GUIDANCE FOR TEMPORARY PIPELINE CROSSINGS

CLIENT: NORTHERN GAS NETWORKS

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EXECUTIVE SUMMARY

Northern Gas Networks (NGN) own and maintain more than 37,000 km of gas pipes. NGN work procedures NGN/PR/SSW/2 and NGN/PR/SSW/22 provide guidance for safe working and land development in the vicinity of NGN plant. Both procedures identify that any assets should be protected at points where construction or abnormal traffic may cross.

The procedures states that protection should be by a suitable method. e.g. temporary rafts of either sleeper or reinforced concrete construction, constructed at ground level, and that ground conditions, vehicle types and crossing frequency should determine the type of raft required. As there are a wide range of situations and plant involved, it is not always clear what approach should be adopted. This can lead to inconsistent protection activities.

NGN has requested that ROSEN(UK) Limited produce a set of clear rules that defines the required protection when construction or abnormal traffic is planned to cross NGN pipelines. This guidance will be used by NGN operatives to assist when dealing with plant protection enquiries.

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1. INTRODUCTION

Northern Gas Networks (NGN) own and maintain more than 37,000 km of gas pipes. NGN work procedures NGN/PR/SSW/2 [1] and NGN/PR/SSW/22 [2] provide guidance for safe working and land development in the vicinity of NGN plant. Both procedures identify that any assets should be protected at points where construction or abnormal traffic may cross.

The procedures states that protection should be by a suitable method. e.g. temporary rafts of either sleeper or reinforced concrete construction, constructed at ground level, and that ground conditions, vehicle types and crossing frequency should determine the type of raft required. As there are a wide range of situations and plant involved, it is not always clear what approach should be adopted. This can lead to inconsistent protection activities.

Furthermore, Institution of Gas Engineers and Managers (IGEM) standard, IGEM/SR/18 Edition 3 [3], documents safe working practices to ensure the integrity of gas assets and associated installations. This includes guidance on working in the vicinity of gas assets including construction traffic.

NGN has requested that ROSEN(UK) Limited produce a set of clear rules that defines the required protection when construction or abnormal traffic is planned to cross NGN pipelines. This guidance will be used by NGN operatives to assist when dealing with plant protection enquiries.

2. EXISTING GUIDANCE

It is understood the NGN receive enquires for construction traffic to cross all types of assets. The following sub-sections outline the pipeline protection requirements for these situations that are documented in NGN procedures and IGEM standards.

2.1 NGN Work Procedures

The requirements for working in the vicinity of NGN assets are documented in work procedures NGN/PR/SSW/2 and NGN/PR/SSW/22. Within the procedures the requirements are separated between pressure tiers, however the requirements for construction traffic are identical:

- Construction traffic should cross an asset only at previously agreed locations with NGN. All crossing points should be fenced on both sides with a post and wire fence, and with the fence returned along the easement for a distance of 6 m.
- The asset should be protected at the crossing points by a suitable method agreed with NGN. Ground conditions, vehicles types and crossing frequency should determine the type of raft required.

2.2 IGEM/SR/18 Edition 3

The requirements for working in the vicinity of a gas asset exceeding 7 bar and a gas asset not exceeding 7 bar are separated within the standard, however the requirements for construction traffic are identical:

Clauses 7.3 and 8.3 state that construction traffic should cross an asset only at previously agreed locations with the operator. All crossing points should be fenced on both sides with a post and wire fence, and with the fence returned along the easement for a distance of 6 m.

The asset should be protected at the crossing points by a suitable method agreed with the operator. Ground conditions, vehicles types and crossing frequency should determine the type of raft required.

This is identical to the requirements that are documented in NGN work procedures (Section 2.1)

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3. PROTECTION/ASSESSMENT OPTIONS

3.1 Bog mats

Bog mats are typically timber mats placed on the ground surface to create temporary access roads for construction projects. They protect the surface from rutting and damage from frequent crossings. See Figure 1.

They offer minimal load protection to a buried pipe because they are relatively flexible and therefore do not spread the imposed vehicle loading. Consequently, the surface load is largely transferred to the pipe as for the case without the mats.



Figure 1: Example bog mats (© Briketts https://www.birkettsbogmats.com/size-bogmat/)

3.2 Ground protection mats

These are similar to the timber bog mats, in that they offer protection to the ground surface from rutting and damage from frequent crossings. They are available in a variety of sizes and can be connected using propriety jointing systems. See Figure 2.

They offer minimal protection to a buried pipe as the loads are transferred to ground surface, which in turn are transferred to the pipe.

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Figure 2: Ground protection mats (© GroundGuards https://www.ground-guards.co.uk/product/maxitrack-1-8m-x-0-9m-6x3/)

3.3 Haul Road (Granular material)

Granular material is frequently placed at surface on larger construction sites to create temporary haul roads. This can protect the surface from damage and rutting. Using granular fill to increase the cover depth at pipeline crossings can help protect the pipe from unacceptable transient vehicle loads but will increase the overburden loading. A vehicle loading assessment would be required to determine suitability of this option.

During placement of the material, pipeline protection measures should be considered because heavy vehicles or compaction equipment may be required during the construction.

3.4 Temporary Bridge/Raft

In some instances a temporary bridge/raft system can be used to form a bridge over the pipeline. Systems need to be designed such that any load transferred to the ground is sufficiently far away that any load transferred to the pipeline is minimal.

The use of any system should ensure that any crossings of the pipeline are perpendicular.

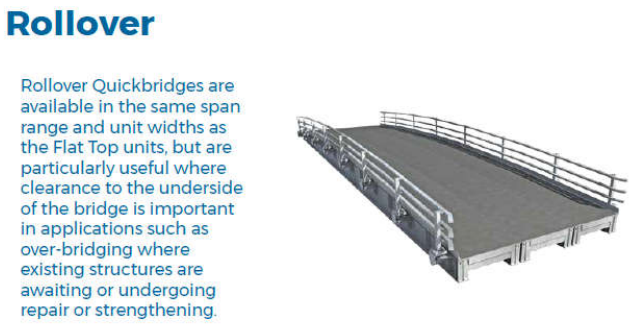


Figure 3: Example temporary bridge (source Mabeyhire.co.uk)

3.5 Concrete Slabs

NGN/SP/CE/12 [4] provides a specification for pipeline protection slabs. There are three types of slabs specified:

- Crossing point slabs

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To be used at locations where analysis shows that protection from vehicle loads is required to reduce the stress to an acceptable level.

Crossing point slabs can be removed after the works have completed. Guidance in NGN/PR/SSW/2 and NGN/PR/SSW/22 should be followed when removing slabs to ensure the pipeline is not damaged.

- Impact protection slabs

  To provide additional protection as requirement by IGEM/TD/1 to reduce the likelihood of pipeline damage by mechanical plant.

- Separation slabs between pipeline and other services

  This could be installed for one of the following reasons:

  - Where a pipeline is to be installed above other services, so as to prevent damage to the other services during its installation, testing and any subsequent maintenance or repair.
  - Where a pipeline is to be installed below other services.
  - Where other services are to be laid above, to prevent damage to the pipeline during installation, maintenance or repair of the other services.

3.6 Vehicle Loading Integrity Assessment

In some instances an assessment of the vehicle loading on the pipeline may show that it is acceptable without the need for additional precautions. NGN/SP/GM/1 [5] provides guidance on undertaking the assessment which is applicable to all pipelines and provides acceptance criteria for steel pipelines operating above 7 bar.

The conclusions from an assessment may be that protection measures are required such as outlined in Sections 3.1 to 3.5, however a concrete crossing point slab in accordance with NGN/SP/CE/12, Section 3.5 is commonly selected. .

4. CONSIDERATIONS FOR PROTECTING ASSETS

The following sub-sections outline the considerations for protecting assets at temporary crossings:

4.1 Vehicle Loading

4.1.1 Temporary Crossing

The predominant factor for determining the type of protection required for temporary crossings is the type of vehicle loading and the frequency that the vehicle is expected to cross the pipe during the work.

Determining whether vehicle loads are acceptable depends on:

- The vehicle weight
- The vehicle loading footprint; based on the tyre or track size and the wheel and axle spacing.
- The pipe properties and ground conditions.

It is considered that provided all the following conditions are satisfied then vehicles can be permitted to cross the pipeline without the need for a vehicle loading integrity assessment (Section 3.6):

- Pipes are laid in gardens, fields, or road verges and pavements without highways traffic loading.

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- The depth of cover is 1 m or greater
- The permitted gross fully laden vehicle weight and pipe diameter range are as specified in Table 1.

Material	Pipe diameter	
	4 tonne vehicle	5 tonne vehicle
Cast iron and ductile iron	12 inch or less	8 inch or less
Steel and PE	All pipe sizes	All pipe sizes

Table 1: Permitted gross fully laden vehicle weight and pipe diameter range

Examples of common vehicle types, which are 5 tonne or less, are listed in **Error! Reference source not found.**.

For locations that meet these conditions, the requirement for measures to protect the crossing surface should be considered, and this can be in the form of bog mats (Section 3.1) or ground protection mats (Section 3.2). These protect from rutting of the surface occurring which can cause in a reduction of depth of cover. The requirement for these additional protection measures depend on a number of factors:

- Expected weather conditions (e.g. Winter vs Summer).
    - If the ground conditions are wet, the ground surface will deteriorate rapidly and therefore surface protection is recommended.
- Frequency of crossings (number per day) – Large or small project (e.g. Road scheme = large, housing development < 10 plots = small).
    - If the daily number of crossings is high the ground surface could deteriorate and therefore surface protection is recommended.
- Duration of the project - Large or small project (e.g. Road scheme = large, housing development < 10 plots =small).
    - A large project is likely to continue over several months and involve wet periods and therefore surface protection is recommended.

For locations that do not meet the stated conditions, a vehicle loading assessment as described in Section 3.6 is required.

Dedicated crossing point(s) should be installed in accordance with the requirements of NGN/PR/SSW/22 and NGN/PR/SSW/2.

4.1.2 Permanent Road Crossings

For permanent road crossing, BS EN 1991-2 and BS 9295:2020 provide guidance on traffic loading models that should be used to assess pipes, however these loadings relate to public roads and not temporary crossings as considered in this report.

It should be noted that existing gas mains in public roads will only require a vehicle loading integrity assessment (Section 3.6) for a notified abnormal indivisible loads (AIL) crossing. In such cases the assessment should be based on the specified vehicle footprint, axle loads and tyres contact areas.

If an existing untrafficked pipe is to be covered by a new public road then the traffic surcharge applicable to a new main as described in BS EN 1991-2 [6] and BS 9295:2020 [7] should be considered. Impact protection in accordance with either IGEM/TD/1 [8] or IGEM/TD/3 [9] may be required.

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4.2 Pipe Material

The material of the pipe that is being is crossed requires consideration. Cast and ductile iron mains have a reduced loading bearing capacity when compared to PE and steel pipes. In addition the joints for cast and ductile iron mains can leak when disturbed.

If the main has history of leakage events then a leakage survey before work commences should be carried out. This should also be scheduled at routine intervals during the project, depending on the duration. A leakage survey after the project should also be completed.

It is expected that cast iron and ductile iron pipes will require protection to prevent disturbance of joints therefore it is expected that most construction projects should involve placement of a load bearing structure such as concrete slabs.

4.3 Ground Conditions

The ground conditions are an important consideration as they influence how the load is transferred from the vehicle to the pipeline, the surface can also degrade resulting in rutting occurring which reduce the depth of cover.

Considerations include:

- Soft ground may deteriorate rapidly due to vehicle on the running surface
- Soft ground provides less support to the pipe in resisting the surface loads than firm ground.
- Soft ground can result in ground settlement if earthworks or additional fill are placed over the pipeline
- Pipelines laid on hard ground will experience higher cross sectional loading than compared to soft ground. This could occur where rock head is close to surface for example.

It is recognised that the evaluation of site conditions is not straightforward and explains why ground investigation information that supports construction projects is important. However, where this is not available, some assessment of likely conditions is still possible based on the environment. For example, soft ground is common in lowland flood plains adjacent to water bodies. Conversely hard pipe bedding might be expected in hilly or upland areas where nearby road cuttings indicate the presence of rock.

As indicated in Section 4.1, winter conditions are likely to result in soft ground conditions for a vehicle running surface at ground level in most environments.

In instances where the depth of cover is less than 1 m, it will be necessary to protect the pipe. The use of granular material to construct a haul road (Section 3.3) can be considered to increase the depth of cover. However, the method statement and vehicles used to construct the haul road over the pipe will require consideration.

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5. DECISION METHODOLOGY

Figure 4 shows a flow chart for the decision methodology to be followed.

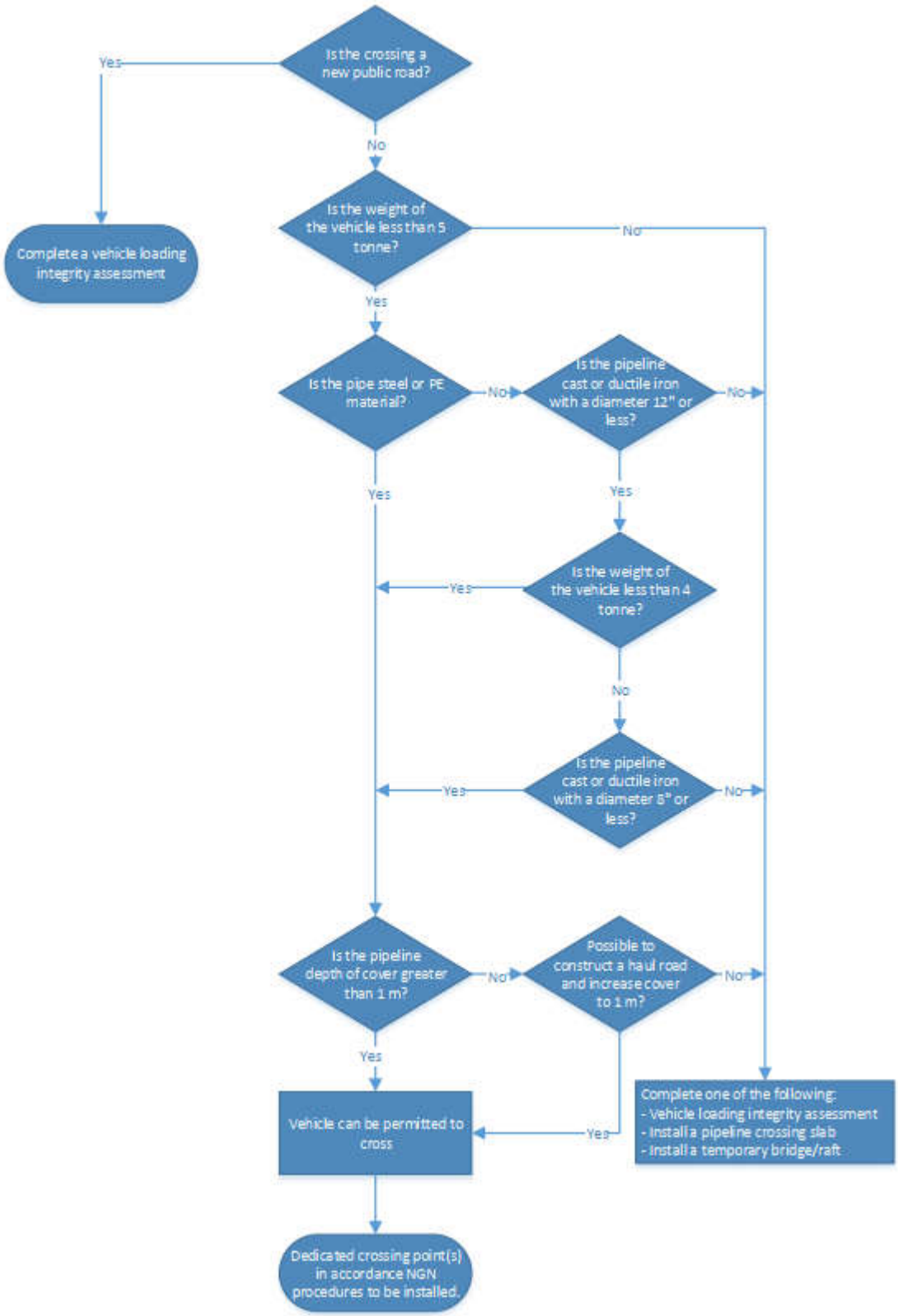


Figure 4: Decision Methodology

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6. REFERENCES

1 NGN/PR/SSW/2. Work procedure for Safe working and land development in the vicinity of NGN plant. Northern Gas Networks, June 2020

2 NGN/PR/SSW/22. Work procedure for Safe working and land development in the vicinity of NGN plant – Requirements for third parties. Northern Gas Networks, June 2020.

3 IGEM/SR/18 Edition 3. Safe working practices to ensure integrity of gas assets and associated installations. Institution of Gas Engineers and Managers, Communication 1828, March 2019.

4 NGN/SP/CE/12. Specification for the Design, Construction and Testing of Civil and Structural Works Part Twelve: Pipeline Protection Slabs. Northern Gas Networks, August 2004.

5 NGN/SP/GM/1. Specification tor the Protection of Pipelines from Ground Movement and External Loading. External Loading on Steel Pipelines and Buried Piping at Installations. Northern Gas Networks, October 2004.

6 BS EN 1991:2003. Eurocode 1. Actions on structures. Traffic loads on bridges.

7 BS 9295:2020. Guide to the structural design of buried pipes

8 IGEM/TD/1 Edition 5. Steel pipelines and associated installation for high pressure gas transmission. Institutions of Gas Engineers and Managers. Communication 1789.

9 IGEM/TD/3 Edition 5. Steel and PE pipelines for gas distribution. Institutions of Gas Engineers and Managers. Communication 1770.

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APPENDIX A EXAMPLES OF COMMON VEHICLE TYPES

Vehicle Reference	Type	Operating Weight (kg)	Images
JCB 6T-2 FT	Dumper	4920	
Terex TA6s	Dumper	4270	
Thwaites MACH2066	Dumper	4420	
JCB 51R-1	Mini Excavator	4982	
Komatsu PC45MR-5	Mini Excavator	5020	
Kubota KX037-4	Mini Excavator	3505	

Table 2: Example vehicles

Vehicles references and details correct at the time of report issue, however, it is recommended that details are checked with the manufacturer/supplier as specifications can be amended.

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