GUIDELINE

GUIDELINE TO DESIGNING, CONSTRUCTING AND OPERATING AROUND THE EXISTING AS4645 NATURAL GAS NETWORK

GAS-9899-GL-CN-001

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AUTHORISATION

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OWNING FUNCTIONAL GROUP & DEPARTMENT / TEAM

Gas Distribution : Asset Management

REVIEW DETAILS

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1 INTRODUCTION

1.1 GAS NETWORKS AND MANAGING RISK

Jemena operates and maintains gas distribution networks throughout NSW and ACT. These networks operate at gas pressures ranging from 2kPa to 1050kPa. Failure to follow the guidelines listed in this document may lead to damage to these gas distribution networks, resulting in Catastrophic consequences, loss of life, and major damage to property and infrastructure as well as loss of gas supply to thousands of gas consumers.

To manage the risk of damage to gas networks from construction activity, Jemena participates in the Before You Dig Australia (Visit: www.byda.com.au) system and provides information to Third Parties planning to perform work around Jemena networks. Our Secondary and Critical gas mains are continuously patrolled via ground patrol, and monitored 24/7 by a Control System.

To make an encroachment enquiry for any work potentially near a gas main, the first step is to lodge a BYDA enquiry. If the BYDA enquiry identifies work near a Jemena asset, you will be issued with a response document by the BYDA system. This response document will provide detail on the process to proceed.

For Jemena Gas Networks (NSW) and EVO Energy Network (ACT) assets, this next step will be to book a Jemena Representative to attend site and to review the proposed work. Depending on the complexity of the job, this may result in further detail being required by Jemena before the proposed work can proceed. To progress this step, an enquiry must be registered via the Jemena Gas Portal located at the following address:

myportal.jemena.com.au

For the remainder of Jemena's gas assets, the process to proceed with Jemena assessment and approval of your proposed work is to review the response document. A Jemena representative will then make contact regarding your proposed work, however, if this contact is not received, the Third Party is not authorised to undertake any work and written Jemena consent must be sought by contacting the appropriate Jemena representative listed on the BYDA response.

1.2 PURPOSE

This document has been developed to provide general guidelines to assist the Third Party in their design/construction proposal prior to submitting it to Jemena for review.

This document does NOT authorise the Third Party to carry out any construction activities unless the design/construction proposal has been reviewed, assessed and accepted by Jemena.

1.3 SCOPE

This document shall be limited to AS/NZS 4645 assets (mains, services, and district regulator sets with an operating pressure ≤1050kPa).

For AS/NZS 2885 assets (>1050kPa), please refer to GAS-960-GL-PL-001 – Designing, Constructing and Operating Assets Near Jemena Gas Pipelines.

For Boundary Regulator Sets, Meter Sets, and services within properties, with an operating pressure ≤400kPa, please refer to the Jemena Network Operator Rules.

1.4 TERMS & DEFINITIONS

Term	Definition
Compaction	Backfilling and compaction of pipe in accordance with Jemena's requirements.
Concrete capping	A physical protection measure made of concrete placed above the gas asset, applied when normal depths of cover cannot be achieved.
Concrete slab	A concrete surface layer, e.g. Driveway, footpath, roadway.
CP	Cathodic Protection
Critical Main	A gas main that is a single source of supply to a large number of gas customers.
BYDA	Before You Dig Australia
DRS	District Regulator Set
Easement	An easement is a form of tenure that is acquired by Jemena to provide protection to its high pressure gas assets. Easements give Jemena the right to use the land for operating its assets and include mandatory requirements for any landholder and third party undertaking work on, over or near the easement.
EvoEnergy Gas Network	A Gas Distribution Network operated by Jemena in Nowra and the Australian Capital Territory (and surrounds)
Encroachment	Any design or construction activity and changes in operating condition that may impact on the integrity of the pipeline.
Gas Main	A Jemena owned/operated natural gas pipeline that operates between 2 kPa and 1050 kPa pressure.
HDD	Horizontal Directional Drilling
High pressure gas main	A gas main with a pressure of 1050 kPa or greater which includes Secondary, Primary and Trunk mains, or that has been identified as high risk.
High Voltage	Voltage that is greater than or equal to 11 kV
Jemena Pipeline (AS2885 pipeline)	A Jemena owned/operated natural gas pipeline that operates above 1050 kPa pressure.
Jemena Representative/Standby	An individual who has been authorised by Jemena as having undertaken the appropriate training and meets the competency requirements. A Jemena Representative will be present on site while third party work is undertaken and will issue the Third Party Works Notice prior to commencement of this work.
Low Pressure Main	A gas main that operates at a pressure no greater than 7kPa.

Term	Definition
MAOP	Maximum Allowable Operating Pressure
Medium Pressure Main	A gas main that operates at pressures between 30kPa and 400kPa.
NAPTHA main	An isolated Jemena owned asset that shall be treated as a Jemena Secondary Main
PE Slabbing	A layer of polyethene material approved as a procedural and physical protection measure for gas mains
PPE	Personal Protective Equipment
Road Reserves	Road Reserves are as defined by the relevant states Land Act and typically include footpath, stormwater drains, roadways, median strips, bus lanes and cycleways.
Secondary Main	A gas main that operates at a pressure of 1050kPa.
Shall	Designates a mandatory action
SWMS	Safe Work Method Statement
TfNSW	Transport for New South Wales
Third Party	Developer, Builder, Owner, Contractor or Customer planning or conducting works in the vicinity of Jemena Gas Networks.
Work site	The location of the intended work that the requestor is requesting a standby for.

1.5 REFERENCE DOCUMENTS

- AS/NZS 4645 (Series) Gas Distribution Networks
- AS 2885 (Series) Pipelines - Gas and liquid petroleum
- AS 4853 Electrical hazards on metallic pipelines

1.6 EMERGENCY CONTACT DETAILS

For faults and emergencies only:

- Jemena Gas Network (NSW) / EVO Energy Distribution (NSW/ACT) **132 909**

2 DUTY OF CARE FOR WORKING AROUND JEMENA GAS NETWORKS

Working near gas mains is extremely dangerous if appropriate controls are not introduced and followed. You should always exercise due care and caution when working near any gas infrastructure. In addition to your general duty of care, there may be other obligations under relevant state legislations which require you to maintain safe practices.

Due care **must** be exercised at all times to ensure there is no damage to any Jemena gas main, gas service, regulator set, asset (marker post, fencing, structure), or land.

Any damage shall be reported to Jemena immediately (see SECTION 1.6 for emergency contact numbers).

On the Jemena Gas Network, a Jemena Standby is required when working within 3m of a:

- Secondary main, or
- Critical gas main, or
- District Regulator Set, or
- Naptha main

To book a Jemena Standby for the Jemena Gas Network, please go to myportal.jemena.com.au, Select a “New Application” / “Gas Mains” / “High Pressure Standby Service”.

On the EvoEnergy Gas Network, a Jemena Standby is required when working within 3m of a:

- Secondary main, or
- Medium pressure gas main with a diameter of 75mm or greater, or
- District Regulator Set

Please note, to book a Jemena Standby / Representative on the EvoEnergy Gas Network, please call **1300 503 237** only.

3 APPROVAL PROCESS

3.1 JEMENA GAS PORTAL

The Third Party shall contact Jemena via the Jemena Customer Portal, myportal.jemena.com.au when:

a) works are proposed within 3m of a Secondary or Critical main, or
b) proposed works will encroach within 500mm of a Medium or Low pressure main, or
c) there are proposed changes to the depth of cover over Jemena assets, or
d) High Voltage (HV) cables are proposed to be installed within **5m** of a steel main, or
e) Extra High Voltage (EHV) cables are proposed to be installed within 20m of a steel main
f) Vibration activity as per section 4.17.
g) Proposed tree canopy will encroach the gas main alignment in its full maturity.
h) There are proposed changes to the ground conditions. For e.g from non-trafficable to trafficable.

A site meeting may also be requested via the Jemena Customer Portal.

If it is determined that the proposed design/work is a **Standard Encroachment**, a discussion and an agreement of the next step will be undertaken to ensure a Jemena Representative/Standby will be available to oversee that the works are undertaken.

If the proposed design/construction does not meet the minimum requirements of this document, then it is considered a **Non Standard Encroachment**. The Third Party may be required to submit their plans to the Jemena Portal, raising a New Gas Application, and selecting Gas Mains, then Encroachments in order for the works to be reviewed. Please note, that there is a fee associated for Non Standard Encroachment reviews.

3.2 JEMENA ENGINEERING REVIEW

If a review of the proposed design/construction is required, the third party shall provide the following information via a New Gas Application in Jemena's Gas Portal for review:

a) Scope/Description of the project impacting on Jemena's assets
b) Site layout drawings which shall include the following:
    i. The location/address of the proposed work.
    ii. Existing and proposed depth of cover
c) Design drawings which shall include the following:
    i. Plan drawings showing the location of Jemena's assets and the proposed works, including horizontal separation distances;
    ii. Cross sectional drawings showing the vertical separation distances as well as existing and proposed depths of cover over Jemena's assets.
    iii. Proposed pavement details where applicable;
d) Size of plant or equipment to be used;
e) Electrical Hazard Assessment in accordance with AS/NZS 4853 for any HV works.

Additional information may be requested as required.

4 GENERAL PRINCIPLES FOR CONSTRUCTION ACTIVITIES

Unless stipulated by Jemena Engineering, the following principles are to be followed.

4.1 ROAD RESERVES AND PARK LAND

Where the gas assets are in road reserves and park lands, the TfNSW or Council are required to notify Jemena when construction works are proposed.

Gas mains shall cross roads at or close to a right angle.

4.2 CONSTRUCTION VEHICLES CROSSING GAS ASSETS

a) Where the minimum depth of cover over a gas asset is 600mm from the top of a sealed area (eg. road/driveway) to top of pipe to of a gas main/service, the acceptable load for vehicles or plant crossing over gas assets is 8 tonnes/axle.
b) Where any construction vehicle crosses a gas main in an unsealed area (e.g. footpaths, park land, road works etc.), the location and depth of the gas main shall be confirmed. All information (ie. depth, weight of vehicle, protection measures, etc.) shall be sent to Jemena Engineering for review.
c) Where a crane needs to set up over a gas main, the location and depth of the gas main shall be confirmed. All information (ie. depth, weight of vehicle, protection measures, etc.) shall be sent to Jemena Engineering for review.
d) Heavy construction vehicles must cross over gas assets **only** at designated locations at right angles.

4.3 EXCAVATION

a) Where a construction activity is required within 3m of a secondary or critical main, a Jemena Standby/Representative shall be present. Excavation shall not commence until the Jemena Standby/Representative is present.
b) If the excavator is greater than a 20 tonne class machine, advice must be sought from Jemena Engineering (via the Gas Portal Application).
c) Ensure the locations of all third party assets have been clearly identified and marked.
d) Locating of the gas mains shall be performed via potholing. Where potholing of a Secondary or critical main is required, a Jemena Standby/Representative shall be present.
e) If a valve is identified at the location, gauges points are likely to be present approximately one metre either side of the centreline of the valve. Gas marker stones may or may not be present at the valve. Hand excavation shall be carried out to locate the valve and gauge points. Note, all valves 200mm or greater are offset to the centreline of the main, but gauge points will still be on the centreline of the main.
f) If syphon risers are identified at the location, gas marker stones may or may not be present at the riser. Hand excavation shall be carried out to locate the riser.
g) Where the excavation is carried out near the gas asset using an excavator, the excavator shall use a toothless (gummy) or mud bucket.
h) If permissible, use HydroVac equipment to positively and visually identify the gas main location and depth along the proposed excavation area, measure the depth and mark the centreline on the ground. Refer to Appendix 7.1 for water pressure limits. AirVac may also be permissible, subject to Jemena approval.

i) No mechanical excavation is permitted within 600mm of a gas main, unless permission has been given by Jemena Engineering or a Jemena Standby/Representative.
j) No piling or augers shall be within 1m of the gas main unless permission has been given by Jemena Engineering or a Jemena Standby/Representative. Continuous vibration monitoring shall be required for any auger or piling works within 5m of a gas main.
k) If the gas asset is going to be exposed for more than one day, physical protection methods shall be used such as:
    i. Hessian
    ii. Rock shield
    iii. Sand or sand bags
    iv. Steel road plates
    v. Site fencing or barriers

4.4 STOCKPILING

The third party shall **not** stockpile machinery, construction, or waste materials directly over gas assets, or within three metres of the gas asset without obtaining Jemena approval.

4.5 SEPARATION DISTANCES

The following minimum separation distances shall be maintained between the gas asset and other services. If these requirements cannot be met, then the proposed design shall be sent to Jemena Engineering via the Jemena Gas Portal Encroachments Application for an Engineering assessment.

4.5.1 UTILITIES

4.5.1.1 Trenching (Open Cut)

Unless otherwise stated, the following minimum separation distances shall apply to both horizontal and vertical separation between a gas asset and another utility:

a) When possible and within reason, other utilities shall cross underneath gas mains.
b) From Secondary and medium pressure steel mains that are 150mm or smaller in diameter:
    i. 300mm when parallel or crossing over the gas asset.
    ii. 500mm when crossing under the gas asset.
c) 500mm from Secondary and medium pressure steel mains that are 200mm or greater in diameter.
d) 300mm from low and medium pressure plastic mains.
e) 500mm from DRSs.
f) 500mm between steel mains and any electrical cables. In addition, for High Voltage electrical cables (≥11kV), an Electrical Hazard Assessment as per AS/NZS 4853 shall be prepared by Third Party and forwarded to Jemena Engineering for review and acceptance. Refer to Section 4.6.
g) For Extra High Voltage electrical cables (≥100kV) near steel gas mains, 4000mm horizontal separation when in parallel, and 1500mm vertical separation when crossing the gas main. In addition an Electrical Hazard Assessment as per AS/NZS 4853 shall be prepared by Third Party and forwarded to Jemena Engineering for review and acceptance. Refer to Section 4.6.
h) 500mm from Thermal Stabilising Backfill (TSB).
i) 300mm from Stabilised Sand

4.5.1.2 Trenchless (Horizontal Direction drill, Horizontal Bore, etc)

If a trenchless activity is proposed to be carried out near or across gas assets, the Jemena representative shall discuss with the Third Party the following details:

a) Drill path profile
b) Depth of drill under the gas assets
c) Separation distance between the new service and the existing gas assets
d) Drill head control and monitoring methodology and accuracy
e) Detailed drill location

Once the gas asset is positively identified and before drilling commences, a slit trench must be excavated parallel to the gas asset on the side from which the drill is approaching to a depth of 500mm below the bottom of gas asset to prove the drill head will not encroach near it. If possible, the slit trench must be one metre away from the gas asset. In addition, physical barriers such as steel plates may be installed down the side of the gas asset to ensure the drilling machinery does not come close to or damage the gas asset and provides the Jemena representative an opportunity to stop works if necessary.

If directional drill activity is proposed to be carried out parallel to gas assets, the gas asset shall be positively identified before drilling commences and the drill path shall be no closer than one metre from the side of the gas asset. Where a one metre separation cannot be kept, Jemena Engineering/Management must be contacted to assess the proposed drill path.

4.5.2 STRUCTURES

Buildings shall be at least 1000mm from any gas main. Other structures, including stormwater pits, shall be at least 500mm from any gas main. Structures shall not be built over gas mains. If these requirements cannot be met, then the proposed design is to be submitted for review via the Jemena Gas Portal Encroachments Application.

Electrical substations shall be at least 3000mm from any steel gas main. In addition an Electrical Hazard Assessment as per AS/NZS 4853 shall be prepared by Third Party and forwarded to Jemena Engineering for review and acceptance. Refer to Section 4.6.

4.6 HIGH VOLTAGE ELECTRICAL INSTALLATION

For any High Voltage Electrical installation, defined as voltage above 10kV, the Electricity Asset Owner or representative shall perform an Electrical Hazard Assessment study on Jemena's steel mains in accordance with the latest version of AS/NZS 4853 (Electrical Hazards on Metallic Pipelines). The study shall be completed by a certified practitioner. The types of electrical hazards that need to be covered are as follows:

- Low frequency induction (LFI);
- Earth potential rise (EPR);
- EPR due to lightning current;
- Capacitive coupling on the pipeline due to adjacent high voltage power lines; and
- Accidental contact of pipeline with other electrical systems.

This report shall be submitted to Jemena for acceptance prior to implementing any design. The report should clearly state the standards it refers to, e.g. AS/NZS 4853:2012, details of the proposed electrical infrastructure, the hazards that have been assessed, the assessment, findings and

Jemena's pipe details (diameter, length, and distance to nearest pipeline facility where contact by personnel is expected, such as Cathodic Protection Test Points).

For Low Voltage Electrical installation defined as voltage below 10kV, the Electricity Owner or representative shall perform a Level 1 assessment on Jemena's steel mains in accordance with the latest version of AS/NZS 4853 (Electrical Hazards on Metallic Pipelines). The study shall be completed by a certified practitioner.

4.7 ISOLATED MAINS

Some gas assets that do not appear on BYDA may be isolated gas mains. Jemena Engineering shall be contacted for approval if relocation or removal of these assets is required.

4.8 REMOVAL OF CONCRETE CAPPING

If cutting or removal of concrete capping is required, then the activity is to be assessed by Jemena Engineering, which may require a special procedure. All existing gas asset protection methods such as pre-cast or poured concrete slabs shall be retained and/or reinstated.

4.9 GAS MAIN MARKERS

All existing gas asset markers shall be retained and/or reinstated. Where gas main markers are affected by construction works, they shall be re-located by Jemena (costs shall be paid by the third party). Additional gas main markers shall be installed at gas asset crossings for all new services or roads.

4.10 CP TEST POINTS, CP GROUND BEDS, CP CABLES AND KIOSKS

Where any CP assets are affected by construction works, all existing CP assets and equipment shall be retained, relocated or reinstated by Jemena and the costs shall be paid by the third party.

Any electrical or earthing works which may affect the CP system must comply with AS/NZS 4853 (Electrical Hazards on Metallic Pipelines) and shall be submitted to Jemena Engineering for review via the Jemena Gas Portal Encroachments Application.

4.11 BLASTING

Blasting is **not allowed within 50m** of Jemena Gas Networks without prior written approval from Jemena.

If the Third Party has a requirement to conduct blasting activities within 50m of Jemena Gas Networks, an engineering review of the design proposal shall be requested from the Third Party.

The following information shall be included in the design package for review:

a. The blasting distance from the pipeline and drawings, map references;
b. Depth of the blast;
c. Shot size (kg);
d. Shot sequence and delay; and

e. Shot strength.
f. Information on Peak Particle Velocity (PPV) and the measures in place during blasting to monitor PPV.

4.12 SUBSIDENCE

Where any ground subsidence is predicted as a result of tunnelling, underground mining, etc, which may impact our gas mains, the risk of subsidence shall be mitigated in accordance with the table in Appendix 7.4. A leakage survey may be required prior to commencement of works to provide a baseline. Regular ground level monitoring will be required during works to highlight any significant changes in height which may result in additional leakage surveys.

4.13 PROLONGED JEMENA PIPELINE EXPOSURE

If the Jemena Pipeline is to be exposed for more than one day, suitable barricades and steel plates shall be installed to ensure the security of the exposed Jemena Pipeline from accidental (construction or vehicle impact) or deliberate damage (vandalism). In addition, the pipeline shall be wrapped in hessian in order to prevent UV damage.

Damage to Jemena Pipeline due to sagging shall be prevented. For any unsupported span of pipe exceeding 6 m, written approval from Jemena will be required.

4.14 DEPTH OF COVER

The minimum depth of cover of a gas main is detailed in the table below. Depth of cover shall not exceed 1500mm. Where there is a proposed change to the existing depth of cover of a gas main, the design shall be sent to Jemena Engineering for review and acceptance.

	Secondary and Critical Mains	**MP and LP Mains (non-critical)**
Arterial roads and their adjacent road reserves	1200mm	1200mm
Other roads	900mm	750mm
Road reserve	900mm	600mm
Railway Reserve (other than under railway)	2000mm	2000mm
Under Railway	Refer to AS4799 – Installation of underground utility services and gas mains within railway boundaries.	

Table 1: Minimum depth of cover for gas mains

4.15 BACKFILLING

The following shall apply when backfilling over our gas mains:

- No stabilised sand, roadbase, or concrete within 300mm of the gas main;
- The gas main shall be in a bed of washed river sand (no recycled material allowed) with a maximum particle size of 2mm with a neutral PH value.

  - For steel mains, the river sand shall extend to a height of 300mm above and below the main, and 300mm either side of the main;
  - For plastic mains, the river sand shall extend to a height of 75mm above and below the main, and 75mm either side of the main;
- Sandbags are not to be used as permanent bedding.

4.16 COMPACTION OVER GAS ASSETS

Compaction shall be in accordance with the diagram in Appendix 7.2.

4.17 VIBRATION

Vibrations from any equipment or processes including vibrating compaction equipment, jack hammers, rock hammers, seismic measuring processes, blasting, etc. are not to exceed the following peak particle velocity readings at the nearest surface of the buried pipeline:

a) 20mm/s for Steel mains.
b) 10mm/s for plastic and cast iron mains.

In the event that such vibrating equipment is to be used close to the pipeline or in blasting operations, suitable trials are to be conducted prior to proceeding with the proposed development to ensure that the stipulated peak particle velocities will not be exceeded.

Suitable vibration monitoring equipment is to be used to record the tests and works as they progress in accordance with agreed procedures with Jemena.

4.18 TREE PLANTING

Any trees proposed to be planted near Jemena's assets shall be in accordance with Appendix 7.3.

4.19 POST CONSTRUCTION PROTECTION MEASURES

All existing Jemena Gas Network's protection measures including but not limited to concrete slabs, marker posts, marker tape and Cathodic Protection Systems shall be retained. Any protection measure that was temporarily removed with Jemena's approval as part of construction is to be reinstated to its original condition post construction.

5 TERMS & DEFINITIONS

Abbreviation	Definition
Compaction	Backfilling and compaction of pipe in accordance with Jemena's requirements.
Concrete capping	A physical protection measure made of concrete placed above the gas asset, applied when normal depths of cover cannot be achieved.

Abbreviation	Definition
Concrete slab	A concrete surface layer, e.g. Driveway, footpath, roadway.
CP	Cathodic Protection
Critical main	A plastic main that has been deemed “critical” due to internal factors. It shall be treated as a secondary main.
BYDA	Before You Dig Australia
DRS	District Regulator Set
Encroachment	An Encroachment is any unauthorised 3rd party activity within three metres of a Secondary main or Critical Medium Pressure main.
Extra High Voltage	Voltage that is greater than or equal to 100 kV
Gas main	All secondary mains, medium pressure mains and low pressure mains covered under AS4645.
HDD	Horizontal Directional Drilling
High pressure gas main	A gas main with a pressure of 1050 kPa or greater which includes Secondary, Primary and Trunk mains, or that has been identified as high risk.
High Voltage	Voltage that is greater than or equal to 11 kV
Jemena Standby/ Representative	A suitably qualified person assigned to carry out a standby on a Secondary or critical medium pressure main. This includes Secondary Standby Officers and Pipeline Patrol Officers.
kPa or MPa	Units of pressure measurement
LP	Low Pressure
Low Pressure gas main	2, 7 kPa
MAOP	Maximum Allowable Operating Pressure
Medium Pressure gas main	30, 100, 210, 300, 400 kPa
MP	Medium Pressure
PE Slabbing	A layer of polyethene material approved as a procedural and physical protection measure for gas mains
PPE	Personal Protective Equipment
TfNSW	Transport for New South Wales

Abbreviation	Definition
Secondary gas main	1050 kPa.
SWMS	Safe Work Method Statement
Work site	The location of the intended work that the requestor is requesting a standby for.

6 REFERENCES

6.1 INTERNAL

GAS-960-GL-PL-001 – Designing, Constructing and Operating Assets Near Jemena Gas Pipelines

Jemena Network Operator Rules

6.2 EXTERNAL

AS 4645 Series – Gas Distribution Networks

AS 4853 – Electrical Hazards on Gas Pipelines

7 APPENDICES

7.1 OPERATING LIMITS FOR THE APPLICATION OF VACUUM EXCAVATION AROUND BURIED NATURAL GAS MAINS

The use of vacuum excavation (or hydro-excavation) on gas mains shall be limited to the water pressures set out in the table below.

Pipe material	**Maximum allowable water pressure, psig***	
	Rotating nozzle	**Fixed nozzle**
Nylon	2000	1500
PE	2500	2500
Uncoated steel pipe	3000	3000
PE coated steel pipe (yellow jacket)	2000	2000
Fusion bonded epoxy (FBE) coated steel	2000	2000
Coal tar enamel coated steel	0	0
Petroleum tape coated steel	1000	1000
Tek-Rap coated steel	1000	1000
Coated steel pipe (unknown coating)	1000	1000

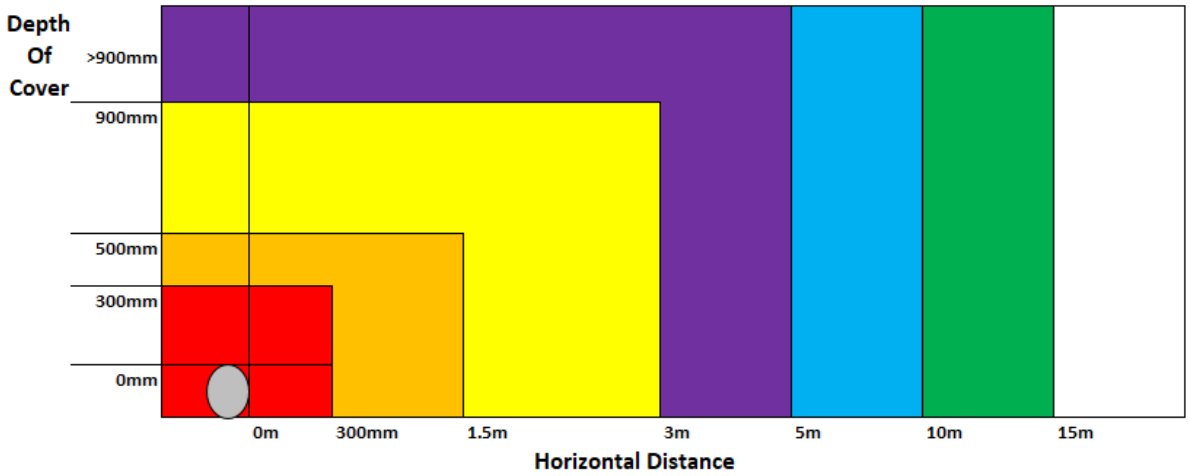
* Notes:

1. The pressure of the water must be measured at the lance, NOT the truck.
2. The nozzle shall be kept at least 300 mm from the surface of the gas asset at all times.
3. In the case of steel pipe only, the minimum water pressure the equipment is capable of delivering must be applied when starting the excavation process until the nature of the pipe coating is identified, then the pressure may be increased to the relevant pressure specified in the table.
4. Vacuum excavation is not permitted on coal tar enamel coated gas mains.

The use of vacuum excavation around buried high-pressure natural gas pipes will require the presence of a Jemena or Zinfra representative.

7.2 COMPACTION REQUIREMENTS

Compaction Requirements

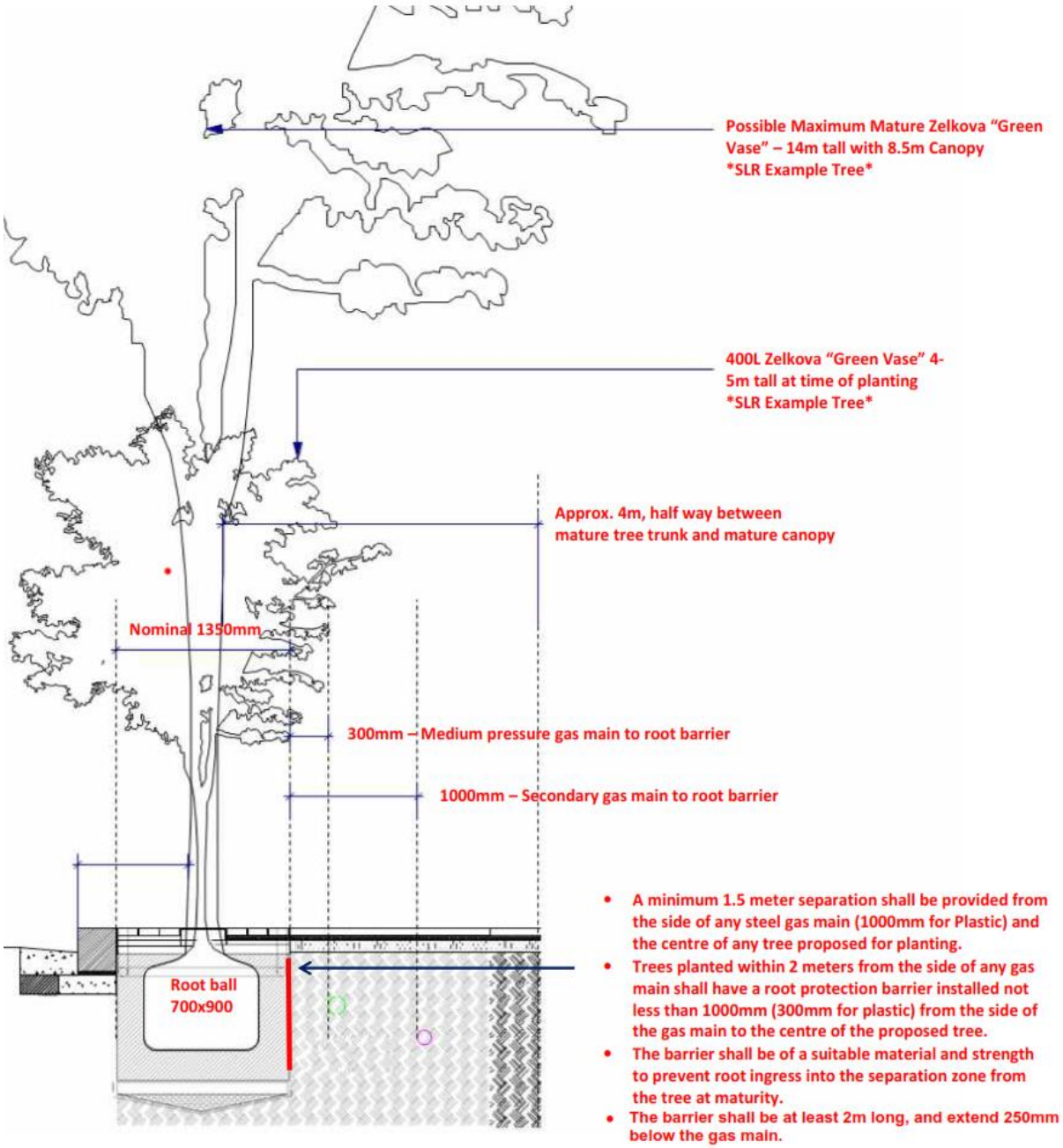


Maximum Allowable Compaction

- No compaction permitted. Hand tamping only.
- Hand-held class 60kg compacter only.
- 8T tandem-drum static roller (no vibration), or a hand-held larger plate compacter at any vibration setting.
- 8T tandem-drum roller set at low-amplitude vibration, or 10T vibratory roller set to static roller only (no vibration).
- 8T tandem-drum roller at any vibration setting, or 10T vibratory roller set to low-amplitude vibration.
- 10T tandem-drum roller at any vibration setting.
- No restrictions.

7.3 TREE PLANTING REQUIREMENTS

Note: *The diagram below is restricted to specific tree species, and is subject to Jemena Engineering approval. Other tree species may require additional separation.*



7.4 SUBSIDENCE RISK CONTROL PROCEDURES

Level	Control Measures	Frequency	Analysis	Trigger Level	Action
1	Baseline Gas Detection Survey Required Undertake a pre-tunnelling gas detection survey of pipes within the area potentially affected.		Jemena reviews: - 2D ground surveys report - pipe integrity - ground conditions report		
	Ground inspections: - 2D survey - ground inspection	Ground surveys by contractor: - Monthly 2D survey along centreline of tunnel for pegs located within active subsidence zone after the length of the tunnelling exceeds 200 metres. - Weekly surveys from when tunnelling exceeds 800 metres, until one month after completion of tunnel. - Weekly surveys along roads where mains exists when within active subsidence zone. Ground inspections by contractor:	Contractor surveys and provides Jemena with: - ground surveys - ground movements / features reports	Ground movement survey and measurements: - Radius of ground curvature greater than 4 (km) - Ground strain 0 to 2 (mm/m) - Ground movements rate of change steady Ground conditions monitoring: - ground cracks reported - ground subsidence reported --- - ground movements showing a step change indicating shear and / or discontinuity in humps near the gas services	Go to LEVEL 2 if LEVEL 1 limit is exceeded: - normal ground patrol by Jemena pipeline officer Jemena actions following receipt of reported incidents: inspects site to confirm operation of gas facilities not affected Assess potential for impacts on pipe crossings due to valley closure. Consider trigger level for Level 2. ---

		- Weekly inspection including at the creek crossings within the active subsidence zone.			- undertake additional inspection e.g. exposing and inspecting gas service as applicable to determine gas facilities integrity - based on above findings, undertake corrective action per Level 3 activities where gas services integrity affected
	Ground subsidence validations: - Observed against predictions	On receipt of data: verify and track results against predictions	Contractor analyses and reports findings to stakeholders		
2	Ground inspections: - 2D survey - ground inspection	Submit data within 24 hours duration Twice weekly 2D survey	Contractor surveys and provides Jemena with: - ground surveys - ground movements / features reports	Ground movement survey and measurements: - Radius of ground curvature 2 to 4 (km) - Ground strain 2 to 5 (mm/m) - Ground movements rate of change increasing with increasing upward trend - Subsidence is delayed (such as subsidence not developing within expectations, and/or reports of no caving underground) Ground conditions monitoring: - ground cracks reported - ground subsidence reported _____ - ground movements showing a step change indicating shear	Go to LEVEL 3 if LEVEL 2 limit is reached: - weekly ground patrol by Jemena pipeline officer Jemena actions following receipt of reported incidents: inspects site to confirm operation of gas facilities not affected _____ based on above findings, undertake corrective action per Level 3 activities where gas services integrity affected - if no immediate corrective actions required, Jemena may put field construction on standby
	Ground subsidence validations: - Observed against predictions	Twice weekly: verify and track results against predictions	Contractor analyses and reports findings to stakeholders		
			Jemena reviews: - 2D ground surveys report - pipe integrity - ground conditions report		

<table>
<tr><td></td><td colspan="2"></td><td></td><td>and / or discontinuity in humps near the gas services</td><td></td></tr>
<tr><td rowspan="3">3</td><td>Ground inspections:
- 2D survey
- ground inspection</td><td>Submit data within 24 hours duration
Daily 2D survey</td><td>Contractor surveys and provides Jemena with:
- ground surveys
- ground movements / features reports</td><td rowspan="3">Ground movement survey and measurements:
- Radius of ground curvature less than 2 (km)
- Ground strain greater than 5 (mm/m)
- ground movements showing a step change indicating shear and / or discontinuity in humps near the gas services.</td><td rowspan="3">Jemena’s field corrective actions:
- mobilisation construction in the field
- excavate affected area
- inspect gas facilities to confirm integrity
- repair and / or replace gas services as applicable
- to maintain supply and safe operation</td></tr>
<tr><td>Ground subsidence validations:
- Observed against predictions</td><td>Daily: verify and track results against predictions</td><td>Contactor analyses and reports findings to
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- 2D ground surveys report
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</table>