective Equipment.
PC	Principal Contractor is the owner of the work place where the construction project is to be carried out unless they appoint a principal contractor for the construction work performed for or on behalf of the owner. The Principal Contractor must manage or control the workplace to the extent necessary to discharge the duties contained in the Victorian OHS regulations.
Permit To Disturb	The process to seek permission from the Track Delivery Manager to control works undertaken on the MTM network that may affect the integrity of the track assets.
PTW	Permit to Work is the form of authorisation issued by the engineer in charge of overhead or his appointed representative to permit work to be carried out in the vicinity of but not in contact with high voltage apparatus which has been isolated, earthed and or short circuited.
Rail Corridor	The Rail Corridor is from fence line to fence line or where there are no fences, fifteen (15) metres from the nearest rail.
Rail Safety Work	Any activity which involves constructing, operating or maintaining the railway system.
Reasonably practicable	Refers to the steps a reasonable person would take to identify and control a hazard. Refer to Worksafe guideline – How WorkSafe applies the law in relation to Reasonably Practicable.
RIWC	Rail Industry Worker Card is an identification card which provides access to an online database in which a worker's competency information is stored.
Rolling Stock	Trains, Track machines, Road / Rail Vehicles.h
RSW	Rail Safety Worker means a person who has carried out, is carrying out or is about to carry out rail safety work.
RSWHA	Rail Safety Worksite Hazard Assessment.
RTO	Rail Transport Operator.
SWMS	Safe Work Method Statement outlines a process for identifying OHS hazards and controlling measures.
TFPC	Track Force Protection Co-ordinator is responsible for completing a RSWHA and the placement of track protection as per the agreed protection plan.
WGS	Work Group Supervisor – Principal Contractor Supervisor allocated to supervise piling works.
WLL	Working Load Limit.

1.1/Purpose of this Industry Guideline

This document has been collated from information obtained following consultation with industry participants as well as review of regulatory guidance material and consideration of recent incidents. It is hosted and made available to industry participants by Metro Trains Melbourne, but represents the collective views of the contributors. It is intended to provide practical guidance on the rail safety related aspects applicable to the piling and foundation engineering industry when working in, or adjacent to the Rail Corridor, in Victoria. It also addresses safety-related considerations to be applied at the design, operation and maintenance stages of piling and foundation activities occurring in a Rail Transport Operator's (RTO) Rail Corridor to mitigate the risk of rail safety incidents occurring.

Finally, the document sets out guidelines for establishing and maintaining a safe working environment during piling works.

This Industry Guideline is not intended to exclude other methods or processes that provide for workplace safety or rail safety. It is also not intended to be an all-encompassing design, maintenance and operation manual.

This guideline should be read in conjunction with the WorkSafe Victoria industry standard, A Guide to Managing Safety, Piling work and foundation engineering sites, industry standard Worksafe Victoria, Edition 1, January 2014, (Figure 1).

This Industry Guideline provides information applicable to all piling and foundation plant and equipment including all fixed piling rigs, excavator-mounted piling attachments, mini-pile, soil nail and anchoring.

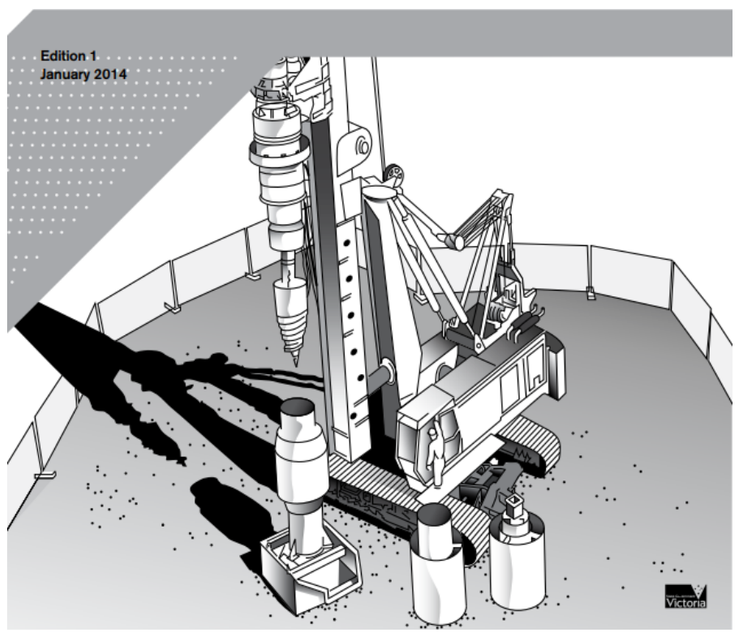
This Industry Guideline can be used by Employers, Designers, Principal Contractors, Health and Safety Representatives, Rail Safety Workers and others planning, designing or managing piling and foundation works in the Rail Corridor.

Photo 1 – Rail Corridor dimensions

A guide to managing safety

Piling work and foundation engineering sites

Industry standard



1.2/Background

The Rail Corridor is a high-risk environment in which to undertake construction work. Specific controls are required for hazards associated arising from the rail infrastructure and rail operations around which piling and foundation work occurs.

- Construction in the Rail Corridor may involve:
- Building new railway stations;
- Removing level crossings;
- Building new stabling yards/ rail facilities;
- Duplicating / Extending the railway;
- Installing new signalling and rail infrastructure;
- Refurbishing railway stations;
- Building new electrical substations; and
- Tunnelling and rail duplication.

1.3/Rail Corridor Hazards

Piling and foundation work in the Rail Corridor introduces additional rail-related hazards including the following:

- Working adjacent the operational railway;
- Working near overhead line equipment (OHLE);
- Working near underground energised and other assets;
- Working near members of the public, rail commuters;
- Nearby commercial and residential buildings;
- Difficult and restricted access options; and
- Work area restricted in size.

This guideline identifies the key issues and considerations for undertaking piling and foundation work safely in the Rail Corridor.

Photo 2 – Piling works adjacent to rail corridor

Photo 3 – Piling work adjacent to Rail Corridor

Photo 4 – Piling works adjacent to Rail Corridor

1.4/Operating Railway

When planning piling and foundation works, the following should be considered:

- The works location (e.g. within the defined Rail Corridor and / or defined Danger Zone);
- The numerical size of the work group and their competency requirements;
- The presence of underground rail and other assets;
- Proximity of the works to energised OHLE and other above ground electrical assets;
- Potential of the works to compromise the integrity of the railway;
- Required certifications (e.g. certificate of train running, signalling or overhead, return of electrical access permit);
- When the works are carried out (e.g. during rail operations on the network)
- **Note:** unless an absolute occupation is in place, rail operations occur on a 24/7 basis;
- Requirement to utilise specialised plant or equipment related to rail; and
- The potential for plant or equipment to affect railway operations (e.g. plant or equipment obstructs signal lines of sight).

The planning will identify specific issues and considerations required to be utilised to ensure the works can be completed safely in the Rail Corridor. Relevant additional requirements may be contained in the RTO's procedures and documentation – and so these should be sought and reviewed prior to work commencing.

Key issues and considerations relevant to piling and foundation works in the Rail Corridor are contained in Appendix B1.

2.1/Mandatory Requirements

Piling and foundation work in the Rail Corridor poses many significant hazards to the operational railway, accordingly a number of controls have been deemed as mandatory. Work must not start or continue whenever a mandatory control cannot be implemented or maintained.

Mandatory Requirements:

- All piling and foundation engineering equipment must exhibit evidence of compliance with the Pilesafe inspection scheme (i.e. a current Pilesafe Green Sticker). The scheme applies to all piling and foundation engineering equipment inclusive of excavator mounted piling attachments used for augering, boring, drilling and includes all plant used for sheet piling, micro piling, soil nailing and anchoring works.
- An active Rail Industry Worker Card (RIWC) must be held by each person undertaking Rail Safety Work (refer section 2.2 for further detail)
- When there is any change to or deviation from the planned methodology and / or controls in the SWMS, it is considered MANDATORY that
  - THE WORK CREW CEASE WORK; and
  - They contact their supervisor and the relevant Principal Contractor site supervisor.
  - Refer section 2.3 for further detail.
- During the planning phase, consultation and agreement must be achieved on the minimum design and inspection requirements for the piling working platform inclusive of:
  - Ensuring a competent person designs and certifies the working platform, including access routes, ramps and roads; and
  - Ensuring a competent person inspects and recertifies the working platform, weekly as a minimum or at a greater frequency as per the design requirement. Refer section 3.4 for further detail.
- It is the position of those contributing to this Industry Guideline that a secondary outer protective hose / sheath on the concrete hose between Continuous Flight Auger piling plant and auxiliary concrete pump plant and all concrete hoses contained on the piling rig mast should be mandatory. The outer protective hose / sheath must be of sufficient capacity to contain any sudden release of concrete due to hose rupture.

2.2/Competencies

Employers must ensure workers are provided with information, instruction and training to enable them to work safely in the Rail Corridor. The following competencies are considered mandatory for work in the Rail Corridor:

An active RIWC must be held by each person undertaking Rail Safety Work and must verify that the person holds at least the minimum Work Role required by each RTO for access to their network.

Note: a person is required to hold other Work Roles, as specified by each RTO, to demonstrate competency to perform particular types of work on that network.

- The requirements to be eligible to attain the minimum Work Role in Victoria include;
  - Complete Safely Access the Rail Corridor (delivered by an approved provider);
  - Complete Safely Work in the Rail Corridor (delivered by an approved provider);
  - Pass a rail medical – category of medical is dependent on each person's Work Role; and
  - Complete the general construction induction.
- A current Victorian Worksafe High Risk Work Licence if performing high risk work (e.g. rigging) or operating high risk plant (e.g. mobile cranes) and other required licences.

2.3/Management of Change

Planned work activities in the Rail Corridor are usually undertaken in line with the requirements of pre-planned construction methodology and SWMs. However, circumstances can change, necessitating changes to methodology and SWM, this potentially increases the risk to both workplace safety and rail safety and can lead to misunderstandings and confusion. Work must cease when any change occurs, to allow careful planning to occur. The change must be clearly identified, assessed and managed inclusive of effective communication with all relevant parties prior to works recommencing.

When there is any change or deviation from the planned methodology and / or controls the SWMS, it is considered MANDATORY that;

- THE WORK CREW CEASE WORK; and
- They contact their piling supervisor and the Workgroup Supervisor (i.e. Principal Contractor site supervision).

The assessment of the change must be made applying each or both of the Principal Contractor's or piling and foundation Contractors' management of change procedure.

In applying the management of change procedure, parties should address the following:

- Identify all aspects of the change inclusive of the rail-safety related aspects, the construction OHS and site co-ordination aspects;
- Review all elements of the SWMS;
- Identify and assess the new or modified risks posed inclusive of the rail-safety related aspects, the construction OHS and site co-ordination aspects;
- Identify whether any new or modified controls are required;
- Adjust the methodology to reflect the deviation;
- Ensure that the Principal Contractor and piling contractor representatives agree the changes have been communicated and understood by the piling work crew; and
- Ensure that the TFPC has undertaken a review of the RSWHA and has provided a rail safety briefing if any amendments are made to the RSWHA.

Figure 2 – Rail Industry Worker Card Sample

3.1/Rail Corridor Safety Principles

When planning piling and foundation work within the Rail Corridor, the following Safety Principles must be included in the design, planning and execution phases of a project:

Access Control	• All work requires access approval from the RTO and may require special permits and authorisations from either VicTrack or other RTOs (e.g. MTM, VLine or Australian Rail Track Corporation) prior to work commencing.
Protect Personnel	• All work activities and use of equipment must take into account the protection of all workers from adjacent rail transport operations, including rolling stock movement, energised electrical assets and operating equipment.
Protect Assets	• All work activities and equipment movement must be designed to prevent damage to all rail infrastructure and other assets.
Protect Rolling Stock	• The design of work activities must take into account the potential damage to rolling stock (e.g. trains) should any activity or equipment fail and cause an obstruction.
Protect Public	• All work activities must take into account the surrounding public/commuters and adjacent environment (e.g. buildings and vehicles) and the potential for the construction works to cause harm to people or damage to property.

Figure 3 - Typical RTO Safety Principles

3.2/Work Planning and Consultation

Planning and preparation should be done early in the development of each project and include consultation with relevant stakeholders (such as those in Figure 4). Prior to carrying out construction work in the Rail Corridor, all works must be assessed and documented to enable a review of risk and control measures so that work is carried out safely and without impact on rail operations or infrastructure. It is recommended that the piling and foundation contractor is consulted in the design phase to provide input into Safety in Design processes and advise on piling solutions that mitigate hazards during construction (e.g. hazards associated with piling in narrow, linear Rail Corridor worksites located between property boundaries and the operating railway).

Key issues and considerations relevant to work planning are contained in Appendix B2.

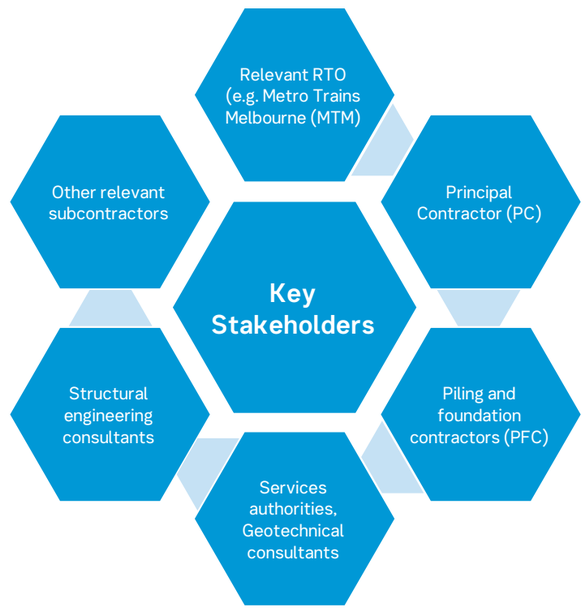


Figure 4 - Key stakeholder for piling and foundation work in rail corridors

3.3/Foundation Technique Selection

During the planning phase of the works, the most appropriate foundation technique should be selected for use in the Rail Corridor. This selection may differ from what may be considered sufficient for other types of workplaces. Considerations should include:

- Ground conditions which may be affected by poor drainage and soil conditions;
- Limited site access, location and size;
- Proximity to existing rail assets including overhead and underground structures (foundations should be distanced as far as practicable from the rail);
- Generation of unacceptable or nuisance vibration;
- Generation of noise that may affect rail commuters / general public;
- Proximity to adjacent structures, dwellings and public infrastructure;
- Ground contamination; and
- Groundwater level.

A competent person who is familiar with the foundation technique proposed should assess the suitability of specific piling and foundation equipment and construction methodology for work in the Rail Corridor.

Any supporting infrastructure to facilitate piling works needs to be suitably engineered and certified, where required. This may involve:

- Certification of lifting points on piling sleeves and reinforcement cages; and
- Engineering certification of temporary soil retention systems.

3.4/Design, Construction and Maintenance of Working Platforms

A critical factor in piling and foundation work is the surface required to support the rig and ancillary equipment during operation or when moving about the site, commonly referred to as a "working platform". Inadequate working platforms can cause piling and foundation equipment to become unstable and collapse.

During the planning phase, consultation and agreement must be achieved on the minimum design requirements for the working platform and ensure a competent person (e.g. a geotechnical engineer) designs and certifies the working platform, including access ramps and roads.

The key factors for platform design and construction are:

- Ensure the working platform is of a suitable size for the piling and foundation equipment;
- Ensure the working platform is able to withstand the imposed loadings during the piling and foundation works. The maximum loadings (i.e. bearing pressures, wheel axle loadings, point loads due to propping, etc) will vary in relation to the type of equipment used and the foundation technique chosen;
- Testing and certifying that the working platform meets the design requirements prior to commencement of piling and foundation works;
- Making sure that the working platform is free-draining and suitable for all weather types; and
- Has a clearly delineated working platform area on site, marked clearly on the Working Platform Certificate.

As a minimum, the working platform must be inspected and re-certified by a geotechnical or other suitably competent, qualified and experienced engineer or other person (e.g. piling superintendent) who can verify that the original Working Platform design intent (i.e. the bearing pressures that platform has been designed to support) continues to be met. This must occur on a weekly basis or more frequently as specified by the competent person who designed the working platform - inclusive of inclement weather events, trenching / excavation of part of the working platform or any other form of alteration or visible signs of deterioration or excavation adjacent to the working platform. Recertification incorporates all activities undertaken to verify that the working platform continues to meet the original design intent in terms of the loads that the working platform will support during all piling operations. Means of verification include visual inspection, dynamic cone penetrometer testing and test rolling.

An example of a Working Platform Certificate is included in this document as Appendix C, a certificate must be issued for every working platform.

3.5/Rail Corridor Work Requirements

Prior to any work commencing in or adjacent to the Rail Corridor, a qualified TFPC will conduct a RSWHA which includes pre-planned work activities and is used to determine which method of protection is most suitable to segregate the work activities from the operational railway.

The RSWHA forms the basis for the Rail Safety Pre-Work Briefing, which must be delivered by the TFPC to the Work Group Supervisor(s) and then to all Rail Safety Workers associated with the work site. This briefing will address rail safeworking protection, use of OSO and OHLE isolation and earthing requirements.

These processes and documents are additional to the occupational health and safety related processes undertaken such as PPE checks, daily pre-start briefings and SWMS briefings / sign off used for piling and foundation works.

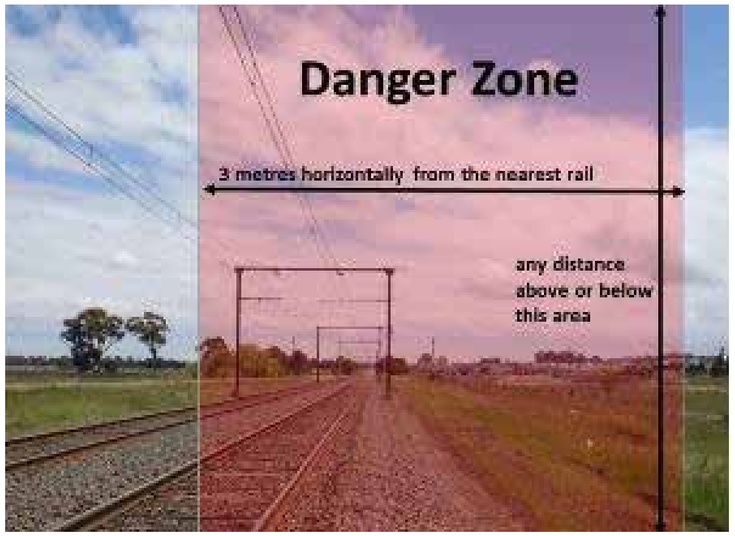


Photo 5 – Danger Zone Delineation

Work planned for the Rail Corridor must be assessed by a TFPC to:

- Determine the work's potential to intrude on and obstruct the Danger Zone; and
- Assign risk controls for an appropriate level of worksite protection.

Work must not commence unless:

- The required work site protection measures are in place inclusive of all permits and certifications required by this document and the relevant RTO;
- There is a Position of Safety that can be easily reached;
- All Rail Safety Workers hold and present a current RIWC with the minimum Work Role and additional roles for the work they will perform; and
- Rail Safety Workers and other relevant personnel have participated in, and signed, the Rail Safety Pre-Work Briefing which has identified any site-specific rail safety hazards and controls.

Photo 6 – RSWHA Sample

4.1 /Rail Assets, Underground Assets and Buried Structures

All excavation and trenching works on RTO controlled premises and leased land requires the following process to be strictly adhered to in the order listed below:

- **Stage 1 - Identification** and Initial Proving of Assets (Visual inspection, Dial Before You Dig, drawings, cable drawings, cable tracing, cable location survey);
- **Stage 2 - Notification** and Approval of Excavation (Refer relevant asset owner / RTO for required permit process);
- **Stage 3 - Physical Proving** and Identification of Assets (Non-Destructive Digging, Pot Hole investigation, ground penetrating radar); and
- **Stage 4 - Excavation** Commencement authorisation via principal contractor permit approval.

Notification

The relevant asset owner / RTO's delegate(s) must be notified in advance of the works occurring. Notification is often at least ten (10) working days in advance of the intention to commence works if an excavation is:

- Within two (2) metres of any railway underground;
- Within ten (10) metres of a railway substation, tie station or switching station;
- Within three (3) metres of the track (within the Danger Zone); or
- If plant is to be involved, within 6.4 metres of OHLE.

All relevant asset owner / RTO's requirements must be complied with. For example, observers and electrical access permits may also be required.

Key issues and considerations relevant to rail assets, underground assets and buried structures are contained in Appendix B3.

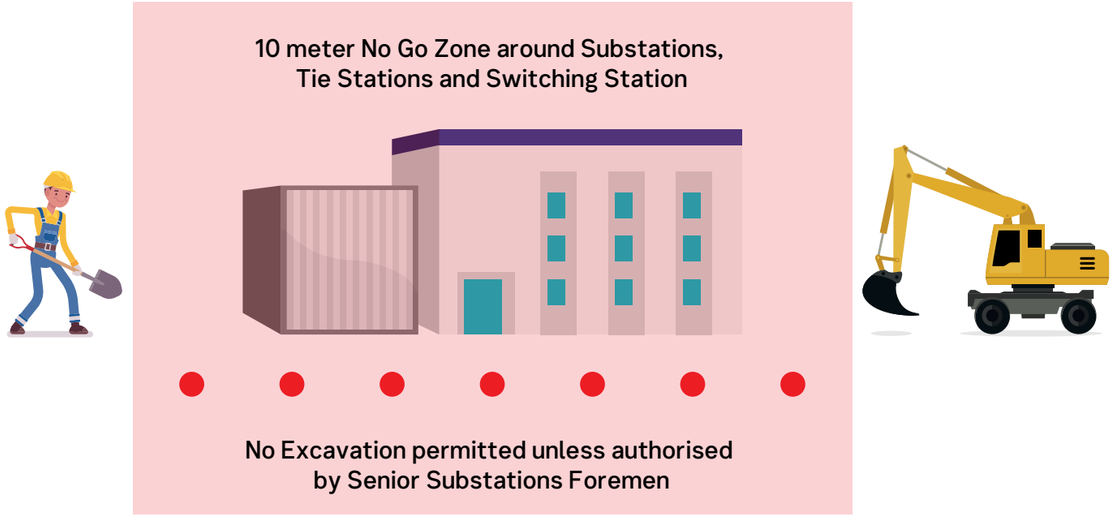


Figure 5 - No Go Zones around substations

4.2/Overhead Electrical Line Equipment

Piling and foundation construction activities in the Rail Corridor and the Danger Zone may require personnel and plant to work in the vicinity of OHLE rail assets. There may be potential for contact with the following electrical assets:

- High Voltage Transmission Feeders 22,000V AC;
- DC traction wiring 1500v DC;
- DC feeders 1500v DC;
- Electrolysis feeders;
- Signal feeders 2.2kV AC; and
- Industrial supplies 22kV AC, 11kV AC and 6.6kV AC.

All parts of the overhead system are to be considered energised at all times unless otherwise advised in writing by an Authorised Electrical Operator in writing.

Photo 7 – Piling works in the rail corridor and involving overhead hazards

4.3/Work Near Rail Assets (Rail Traffic, OHLE, AC power lines)

Where piling is planned in proximity to energised rail assets, OHLE, AC power lines or other rail assets, all hazards must be identified, assessed and controlled.

Energised assets should be isolated where possible.

Piling work crews must follow:

- The RTO's / other asset owner requirements for Safe Approach Distances (SADs) to OHLE and other electrical assets;
- Energy Safe Victoria requirements for approach distances and No-Go Zone requirements for AC power lines on poles and transmission towers; and
- Plant must be positioned so that the slewing radius does not encroach the SAD specified by the asset owner and / or Energy Safe Victoria as applicable.

Key issues and considerations relevant to works near rail assets are contained in Appendix B4.

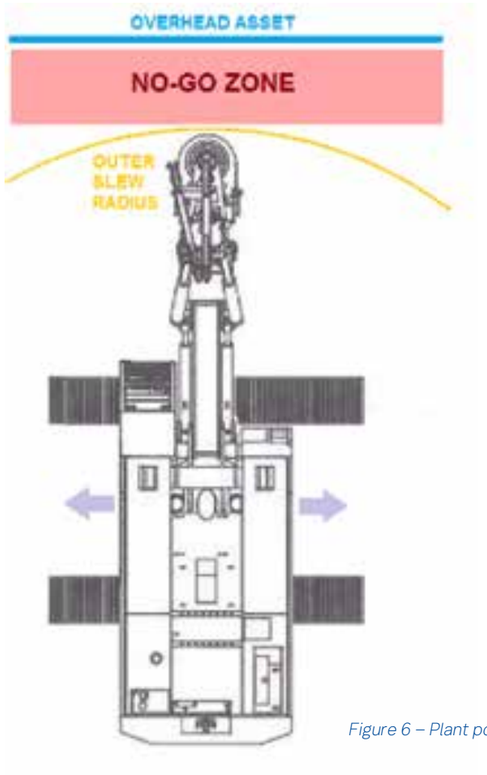


Figure 6 – Plant positioning example

4.4/Safe Approach Distances to Overhead Line Equipment

SAD 1 is defined as distance greater than 6.4m from OHLE.

SAD 2 is defined as distance between 6.4m to 2.m from OHLE.

SAD 3 is defined as distances less than 2m from OHLE.

Note: Each of these SADs require specific sets of controls to be implemented in consultation with RTO. Under no circumstances can SAD 3 be encroached upon without isolation and earthing of the OHLE.

4.5/Height and Slew Restriction of Plant

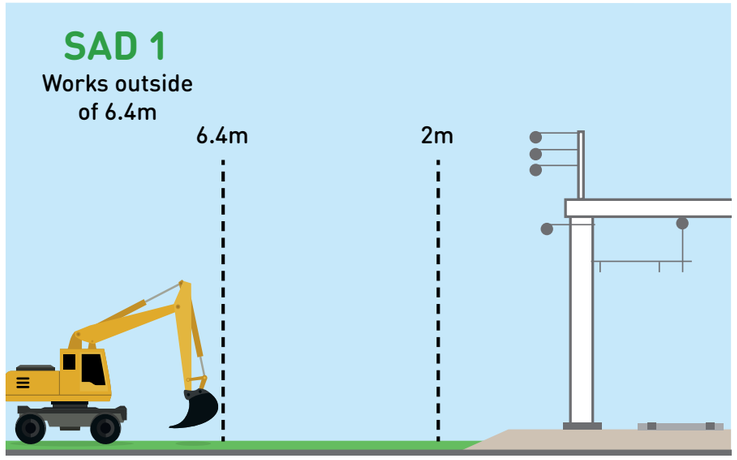
An approved Height or Slew Restrictor is a mechanical or electronic device that limits the extent that plant can elevate or slew. This reduces the risk of contact with OHLE and other assets during operation of the machine.

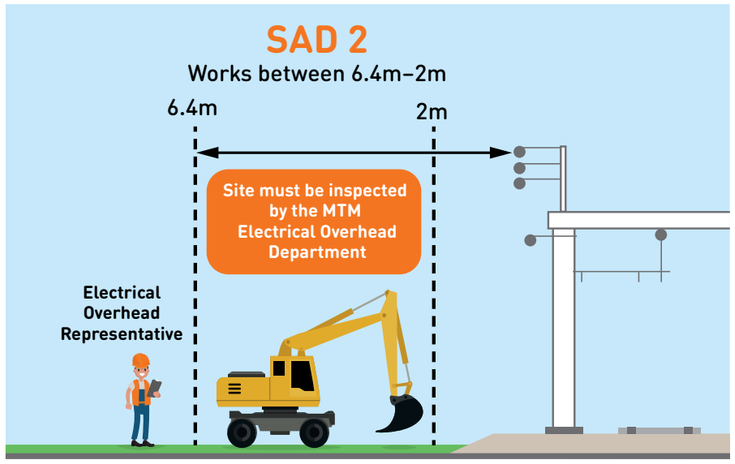
The relevant asset owner or RTO procedure outlines the method for enabling plant with height and slew restrictors to be used under, or within, the limits of approach to OHLE.

The restricted plant height for any specific worksite will vary between the relevant asset owner or RTO, however is often no greater than 3.9 metres above top of rail.

All height restricted plant working on the RTO's network must be approved prior to work commencing.

Approved plant may be identified using a label (Photo 8) which is attached to the plant and / or a copy of the relevant approval must be kept in the cabin with the operator at all times.





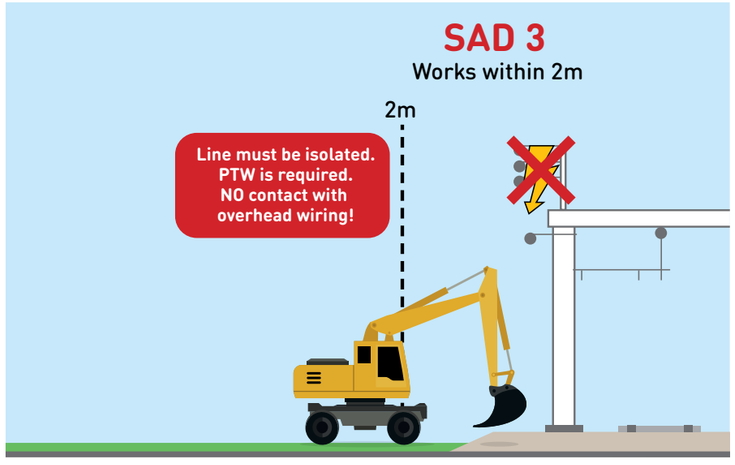


Figure 7 – Various images of SADs

4.6/Plant Contact with OHLE

Should plant contact OHLE that is energised, assume that the OHLE is live and remain in the cabin until help arrives. If it is unsafe to remain in the cabin (e.g. due to fire), exit the cabin, do not touch anything other than the item of plant, check boots are laced and jump to the ground, do not roll or walk, do not touch the plant during or after the jump, do not use the grab / step handles when jumping from the plant, hop or shuffle away from the plant.

4.7/Potential to Disturb Track and other Rail Infrastructure (Maintaining Integrity of the Railway)

There is potential for piling works to cause "track heave", undermine track formation, undermine structures and foundations, cause loss of ballast and rail formation. As a consequence, this may compromise track integrity. Should any of these situations be observed, immediately cease works and notify your supervisor and the Workgroup Supervisor (i.e. Principal Contractor site supervision).

Key issues and considerations relevant to potential to disturb track and other rail infrastructure are contained in Appendix B5.

4.8/People and Plant Interaction

Piling equipment often must work close to the public and RTO staff. All parties must clearly understand where the work area is so that there is a separation distance or barriers between people, plant and work activity.

Key issues and considerations relevant to people and plant interaction are contained in Appendix B6.

Photo 8 - Approval Sticker

Photo 9 – Piling rigs operating near workers and pedestrians

4.9/Site Access and Logistics

Piling and foundation works undertaken in the Rail Corridor are typically occur in constrained work areas. The Rail Corridor is linear and narrow and often work areas are located between the operating railway on one side and private property boundaries on the other. This work environment necessitates additional detailed planning be undertaken to ensure works are completed safely from both an occupational and rail safety perspective.

Key issues and considerations relevant to site access and logistics are contained in Appendix B7.

Photo 10 - Examples of restricted access / small area works sites

4.10/Travel to, from, and within the Works Area

Piling and foundation works require the operation of support equipment such as excavators, cranes tippers and delivery trucks during works. Worksite planning must consider arrangements for the operation of these items of support equipment and provisions for safe access and egress from the Rail Corridor and works area. It is also necessary to minimise the need to reverse trucks is necessary also.

Key issues and considerations relevant to travelling to, from and within the works area are contained in Appendix B8.

4.11/General Lifting

Support cranes, auxiliary winches and excavators are typically utilised during piling and foundation works to lift a variety of plant equipment and materials required to complete the works. The use of these lifting systems must be planned for in the Rail Corridor and the hazards associated with their use in the Rail Corridor must be identified, assessed and controlled.

Key issues and considerations relevant to introducing and operating support cranes, auxiliary winches and excavators for lifting in the Rail Corridor are contained in Appendix B9.

Photo11 – CFA piling rig

5.1/Commissioning, Assembly and Disassembly of Piling Rigs

Key issues and considerations relevant to commissioning, assembly and disassembly of piling rigs in the Rail Corridor are contained in Appendix D1.

5.2/Continuous Flight Auger and Bored Piling

Key issues and considerations relevant to CFA / Bored piling in the Rail Corridor are contained in Appendix D2.

5.3/Driven Precast / Sheet Piling

Key issues and considerations relevant to Driven Precast / Sheet Piling in the Rail Corridor are contained in Appendix D3.

Photo 12 – Piling rigs adjacent to the Danger Zone

Photo 13 – Driven Precast and sheet piling

5.4/Press in Method Piling

Key issues and considerations relevant to the Press in Method in the Rail Corridor are contained in Appendix D3.

5.5/Soil Nail and Anchoring

Key issues and considerations relevant to Soil Nail and Anchoring works in the Rail Corridor are contained in Appendix D4.

Photo 14 – Piling using the press in method

Photo 15 - Soil nails and anchoring

Appendix A – Emergency Management Protocol

(for works on MTM assets)

Emergency Management Protocol:

If any of the below events occur, the Track Force Protection Co-ordinator (if present) or the Piling / Workgroup Supervisor must IMMEDIATELY ring METROL on

(03) 9610 7204 or (03) 9610 7205

- **If a piling activity results in obstruction of a running line (i.e. unplanned access of plant materials or people to the danger zone – within 3.0m of track).**
- **If a piling activity affects the integrity of rail infrastructure (i.e. OHLE , signalling assets, comms assets, track and other supporting infrastructure).**

Appendix B – Issues and Consideration Tables

The following tables provide a summary of matters for consideration in relation to various aspects of Piling and Foundation works in the Rail Corridor, as identified by the contributors to this Industry Guideline. The issue set out below should be supplemented by site-specific risk assessments, or any preferable industry or business systems of work.

B1 Operating Railway

Operating Railway

Item	Issue	Consideration	Consult with
B1.1	Workers struck by rolling stock / rail plant.	Undertake a RSWHA and identify Positions of Safety. Establish physical barriers to delineate the danger zone, allocate track refuges incl. safe access and egress locations.	RTO Rail Safety Manager and TFPC
B1.2	Movement of workers and plant within the Rail Corridor could affect the train driver's vision or line of sight.	Early communication with Train Driver Area Manager to highlight any hazards or controls that may be required for the work. Use plant spotters and / or track force protection - related controls (e.g. lookout protection) following a RSWHA.	Engineer responsible for works, TFPC and WGS
B1.3	Piling equipment, or materials, contacting rolling stock / rail plant, residential and commercial premises.	Undertake RSWHA and implement identified controls Establish physical barriers to separate rail from surrounding premises where practicable. Use piling rig slew restrictors. Delineate the Danger Zone with a physical barrier.	RTO Rail Safety Manager, TFPC and WGS

B2 Work Planning and Consultation

Work Planning and Consultation

Item	Issue	Consideration	Consult with
B2.1	The generally narrow and restricted area of Rail Corridor work sites is likely to increase the potential for: • Plant / people interaction; • Plant / train interaction; • Plant / plant interaction; and • Rail infrastructure damage. which may result in injury, property damage or rail safety incidents.	**When planning piling and foundation works in the Rail Corridor, the following controls should be considered:** • Involve the Piling and Foundation Subcontractor early in the design phase. **Assess and determine as part of preliminary design options development:** • The size and type of plant that can be used in the available space. • Ability to slew the rig in either direction. • Type of piles that can be installed. • Location and volume of spoil that can be stored. • Movement of the rig within the corridor (i.e. more linear up and down the corridor). • Number of rigs and support equipment on site at any one time. • Movement of people, materials and auxiliary equipment to support the piling operation. Consider whether the piling solution (type, size, etc) introduces additional hazards during construction, especially given the nature of the Rail Corridor (i.e. narrow, linear, substantial above and below ground assets).	RTO Rail Safety Manager, Engineer responsible for works, WGS & Piling contractor

B3 Rail Assets, Underground Assets and Buried Structures

Rail Assets, Underground Assets and Buried Structures

Item	Issue	Consideration	Consult with
B3.1	Underground asset strike.	Work must be undertaken in accordance with relevant asset owner / RTO's procedures for 'Protection of underground assets' for any works that include excavating, trenching, or boring and activities that have the potential to disturb the ground surface.	RTO Rail Safety Manager, Engineer responsible for works and WGS
B3.2	People, plant or equipment contacting energised electrical or other rail assets above ground or underground.	Identify energised electrical and other rail assets in the vicinity and determine methods of protection (e.g. mechanical protection, separation / barricading).	Engineer responsible for works, WGS and RTO Electrical HV Co-ordinator
B3.3	Works near other above / below ground infrastructure and assets (e.g. roads, substations and utility assets).	Identify infrastructure / assets affected by the works, relocate the works, redesign construction methodology or protect the assets in consultation with the relevant infrastructure / asset owner.	Engineer responsible for works, WGS and Piling Contractor
B3.4	Inaccurate drawings (i.e. old drawings or lack of drawings). Inadequate visual inspection / identification of asset markers. As built plans do not accurately reflect in situ construction.	Obtain positive confirmation of underground assets or structure locations from the asset owner. Ensure visual inspection occurs with the asset owner present to assist with identification of asset routes. Undertake adequate asset proving for asset depth and alignment.	RTO Electrical Department, Engineer responsible for works and WGS

B4 Work Near Rail Assets (Rail Traffic, OHLE, AC power lines)

Work Near Rail Assets (Rail Traffic, OHLE, AC power lines)

Item	Issue	Consideration	Consult with
B4.1	Piling work occurring within 6.4m of OHLE without asset owner assessment and approvals - increased potential for contact with or damage to energised OHLE.	Mandatory inspection of the OHLE asset(s) near the works must occur with the asset owners' representative (i.e. RTO) to confirm the method of protection to be used which may include: • DC Rail Assets - Works to occur outside asset owner's SAD (i.e. no asset owner controls apply). • Works occurring within DC rail asset owners SAD, but do not require isolation of the asset, comply with asset owner requirements which may include assigning of OSO where required to observe the works and defined limit of approach to the asset during the works. • Isolating the asset, where required and issuing of a permit document confirming the isolation. • Issuing a permit document that requires a re-inspection of the asset once works are completed in those cases where the asset was moved to confirm no damage prior to re-energisation. The asset owner may also require additional controls such as: • Energised line protection during the works. • Set up rig to minimise obstruction to OHLE. • Utilise slew restrictors. • solate / mechanically protect adjacent assets. • Delineation of on ground / above ground assets.	Engineer responsible for works, RTO Electrical Asset Managers and WGS

Work Near Rail Assets (Rail Traffic, OHLE, AC power lines)

Item	Issue	Consideration	Consult with
B4.2	Working in contact with OHLE.	Obtain relevant asset owner / RTO approval where contact with OHLE is unavoidable and / or planned to occur.	RTO's Electrical Asset Managers, engineer responsible for works and WGS

B5 Potential to Disturb Track and other Rail Infrastructure (Maintaining Integrity of the Railway)

Potential to Disturb Track and other Rail Infrastructure (Maintaining Integrity of the Railway)

Item	Issue	Consideration	Consult with
B5.1	Heave destabilising track formation. Ground Movement / Subsidence / undermining. Piling activities affect track, rail or other infrastructure (e.g. platforms move horizontally affecting clearances).	Undertake geotechnical assessment of ground conditions. Select appropriate piling method to address hazards found in the geotechnical assessment. Select appropriate retention / ground improvement methods to support ground loadings during piling. Consult with the relevant RTO to obtain approvals, determine permit document requirements and rail asset recertification requirements prior to resumption of rail operations. Monitor and survey for ground movement / heave / rail asset movement during piling in accordance with monitoring plan approved by the RTO. Piling supervisor to monitor for heaving or rail formation, track and other signs of movement during piling operations Works must immediately cease if survey / visual identifies any of the above occurrences.	RTO Rail Safety Manager, Engineer responsible for works and WGS & piling contractor

B6 People and Plant Interaction

People and Plant Interaction

Item	Issue	Consideration	Consult with
B6.1	Unauthorised personnel or plant entering the Rail Corridor / piling work area when piling works are occurring.	Consult with train drivers and other rail staff to understand travel path / access requirements and include in worksite planning. Establish exclusion zones around piling operations using robust physical barriers and / or other engineering controls to delineate the work area. Note: within the Rail Corridor, it may not be practicable to achieve the desired exclusion zone required for piling rig support operations. In these cases, additional controls will be required. However, the falling object exclusion zone around a piling rig must be maintained at all times during operation. Delineate the Danger Zone with a physical barrier. Use dedicated spotters to monitor plant movement and control access to the work area. Complete a RSWHA. Secure the work site and plant prior to leaving the site.	RTO Rail Safety Manager, Engineer responsible for works, WGS, piling contractor and TFPC
B6.2	Work activities affect the public outside the works area.	Physically separate the public from the work activity if practicable. If it is not practicable, utilise engineering controls such as hoardings. Control site access and egress points open to the public (e.g. close gates, or station a person at the gate).	WGS and Piling Contractor

B7 Site Access and Logistics

Site Access and Logistics

Item	Issue	Consideration	Consult with
B7.1	Limited site access due to potential disruption to rail operations.	Ensure adequate consideration is given to the detailed planning and sequencing of piling and foundation work, access requirements, co-ordination and interface with other activities occurring concurrently. Ensure that staging of work activities is considered, particularly whether all piling and foundation and other operations occurring concurrently onsite, can fit within the available site works area and occur safely.	Engineer responsible for works and Work Group Supervisor & piling contractor
B7.2	Site congestion caused by access / egress restrictions.	Consider the staging and sequencing associated with piling and foundation movement between work locations and demobilisation. Develop internal and external traffic management plans to manage logistics. Plan truck movements and define truck routes on public roads and on-site. Apply dedicated travel routes that have identified overhead assets. Schedule deliveries of plant and materials outside of peak traffic times. Provide multiple access points, when possible. Maintain communication with delivery truck drivers..	Engineer responsible for works and Work Group Supervisor & piling contractor
B7.3	Limited space to provide an adequate exclusion zone around the rig for piling rig support operations.	Clearly identify and maintain a No-Go Zone for dropped objects around each rig. Note: this is mandatory. Identify the size of the operating zone around a rig that can be achieved based on site constraints and assess or develop a work methodology for this operating zone inclusive of engineering controls. Design and use dedicated lay down areas. Allocate and maintain a designated area for piling. Communicate with site workers to ensure understanding of works.	Engineer responsible for works and Work Group Supervisor & piling contractor
B7.4	In-situ refuelling, inspection and maintenance of plant.	When reactive / planned maintenance is required to be performed, ensure both the RTO and / or Principal Contractor's access rules and requirements are sought, understood and complied with.	Work Group Supervisor & piling contractor

B8 Travel to, from, and within the Works Area

Travel to, from, and within the Works Area

Item	Issue	Consideration	Consult with
B8.1	Access to and from the Rail Corridor work site may be affected by the: • Railway Station public access path location. • Level crossing road interface with cyclists, cars and traffic management operations. • Increased road traffic movement during peak times. • School zones. • Restricted height of rail overhead assets. • Narrow urban area roads restricting the ability to travel / turn. • Inclement weather and poor drainage requiring the re-establishment of the working platform. • Traffic congestion due to other plant / equipment / materials on site. • The type of rig used and its size (e.g. tracking with its mast up). • Damage to above ground / underground rail assets, platforms, points, CSR trenches, signals and spark gaps. • Signal fouling during rig movement.	Develop and apply a mobilisation plan for work crews which includes the following considerations of: • Identify travel routes to and from the worksite at the design stage. • Produce a route transport map which illustrates all possible obstructions on the access routes. • Produce and apply a suitable traffic management plan for accessing the work site and moving plant within the work site. • Survey all overhead assets along access routes, include them in transportation maps and make sure that drivers are aware of these assets. • Provide access from both ends of the Rail Corridor, if possible, to limit reversing/turning. • Provide intermediate access points and suitable traffic control measures. • Recertify the pile rig travel pathway at pre-determined intervals based on usage and after inclement weather events. • Interface with RTO regarding operational activities to identify additional hazards. • Identify rail assets at risk of damage and temporarily remove them or protect them from damage. • Minimise the use of support plant that is required to be mobilised with the rig. • Movement across rail tracks / level crossings is forbidden without RTO approval.	Engineer responsible for works, WGS, piling contractor & RTO's Rail Safety Manager

B9 General Lifting in the Rail Corridor

General Lifting in the Rail Corridor

Item	Issue	Consideration	Consult with
B9.1	Introduction of support cranes, auxiliary winches and excavators for lifting.	Assess the operation of support cranes and the potential damage to infrastructure and / or strike personnel. Identify all rail assets in proposed work zones and implement agreed network asset protection during crane operations. Assess intended work zones in the Rail Corridor to ensure NO impact to operational network, specifically "Line of Sight" to signal assets by train drivers. Excavators used for lifting must not be used outside safe work load limits. All changes to agreed methodologies must be agreed by all parties (refer to consult with column) and documented in the SWMS.	Engineer responsible for works, RTO's Rail Safety Manager, Work Group Supervisor & piling contractor
B9.2	General use of cranes.	Assess work area for any constraints on planned crane operations. Identify any required slew zones. Identify, monitor and enforce required exclusion zones. Ensure that the crane type, size and capacity is the best for the working conditions and minimises potential for damage to infrastructure and personnel. Fit all cranes with wind speed monitoring device (anemometer). Cease work when wind speeds exceed limits specified by crane manufacturer in operator's manual. All loads to be dogged from clearly identified & certified lifting points. Clearly mark all loads with Safe Working Load or documented lifting weights. Provide lift plans for all lifts within 75-90% of rated crane capacity.	Piling Contractor
B9.3	Crane lifting near OHLE.	Assess the work zone to determine the appropriate controls for works near OHLE. (Follow controls as per current RTO SADs. Strictly no lifting of suspended loads over energised OHLE. Position crane to limit potential for slewing into OHLE SAD. Where potential slew radius overlaps OHLE SAD, use slew limiters, where practicable, and identify the SAD with ground markers. Limit the crane lifting activity within OHLE restricted areas – e.g. establish lifting (loading / unloading) zones away from OHLE.	RTO Rail Safety Manager, Engineer responsible for works, WGS & piling contractor

General Lifting in the Rail Corridor

Item	Issue	Consideration	Consult with
B9.4	Auxiliary lines (piling rigs).	Assess the requirement for using auxiliary lines when reviewing work conditions and activities. Auxiliary winches must always be used in accordance with the piling rig manufacturers operations manual. The auxiliary winch must have an engineered restraint control device, the engineered device is engaged when the line is attached to the rigs stowage point. Two examples: • Auxiliary line is attached to a stowage arm, when the line is inadvertently operated, the stowage arm trips a limit switch which cuts out the winch, • Auxiliary line is attached to a retractable winch that allows the line to feed out when the auxiliary line is inadvertently operated, and • Other devices that can be demonstrated to remove the risk of the auxiliary line being over tensioned are acceptable also. *Note: When the auxiliary line is not in use, the piling rig must not be operated unless the auxiliary line is attached to the manufacturer approved and engineered restraint device.* • Document the work procedure and risk assessment. • Only lift clearly identified weights with auxiliary lines. • Do not lift loads with unidentified resistance (in-ground casings). *Note: Other engineered devices that can be demonstrated to remove the risk of the auxiliary line being over tensioned can be reviewed and accepted on a case by case basis.* The PFSF has provided recommendations on auxiliary line best practices, see PFSF website www.pilingfederation.org.au for further information.	Engineer responsible for works and WGS & piling contractor
B9.5	Load lifting with Excavator.	Assess lifting requirement for Excavator when reviewing work activities and conditions with particular attention to the Slew radius, boom reach, and Working Load Limit (WLL) capacity Select capacity of excavator based on planned lifting tasks. Excavator to be designed by the original equipment manufacturer for lifting with load charts and / or marked WLL. Make the load charts or WLL available for the operator to refer to. Carry out all lifting on or near ground level. Use for basic pick and place lifting activities. Height restrictors must be fitted, if working beneath OHLE. Height Restricted equipment MUST comply with RTO procedures (e.g. Height Restricted to 3.9 metres). WLL must be displayed on excavator boom, NEVER exceed WLL safe working limits. Fit anti-burst valves to both sections of lifting boom. All excavators are to be fitted with Rollover Protective Structures (ROPS) and Falling Object Protective Structures (FOPS). No lifting with attachments fitted (e.g. buckets).	Engineer responsible for works and WGS & piling contractor

Appendix C – Working Platform Certificate Example / Graphics

PILING AND FOUNDATION SPECIALISTS FEDERATION

WORKING PLATFORM CERTIFICATE

Project Name	
Section/Activity	

Part 1- WORKING PLATFORM DESIGN

Equipment to be used on site:	
Maximum plant loading:	

Note: Reference material developed by the Federation of Piling Specialists to assist with the calculation of bearing pressures is available on www.pilingfederation.org.au - follow the prompts to "Safe Working Platforms"

PART 2 – WORKING PLATFORM INSTALLATION

The Working Platform on the work site detailed above has been designed by an **independent geotechnical engineer** and installed to safely support the equipment detailed on this certificate. The working platform will be maintained and repaired, and reinstated to the as installed condition after any excavation or damage, throughout the period that the equipment is on the site.

Signature		**Name**	
Position	**Geotechnical Engineer**	**Date**	
Organisation		**Address**	
Signature		**Name**	
Position	**Principal Contractor**	**Date**	
Organisation		**Address**	

A completed copy of this certificate signed by the Geotechnical Engineer and the Principal Contractor must be given to each user of the specific Working Platform prior to commencement of any works on that platform.

Received by Signature		**Name**	
	Piling Contractor	**Date**	
Organization			

PFSF – October 2018

Appendix D – Piling Specific Information

D1 Commissioning, Assembly and Disassembly of Piling Rigs

Commissioning, Assembly and Disassembly of Piling Rigs

Item	Issue	Consideration	Consult with
D.1.1	Potential contact with rail infrastructure, rolling stock and construction personnel	Obtain an understanding of the piling rig configuration and space required for establishment prior to commencing works. Obtain a signed / approved Work Pack (relevant principal contractor work package documentation) to start works. Identify and maintain a piling rig exclusion zone for dropped objects. Identify radius of achievable piling commissioning, assembly and disassembly operations zone and plan for activities in this zone to be undertaken safely via the SWMS. Identify the proximity of piling commissioning, assembly and disassembly operations to rail infrastructure and / or rolling stock operations. Consult with the RTO when developing this plan and obtain agreement to it. Conduct a risk assessment of the assembly and disassembly processes.	Principal Contractor / Piling Contractor / RTO rail safety manager
D.1.2	Compromised safe operation of piling rig due to lack of verification of commissioning.	Introduce and use a plant commissioning checklist. Follow the rigging procedure which has been implemented and signed off by a person authorised by the Piling and Foundations Contractor.	Piling Contractor / Principle contractor
D.1.3	A congested setup location	Conduct a risk assessment of the rig tracking path. Develop a traffic management plan for movement within the work site. Set the rig up in a designated area away from the Rail Corridor. Set the rig up outside of live train running schedule or outside of peak times, perhaps during an "Absolute Occupation". Conduct set up outside of overhead assets. Isolate assets prior to the setup process. Seek PC guidance for preferred assembly location. Schedule works to minimise impact of setup and derigging activities. Implement an overhead lookout during setup, if required.	Principle Contractor / Piling Contractor / RTO Rail Safety manager
D.1.4	A congested area for multiple crane set ups	Consult the Principal Contractor early in the design process to identify assembly and disassembly requirements and correct sequence. Allocate and use a designated set up and lay down area.	Principal Contractor / Piling Contractor
D.1.5	Dropped items or tools during setup	Establish and enforce drop zone, fall zone and suitable exclusion zones.	Piling Contractor
D.1.6	Disruption / Delay due to inadequate assessment of rail safety requirements	*Implement Appendix B requirements*	
D.1.7	Inadequate working platform for piling activities	Ensure working platforms are certified. Ensure the size of work areas are adequate for works. Certify working platform prior to piling rig assembly. Confirm the certification and extent of the working platform, reinspect as specified by the competent person who designed the working platform.	Principal Contractor / Piling Contractor

D2 Continuous Flight Auger and Bored Piling

Continuous Flight Auger and Bored Piling

Item	Issue	Consideration	Consult with
D.2.1	Falling spoil during movement of rig into position and drilling	Ensure that all drill rigs have an effective mechanical means of cleaning the auger during operation. Maintain restricted access zones and visual monitoring of the auger at all times.	Piling contractor
		Use protective gantries / hoarding as an engineering control where needed.	Principal Contractor
D.2.2	Failure of concrete lines during pressurization and injection of concrete	Mandatory use of a secondary outer protective hose / sheath on all CFA concrete hoses between the piling rig and auxiliary concrete pump and concrete hoses on the piling rig mast, with sufficient capacity to contain sudden release of concrete due to hose rupture. Visually inspect all hoses daily. Thickness checks on steel pipes in accordance with industry standard. Ensure all hose joints have adequate whip-checks in place.	Piling contractor
D.2.3	Spoil fouling delineation fencing and rail assets	Reinforce delineation fencing to withstand lateral pressure of build-up of pile spoil in instances	Principal Contractor / Piling Contractor
D.2.4	Struck by pressurized concrete or materials during pump / hose blow-out	Develop an effective means of capturing the blow-out ball and containing concrete blow-out material. Fully restrain the end of the hose to prevent whipping during pressurization. Provide a manual pressure release valve to the blowout system to prevent excess pressure build up.	Piling contractor
D.2.5	Contact with surrounding assets / plant / personnel due to Increased slew activity	Services / assets to be removed and de-energised if possible.	Principal Contractor Piling contractor
		Use slew restricting devices, if deemed appropriate.	Piling contractor
		Position the drill rig to minimise the risk of impact within the slew radius (e.g. drilling perpendicular to the obstruction). Establish and maintain clear restricted access/slew zones	Principal Contractor
D.2.6	Fall hazard and hole collapse	Use certified / engineered temporary casing where ground conditions dictate / warrant. Use fall prevention barriers for all open bored pile excavations. Use secure hole covers for all open bored pile excavations.	Piling contractor
D.2.7	Slip hazard or environmental hazard from pumping of groundwater	Pump all pile groundwater directly to a settlement tank.	Piling contractor
D.2.8	Inappropriate location of drilling fluid storage	Establish a designated area for fluid plant.	Principal Contractor

Item	Issue	Consideration	Consult with
D.2.9	Auxiliary line moving	Assess the requirement for using auxiliary lines when reviewing work conditions and activities. Auxiliary winches must always be used in accordance with the piling rig manufacturers operations manual. The auxiliary winch must have an engineered restraint control device, the engineered device is engaged when the line is attached to the rigs stowage point. Two examples: • Auxiliary line is attached to a stowage arm, when the line is inadvertently operated, the stowage arm trips a limit switch which cuts out the winch, • Auxiliary line is attached to a retractable winch that allows the line to feed out when the auxiliary line is inadvertently operated, and • Other devices that can be demonstrated to remove the risk of the auxiliary line being over tensioned are acceptable also. Note: When the auxiliary line is not in use, the piling rig must not be operated unless the auxiliary line is attached to the manufacturer approved and engineered restraint device. • Document the work procedure and risk assessment. • Only lift clearly identified weights with auxiliary lines. • Do not lift loads with unidentified resistance (in-ground casings). *Note: Other engineered devices that can be demonstrated to remove the risk of the auxiliary line being over tensioned can be reviewed and accepted on a case by case basis.* The PFSF has provided recommendations on auxiliary line best practices, see PFSF website www.pilingfederation.org.au for further information.	Piling Contractor / Principal Contractor

D3 Driven Precast / Sheet Piling / Press in Method

Driven Precast/Sheet Piling

Item	Issue	Consideration	Consult with
D.3.1	Pitching precast / sheet piles in close proximity to Rail Corridor / Danger Zone or OHLE	Piling rig to slew away Danger Zone / OHLE when preparing to pitch precast and sheet piles.	Piling Contractor
		Pile lay-down area to be established well clear of Danger Zone / OHLE.	
		Setup piling rig to minimise potential for slewing into Danger Zone / OHLE.	
D.3.2	Making contact with overhead assets and other rail infrastructure	Plan to position the rig to minimise the risk of impact within the slew radius (e.g. piling perpendicular to the obstruction).	Piling Contractor
		Hazards such as services and assets must be removed and de-energised whenever possible.	
		Use slew restricting devices if deemed appropriate.	
		Establish and enforce clear restricted access / slew zones.	
D.3.3	Piling adjacent to energised rail or vehicle traffic	Undertake pre-planning.	All
		Maintain a minimum distance from the nearest energised asset at all times in accordance with Energy Safe Victoria requirements (AC Power) or RTO requirements (OHLE).	
		Include piling risks in Traffic Management Plans.	Piling Contractor
		Use protective gantries / hoarding as an engineering control in all circumstances where it's possible.	
D.3.4	Installation of piles (concrete chips, hydraulic hose burst)	Undertake pre-site establishment and recorded inspection of hydraulic hoses. Visual checks to then be undertaken daily.	Piling Contractor
		Establish and maintain clear restricted access/slew zones.	
D.3.5	Ground heave and movement of the rail track due to vibration	Pre-drill, if required or applicable.	Piling Contractor
		Establish and monitor track movement	
D.3.6	Excessive noise	Subject to project location and specifics, undertake works during day shift only.	Piling Contractor
		Make sure that appropriate hearing protection is worn by all personnel, including non-piling specific personnel.	All
		Provide advanced notice to the public and local councils of the commencement of works.	Principal Contractor

Driven Precast/Sheet Piling

Item	Issue	Consideration	Consult with
D.3.7	Auxiliary line moving	Assess the requirement for using auxiliary lines when reviewing work conditions and activities. Auxiliary winches must always be used in accordance with the piling rig manufacturers operations manual. The auxiliary winch must have an engineered restraint control device, the engineered device is engaged when the line is attached to the rigs stowage point. Two examples: • Auxiliary line is attached to a stowage arm, when the line is inadvertently operated, the stowage arm trips a limit switch which cuts out the winch, • Auxiliary line is attached to a retractable winch that allows the line to feed out when the auxiliary line is inadvertently operated, and • Other devices that can be demonstrated to remove the risk of the auxiliary line being over tensioned are acceptable also. Note: When the auxiliary line is not in use, the piling rig must not be *operated unless the auxiliary line is attached to the manufacturer approved and engineered restraint device.* • Document the work procedure and risk assessment. • Only lift clearly identified weights with auxiliary lines. • Do not lift loads with unidentified resistance (in-ground casings). *Note: Other engineered devices that can be demonstrated to remove the risk of the auxiliary line being over tensioned can be reviewed and accepted on a case by case basis.* The PFSF has provided recommendations on auxiliary line best practices, see PFSF website www.pilingfederation.org.au for further information.	Piling Contractor / Principal Contractor

D4 Soil Nail and Anchoring

Soil Nail and Anchoring

Item	Issue	Consideration	Consult with
D.4.1	Contact with overhead and lateral assets and rail infrastructure	Plan to position the rig to minimise the risk of impact within the slew radius. Hazards such as services and assets must be removed and de-energised whenever possible.	Principal Contractor
		Use slew restricting devices if deemed appropriate. Establish and enforce clear restricted access / slew zones.	Piling contractor
D.4.2	Drilling adjacent to OHLE	Determine the SAD in consultation with the RTO Rail Safety Manager. A separation distance of 6.4 metres must be maintained at all times unless agreed otherwise.	Principal Contractor, Piling Contractor and RTO Rail Safety Manager
	Drilling adjacent to vehicle traffic	Traffic Management Plan to include controls for drilling hazards, with specific consideration of the length of element to be installed (e.g. should couplers be considered to reduce total supplied length of soil nail prior to installation). Use protective gantries and hoarding in all circumstances.	Principal Contractor
D.4.3	A burst hydraulic hose during the drilling of soil nails / anchors	Undertake and record pre-site establishment inspections of hydraulic hoses	Piling Contractor
		Establish and maintain clear restricted access / slew zones.	
D.4.4	Dislodged material falling on equipment or personnel during drilling of soil nails / anchors	Inspect batters prior to commencement to assess whether scaling with excavator is required.	Principal Contractor
		Establish and maintain clear restricted access / slew zones.	Piling contractor
D.4.5	Personnel being crushed or falling from height while installing soil nails / anchors at height	Assess suitability of access for EWP / boom lifts in Rail Corridor.	Principal Contractor
		Ensure that only suitably qualified personnel operate EWP / boom lifts. Ensure there is a Spotter on the ground at all times.	Piling contractor
		Ensures harness is fit for purpose and meets the relevant standards.	
D.4.6	Excessive noise e.g. works near operating railway station	Subject to project location and other project specifics, undertake works during day shift only. Provide advanced notice to the public and local councils of the commencement of works.	Principal Contractor
		Make sure that appropriate hearing protection is worn by all personnel, including non-piling specific personnel.	All

Soil Nail and Anchoring

Item	Issue	Consideration	Consult with
D.4.7	Auxiliary line moving	Assess the requirement for using auxiliary lines when reviewing work conditions and activities. Auxiliary winches must always be used in accordance with the piling rig manufacturers operations manual. The auxiliary winch must have an engineered restraint control device, the engineered device is engaged when the line is attached to the rigs stowage point. Two examples: • Auxiliary line is attached to a stowage arm, when the line is inadvertently operated, the stowage arm trips a limit switch which cuts out the winch, • Auxiliary line is attached to a retractable winch that allows the line to feed out when the auxiliary line is inadvertently operated, and • Other devices that can be demonstrated to remove the risk of the auxiliary line being over tensioned are acceptable also. Note: When the auxiliary line is not in use, the piling rig must not be operated unless the auxiliary line is attached to the manufacturer approved and engineered restraint device. • Document the work procedure and risk assessment. • Only lift clearly identified weights with auxiliary lines. • Do not lift loads with unidentified resistance (in-ground casings). Note: Other engineered devices that can be demonstrated to remove the risk of the auxiliary line being over tensioned can be reviewed and accepted on a case by case basis. The PFSF has provided recommendations on auxiliary line best practices, see PFSF website www.pilingfederation.org.au for further information.	Piling Contractor / Principal Contractor

Appendix E – Case Studies

Case Study 1. Piling Rig Induced Voltage

Figure 1 – Location of Pile ri (left towards OHLE)

Figure 2 – Pile Rig Ground Marker Proximity Sensor Retrofit (post incident)

What was the activity?

Open hole bored piling being conducted approximately 4200mm from 22KV powerline under Asset owner approved permit.

What went wrong?

A piling rig slewed into the "No Go" Zone (approximately 1.5m past permit conditions) before slewing away from the OHLE. A discharge of induced voltage from the 22KV OHLE to the rig to the ground was observed by two personnel. The approved permit included a line auto reclose (i.e. suppression) with full isolation not possible. An Energy Safe Victoria qualified Electrical Spotter was in place but spotting more than one item of plant at the time of the event.

What was the Actual or Potential Consequence?

Actual – no injury or damage to people, piling rig required major repair

Potential – electric shock / electrocution of operator or those on the ground in proximity to the rig.

Investigation determined:

Key Contributing Factors	Key Corrective Actions
• Planning identified that full isolation of the 22KV asset was not possible. • "No Go" Zone identification and controls to eliminate contact with overhead assets need to be effective. • Energy Safe Victoria authorised Electrical Spotters must only spot for one item of plant at any one time.	• Piling rig controls need to challenge industry standards/ norms around implementation of high voltage isolations. • Identification markers need to provide a clear indication of "No Go" Zone to both operator and spotter. • Where practicable, plant slewing isolators or other controls should be considered. *Note: The pile rig involved in the incident was retro fitted with additional operator proximity sensors to assist in operating with a "No Go" Zone indication.* • Project procedures and the verification of spotter competencies need to be effective. • Where multiple plant is used, adequate spotter resources need to be identified. • Procedures must call for cessation of works where spotters are required to leave the immediate area.

Case Study 2. Piling Rig Lifting Equipment Contacts OHLE

Failed pile casing lifting points

Piling rig with chains connected to auxiliary hoist rope wrapped around the overhead wires

What was the activity?

Installation of a pile casing via a piling rigs auxiliary hoist cable.

What went wrong?

As the casing became caught during the installation process, it was lifted up and dropped down multiple times to progress past the snag point. The lifting points on the casing failed and the lifting chains subsequently swung out towards the adjacent rail overheads, resulting in them wrapping around the rail overhead wires.

What was the Actual or Potential Consequence?

Actual – no injury or damage to people, piling rig required major repair.

Potential – electric shock / electrocution of operator or those on the ground in proximity to the rig.

Investigation determined:

Key Contributing Factors	Key Corrective Actions
• The pile installation required the use of a non-standard casing to create a void alongside the pile when installed. • Design of the casing was changed prior to arriving on site and works commencing and the installation methodology of the casing changed without a formal change management process being implemented or a review against Fatal and Severe Risks Standard. • Lifting points in the casing were not engineered, however they were found to be sufficient for the lifting and installing process post incident. • Piling hole diameter was inadequate for casing to be easily installed. • Repeated lifting strain on the casing resulted in shear failure of both the lifting points during lifting of the casing.	• Lessons learnt to be developed on the investigation outcomes, including lessons on the importance of formal change management reviews and the implementation of the Fatal and Severe Risks before work commences. • Detailed inspection / assessment of the piling rig and associated lifting equipment must been completed. • An engineered design to be provided for all lifting points. • Methodology, Work Pack, Lifting Operations Plan and SWMS to be updated and include process for re-reaming hole if casing does not initially fit. • Piling Rig operations to be raised at the Joint Co-ordination Committee Safety Sub-Committee to run an industry forum to investigate potential improvements to the piling industry.

Case Study 3. Concrete Pump Hose Failure

Failure of hose

Trajectory of sprayed aggregate (blue arrow)
Windscreen that was shattered (red circle)

What was the activity?

Concrete pumping for CFA Piling.

What went wrong?

Failure of steel-reinforced rubber hose connecting concrete pump to CFA Piling Rig.

What was the Actual or Potential Consequence?

Actual

Small quantity of concrete product (aggregate) sprayed 35 metres across the Rail Corridor / Station Platform.

The aggregate shattered the rear windscreen of a private vehicle in the Station car park, the roof screen and bottom glass door panel of the Piling Rig Operator's cabin.

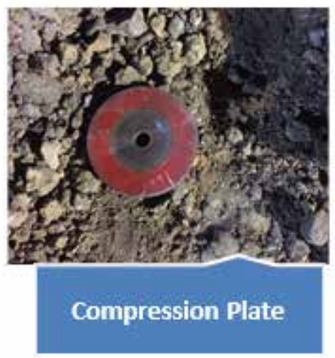
Potential

There was the potential to hit a train, persons, etc which would result in personal injury or property damage to rolling stock..

Investigation determined:

Key Contributing Factors	Key Corrective Actions
• "Rough" handing practices of hoses (e.g. constant movement, flexing, interchange between rigs, lack of protection during use). • Ineffective routine maintenance and inspection regime of hoses (e.g. poor tracking of hose usage - hours or cubic metres of concrete pumped through them, no unique hose identification). • Ineffective daily inspection by site crews. • Lack of company inspection / auditing of equipment maintenance implementation.	Investigate engineering controls to prevent damage and / or mitigate effects of hose failure, for example: • A protective "sock" designed to prevent aggregate spray in the event of failure; and • Support of hoses during use (e.g. sitting hose on tyres). Implement existing company hose management procedures that have not been effectively implemented. This includes: • Providing each hose with unique ID numbers; • Tracking hours of use closely; • Regular daily and periodic inspections; and • Hoses assigned to rigs and not moved from rig to rig.

Case Study 4. Wire Rope Failure - Sheet Pile Rig



What was the activity?

Sheet piling for the ground water sump.

What went wrong?

Sheet pile became jammed within the clutch of the adjoining sheet during the initial pitching process. The operator of the piling rig attempted to lift free the jammed sheet pile, by doing so the winch wire rope failed (i.e. it snapped) resulting in the compression plate / wire rope assembly falling 12 metres to the ground within an exclusion zone.

What was the Actual or Potential Consequence?

- Actual Consequence – Unsafe condition, falling object, no personnel in the vicinity, no injuries sustained.
- Potential Consequence – Serious injury to personnel below.

Investigation determined:

Key Contributing Factors	Key Corrective Actions	Other Factors that may have contributed to the failure
• Wire rope failed due to load being applied that exceeded the wire's breaking strength. • Safe system of work not recognised to mitigate risk with freeing sheet piles that became jammed / obstructed. • Inspection of winch rope did not identify potential damage to the wire rope at the base of the aluminium ferrule.	• Incident area and Sheet Pile Rig isolated and removed from site for inspection. • Damaged Sheet Pile Rig was tagged out of service pending the investigation. • Contractor Inspected the winch ropes on other Sheet Pile Rig, by competent person to confirm condition of ropes and thimble's. • Contractor Task Risk Assessment was reviewed and updated to reflect the change in methodology to pitch the sheet pile with a crane. • Contractor ceased all other Sheet Piling Rig operations until sheet piles are clutched with a crane or use of T-Chain system.	• Localised mechanical damage to the rope adjacent to the failure point and placed load on the remaining intact strands resulting in their failure. • The size of the aluminium ferrule (an incorrect sized ferrule can lead to over-pressing the rope and result in a loss of breaking force). This type of failure results in the strands failing inside the ferrule.

Case Study 5. Continuous Flight Auger (CFA) Piling Incidents

Auxiliary Cable Damage 478

Auxiliary line & Hambone Fitting 482

What was the activity?

CFA piling works.

What went wrong?

On the first day, the Piling Rig auxiliary winch line was severed due to entanglement in the drive motor, which caused the winch assembly to fall into a barricaded exclusion zone. The subcontractor reviewed the method of stowing the auxiliary winch post incident resulting in the winch temporarily being stored at ground level prior to permanent removal from the rig as it was no longer required to support piling operations.

On the second day, the Piling Rig was preparing to track backwards. The operator began to 'boom up' the mast, when the end of the auxiliary line and Hambone fitting became snagged on the Auger cleaner. This tensioned the cable, which released causing the cable to rise upward and projected outward striking a nearby residential house.

What was the Actual or Potential Consequence?

- 1st day - Actual Consequence: Fall From height near miss. Potential Consequence: Personal injury and property damage.
- 2nd day - Actual Consequence: Minor property damage. Potential Consequence: Personal injury.

Investigation determined:

Key Contributing Factors	Key Corrective Actions
• Day 1 – Risk assessment failed to identify winch rope entanglement. • Day 2 – Hook was not secured resulting in auxiliary line becoming slack and entangled. • Redundant equipment involved in previous incident not removed prior to commencing works. • Day 2 – Changes to work method operations for all Piling Rigs were made prior to the finalisation of the previous incident report. • Day 2 – Changes to SWMS following the incident on the Day 1 were made without the application of any management of change process.	• Update Risk Register to include additional hazards now identified. • Removal of redundant equipment from CFA piling rig. • Decommission Auxiliary Winch on all CFA rigs on the project. • Independent Mechanical Check. • Management of change process amended. • CFA Operational SWMS review and verification. • Verification of competency.

Case Study 6. - Service Winch Cable Failure

What was the activity?

Drilling as part of piling activities with use of 45t excavator with low drilling attachment.

What went wrong?

During drilling activities, the latch of the auxiliary hook failed. This resulted in the tongue of the hook opening and the hook separating from the 'D' shackle connected to the winch limit switch. Due to the separation of the hook there was no longer pressure on the service winch limit switch. The winch retracted due to the operator crowding down on the mast, raising the wire rope. The hook assembly while retracting could not pass through the head block, resulting in the wire rope being stretched until the wire rope from the service winch broke. The hook assembly (hook, swivel and hambone) fell approximately 6 meters to the ground.

What was the Actual or Potential Consequence?

- Actual Consequence: The hook assembly fell and brushed the shoulder of a worker, before hitting the ground.
- Potential Consequence: Serious injury or death to persons.

Investigation determined:

Key Contributing Factors	Key Corrective Actions
• SWMS didn't include working close to machine or the risk of falling objects. • Plant assessment didn't identify the risk of materials / equipment falling from height. • Operator did not check hook as part of daily prestart. • Operator did not perform daily inspection on night shift. • Plant daily checklist did not specifically look at safety latch operation.	• SWMS modified to include hazard / controls around off-sets and the need to be inside the exclusion zone. • Plant risk assessment reviewed to include risks of items falling from height (e.g. wire rope and hook assembly). • Toolbox talk to cover the need to complete a full Plant Maintenance & Safety Checklist and ensuring that the checklists completed and documented each shift. • Developed schedule of inspections and observations. • Investigate feasibility of additional engineering failsafe controls regarding winch rope security. • Review machine record keeping procedure to clarify lifting gear to be inspected. • Remove the hooks from service winch and replace with D-shackle.

Case Study 7. – Gas Strike Incident

What was the activity?

CFA piling works at a level crossing.

What went wrong?

- CFA Piling Rig struck a 150mm low pressure gas line in a steel sleeve.

What was the Actual or Potential Consequence?

Actual

- Emergency Services took control of the scene, surrounding businesses were evacuated for a short period.
- Trains were delayed for 150 minutes until the asset was repaired.
- Emergency Services were required due to uncertainty of ignition sources in the public domain and extent of release being unquantifiable.

Investigation determined:

Key Contributing Factors	Key Corrective Actions
• Underground gas asset struck was not on either the Dial Before You Dig (DBYD) asset owner issued drawings. • Multinet drawing did reference a further drawing showing the asset which was struck. • Reference on asset owner drawing was not identified by asset team and referenced drawing not requested. • Service detailed on DBYD / asset owner drawings received was a NB 150mm low pressure Cast Iron Gas main, which was plated prior to piling. This pipeline was confirmed redundant post incident. • Asset struck ran adjacent to the service which was proved, plated and later found to be redundant.	• Establishment of a workgroup to review current Ground Penetrating Permit (GPP) process with an intention to simplify. • Development of a standard template for recording of assets identified. • Implementation of significant hold point within revised GPP document to ensure review and sign off on all documentation by Permit Controller. • Establishment of a custodian of the overall issuing and execution of the GPP, with an initial focus on Section 3 to ensure all Asset and Services information has been accurately reviewed and is current. • Consolidation of existing information captured by Services Team into Geographic Information System.

Case Study 8. – Fall of Person, pile excavation

What was the activity?

Bored piles for the installed power sub-station at a Stabling Yard was being covered with hardwood timber pallets.

What went wrong?

- Worker lifted a pallet to use to cover another pile hole and did not identify the presence of a pile hole under the pallet.
- Strong gust of wind caught the pallet causing the worker to unbalance and subsequently fall into the unprotected pile hole feet first.
- The pallet dropped back over the pile hole.

What was the Actual or Potential Consequence?

Actual

- Off balance worker fell down uncovered pile hole.
- The pallet dropped back over the pile hole.
- Two nearby workers pulled the worker from the hole immediately with no sustained injuries.

Investigation determined:

Key Contributing Factors	Key Corrective Actions
• The subcontractor was using a SWMS for the task (Excavations) which did not include bored piling work. • Engineered pile hole guard / cover or barricade was not used to protect or indicate open bored pile holes. • Extreme inclement weather (i.e. high winds).	• Controls outlined in the Principal Contractor Construction Risk Register to be transferred into all subsequent documentation (i.e. SWMS). • Engineered fall protection barricading to be installed and maintained throughout piling operations. • Works must not commence without approved SWMS, especially High Risk Works.

Appendix E – Legal Resources and Other Documents

This Industry Guideline provides information to assist duty holders in the piling and foundation industry to provide and maintain safe workplaces and achieve a minimum level of health and safety compliance. An alternative method may be followed if it achieves an equivalent or higher level of OHS. Where the word 'must' is used, the guidance is expected to be followed, so far as is reasonably practicable.

The key legislation specific to conducting work in the Rail Corridor is outlined below:

- Occupational Health and Safety Act 2004 (Vic);
- Occupational Health and Safety Regulations 2017 (Vic);
- Rail Safety (Local Operations) Act 2006 (Vic);
- Rail Safety Law National Regulations 2012;
- Rail Safety National Law (South Australia) Act 2012; and
- Electricity Safety (Installations) Regulations 2009 (Vic).

The key guidelines specific to conducting work in the Rail Corridor is outlined below:

- Victorian Framework for Undertaking Work near Overhead and Underground Assets; June 2006: http://electricalspotter.com.au/resources/framework_overhead_underground.pdf
- WorkSafe Victoria Excavation Compliance Code – Edition 1 May 2018: https://www.worksafe.vic.gov.au/resources/compliance-code-excavation
- National Standard for Health Assessments of Rail Safety Workers – 2nd Edition 2012: https://www.ntc.gov.au/Media/Reports/(7B079897-1863-CA93-474F-AD96AD9C6C3F).pdf
- Metro Trains' 'Train Electrical Safety Rules 2012';
- Book of Rules and Operating Procedures - 1994, Public Transport Corporation;
- L0-SQE-PRO-014 - Safety & Environmental Requirements for Third Parties Working on MTM Premises;
- Code of Practice for Safe Electrical Work – Energy Safe Victoria: https://www.esv.vic.gov.au/technical-information/electrical-installations-and-infrastructure/the-blue-book/;
- Code of Practice for the defined Interstate Rail Network; and
- TS-SP-015_V02_R3 VicTrack 'Telecommunications Network Protection Plan'.

Go to the relevant RTO websites and search for 'Operating Procedures' or similar to locate relevant documents.

The following non-rail specific piling documents should also be reviewed:

- WorkSafe Victoria, Industry Standard, A Guide to Managing Safety, Piling work and foundation engineering sites, Edition 1, January 2014 - http://piling federation.org.au/wp-content/uploads/2017/08/Piling -Works-Industry-Standard.pdf.
- WorkSafe Victoria, Compliance Code : Plant, Edition 1, March 2018 - https://www.worksafe.vic.gov.au/resources/compliance-code-plant.
- WorkSafe Victoria, Industry standard, Concrete pumping, April 2004 - https://www.worksafe.vic.gov.au/resources/industry-standard-concrete-pumping.
- WorkSafe Victoria, Working safely in the general construction industry, Edition 1, February 2008 - https://www.worksafe.vic.gov.au/resources/working-safely-general-construction-industry-handbook-construction-regulations.
- WorkSafe Victoria, Using earthmoving equipment near overhead electrical assets, Edition 1, December 2009 - https://www.worksafe.vic.gov.au/resources/using-earthmoving-equipment-near-overheard-electrical-assets.
- Piling and Foundation Specialists Federation information, working platforms for tracked plant: good practice guide to the design, installation, maintenance and repair of ground supported working platforms.