Northern Gas Networks

Highways England
3 South Lateral 8 City Walk
Leeds
LS11 9AR

Our Ref: [redacted]
Your Ref: TR010059

23-10-2020

Who are Northern Gas Networks?

We look after the 37,000km of gas mains in the north of England. We don't own the gas but it's our job to transport it safely it to you.

Get in touch

If you have any questions, our Before You Dig Team will be able to help:

0800 040 7766

beforeyoudig@northerngas.co.uk

northerngasnetworks.co.uk

Dear Sir/Madam

We object to your planning application

Thank you for sending your notice dated 14-09-2020.

We enclose a plan showing our plant in the area of Morpeth To Ellingham A1 Northumberland. We object to the planning application on the grounds that the protection given to our plant may be diminished by the works you intend to carry out.

There are specific building proximity distances for individual pipelines, which are dependent on pre-defined risk levels and the type of development. If your proposal includes the construction of buildings, it is essential you contact Donald Gilbank pipeline manager for the area in question on DGilbank@northerngas.co.uk.

Yours faithfully,

Jameson Bwanali

Administration Assistant

0800 040 7766 (option 5)

If you'd like this information in Braille, large print or another language, please call us.

@NGNgas facebook.com/northerngasnetworks

Northern Gas Networks

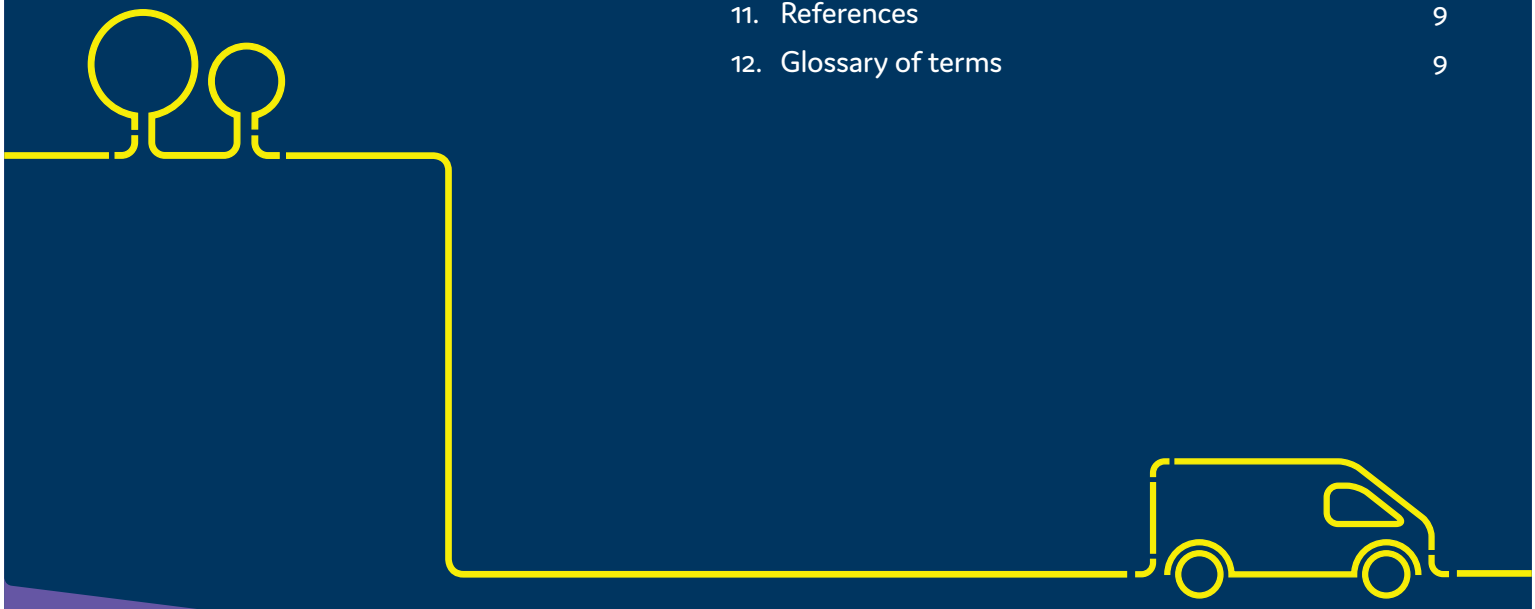
Working safely near high pressure gas pipelines and associated installations

Third party requirements

November 2017

we are the network

Contents



Welcome

What's it all about?

This work procedure is meant for third parties who are working nearby high pressure gas pipelines and associated installations (anything above 7 bar gauge). We need you to follow this best practice procedure so we can be sure that all measures are taken to prevent damage.

It's essential that all procedures in this document are complied with because damage to a high-pressure gas pipeline or its coating can result in failure, causing hazardous consequences for anyone nearby. If NGN thinks any work is in breach of this document, they'll stop the work until the correct procedure is being followed.

Regulation 15 of the Pipelines Safety Regulations states: 'No person shall cause such damage to a pipeline as may give rise to a danger to persons'. This means that if you don't follow these requirements the Health and Safety Executive (HSE) could also prosecute you.

All the requirements in this document are in line with the HSE's and the Institution of Gas Engineers and Managers (IGEM) recommendations. You can find these in HSE's guidance document *HS(G)47 Avoiding Danger From Underground Services.* They are also available in document *IGE/SR/18 Edition 2 - Safe Working Practices To Ensure The Integrity Of Gas Pipelines And Associated Installations.*

Third parties must also make sure that all work follows the requirements of the Construction and Design Management Regulations and all other relevant health and safety legislation.

Disclaimer

It is the responsibility of anyone carrying out work near our pipeline infrastructure to ensure that the requirements of this document are applied correctly.

Please keep in mind that being compliant with this document doesn't make you immune to prosecution for breaches of any other statutory or legal obligations.

Important definitions

Must: This indicates a mandatory requirement.

Should: This indicates both best practice and the preferred option. You can use an alternative method but you must complete a suitable and sufficient risk assessment to show that the alternative method delivers an equal, or better, level of protection.

The step by step process for when you're working near a high pressure pipeline

Use this flowchart alongside this entire document and never in isolation.
If the pipeline is damaged at any time, even slightly, follow the precautions in Section 10.
If in any doubt at all please contact NGN.

Step 1
Contact NGN

Before starting work you need formal consent from NGN (see Section 2). NGN need at least 7 days' notice in advance of work starting.

Step 2
Consider safety

Think about all the safety requirements, both legal and practical (see Section 3).

Step 3
Contact NGN and request pipeline location

Contact NGN to let them know about the work and arrange for them to locate the pipeline (see Section 4). Note: NGN needs at least 7 days' notice.

Step 4
Observe restrictions

Ensure you read and follow the NGN restrictions on how near mechanical excavators and other power tools are allowed. You must also follow all measures to protect the pipeline from construction vehicles (see Sections 5, 6 and 7). NGN might decide to supervise the work. You can contact NGN to find out if this is necessary.

Step 5
Specific activities

You must comply with the requirements in Section 8 if work involves any of the following activities:

- No-dig techniques
- Hot work
- Landfilling
- Increase in cover
- Blasting
- Pressure testing
- Piling
- Surface mineral extraction
- Seismic surveys
- Demolition
- Deep mining
- Excessive loading (eg cranes)
- Drainage/sewerage work
- Ditch maintenance

Step 6
Consult NGN

Get NGN's agreement before backfilling over, alongside or under the pipeline. NGN usually need 48 hours' notice before backfilling (see Section 9).

If in any doubt at all please contact NGN

The requirements

Section 1
Scope

This work procedure sets out the safety precautions and other conditions affecting the design, construction and maintenance of services, structures and other works in the vicinity of NGN pipelines and associated installations operating at pressures greater than 7 bar gauge, located in both negotiated easements (see Section 12) and public highways.

Section 2
Formal consent

High pressure pipelines are generally laid across country within an easement agreed with the landowner or within the highway. As the required arrangements for working within an easement and working within the highway differ, this document has been structured to highlight the specific requirements for these two types of area where work may be carried out.

Generally, normal agricultural activities are not considered to affect the integrity of the pipeline, however please consult NGN prior to undertaking deep cultivation in excess of 0.5m. In all other cases no work shall be undertaken in the vicinity of the pipeline without the formal written consent of NGN.

Any documents, handed to contractors on site by NGN, must be signed for by the site manager. NGN will record a list of these documents, and the contractor should maintain a duplicate list.

2.1 Within an Easement

The promoter of any works (see Section 12) within an easement must provide NGN with details of the proposed works including a method statement of how the work is intended to be carried out.

Work must not go ahead until formal written consent has been given by NGN. This will include details of NGN's protection requirements, contact telephone numbers and the emergency telephone number. On acceptance of NGN's requirements the promoter of the works must give NGN 7 working days' notice, or shorter only if agreed with NGN, before commencing work on site.

2.2 Within the Highway

Work must be notified to NGN in accordance with the requirements of The New Roads and Street Works Act (NRSWA) and HS(G)47.

The promoter of any works within the highway should provide NGN with details of the proposed works including a method statement of how the work is intended to be carried out. This should be submitted 7 working days before the planned work is to be carried out or shorter, only if agreed with NGN. If similar works are being carried out at a number of locations in close proximity a single method statement should be adequate.

Work should not go ahead until formal written consent has been given by NGN. This will include details of NGN's protection requirements, contact telephone numbers and the emergency telephone number.

Section 3
EH&S considerations

3.1 Safe Control of Operations

All working practices must be agreed by NGN prior to work commencing. All personnel working on site must be made aware of the potential hazard of the pipeline and the actions they should follow in case of an emergency.

3.2 Deep Excavations

Special consideration should be given to the hazards associated with deep excavations. The HSE website provides further guidance, particularly at http://www.hse.gov.uk/construction/safetytopics/excavations.htm.

3.3 Positioning of Plant

Mechanical excavators must not be sited or moved above the pipeline unless written authority has been given by the NGN responsible person.

Mechanical excavators must not dig on one side of the pipeline with the cab of the excavator positioned on the other side. Mechanical excavators and other traffic must be positioned far enough away from the pipeline trench to prevent trench wall collapse.

3.4 General

Activities associated with working in the vicinity of pipelines operating above 7 bar gauge may have impact on the safety of the general public, NGN staff and contractors, and may affect the local environment. Contractors must carry out suitable and adequate risk assessments prior to the commencement of work to ensure that all such issues are properly considered and risks mitigated.

Section 4
Pipeline locating

Where formal consent to work has been given, the third party should give 7 working days' notice or shorter, only if agreed with NGN, to ensure that the pipeline is suitably located and marked out by NGN prior to the work commencing.

Prior to work commencing on site the pipeline must be located and pegged or suitably marked out by NGN personnel. In exceptional circumstances, with the prior agreement of NGN, the locating and marking out of the pipeline could be carried out by competent third parties on behalf of the contractor, as long as NGN is assured of their competence and the procedures to be followed.

Safe digging practices, in accordance with HSE publication HS(G)47, should be followed as both direct and consequential damage to gas plant can be dangerous both to employees and to the general public. Previously agreed working practices should be reviewed and revised based on current site conditions. Any changes must be agreed by the NGN responsible person.

The requirements for trial holes to locate the pipeline or determine levels at crossing points must be determined on site by the NGN responsible person. The excavation of all trial holes must be supervised by the NGN responsible person.

Section 5
Slabbing and other protective measures

Protective measures including the installation of concrete slab protection should only be installed over or near to the NGN pipeline with prior permission from NGN. NGN will need to agree the material, the dimensions and method of installation of the proposed protective measure. The method of installation must be confirmed through the submission of a formal written method statement from the contractor to NGN.

Where permanent slab protection is to be applied over the pipeline, NGN will normally carry out a survey of the pipeline to check that there is no existing damage to the coating of the pipeline prior to the slab protection being put in place. NGN must therefore be contacted prior to the laying of any slab protection to arrange for them to carry out this survey.

The safety precautions detailed in Sections 3 and 6 of this document should also be observed during the installation of the pipeline protection.

Section 6
Excavation

6.1 In Proximity to a Pipeline in an Easement

Third parties may excavate, unsupervised, with a powered mechanical excavator to within 3 metres of the NGN located pipeline and with handheld power tools to within 1.5 metres. Any fitting, attachment or connecting pipework on the pipeline must be exposed by hand. All other excavation should be by hand. Consideration may be given to a relaxation of these limits by agreement with the NGN responsible person on site and only whilst he remains on site. In this case a powered mechanical excavator shall not be allowed to excavate closer than 0.6 metres to the nearest part of the pipeline.

Where sufficient depth of cover exists, following evidence from hand dug trial holes, light tracked vehicles may be permitted to strip topsoil to a depth of 0.25 metres, using a toothless bucket. No topsoil or other materials should be stored within the easement without the written permission of NGN. No topsoil or materials should be stored over the pipeline. No fires should be allowed in the easement strip or close to above ground gas installations.

After the completion of the work the level of cover over the pipeline should be the same as that prior to work commencing unless agreed otherwise with the NGN responsible person. No new service shall be laid parallel to the pipeline within the easement. In special circumstances, and only with formal written agreement from NGN, this may be relaxed for short excursions where the service shall be laid no closer than 0.6 metres to the side of the pipeline. Where work is being carried out parallel to the pipeline within or just alongside the easement a post and wire fence must be erected as a protective barrier between the works and the pipeline.

6.2 In Proximity to a Pipeline in the Highway

Removal of the bituminous or concrete highway surface layer by mechanical means is permitted to depth of 0.3 metres, although the use of chain trenchers to do this shall not be permitted within 3 metres of the pipeline. The NGN responsible person may want to monitor this work.

Where the bituminous or concrete highway surface layer extends below 0.3 metres deep it should only be removed by handheld power assisted tools under the supervision of the NGN responsible person. In exceptional circumstances, and following a risk assessment, these conditions may be relaxed by the NGN responsible person.

Third parties may excavate, unsupervised, with a powered mechanical excavator to within 3 metres of the located NGN pipeline and with handheld power tools to within 1.5 metres. Any fitting or attachment must be exposed by hand. In special circumstances consideration may be given to a relaxation of these rules by agreement with the NGN responsible person on site and only whilst he remains on site.

The use of 'No Dig' techniques is covered in Section 8.1.

Any new service running parallel to the pipeline should be laid no closer than 0.6 metres to the side of the pipeline (see Section 6.4).

6.3 Crossing Over a Pipeline

Where a new service is to cross over the pipeline a clearance distance of 0.6 metres between the crown of the pipeline and underside of the service must be maintained. If this cannot be achieved the service must cross below the pipeline with a clearance distance of 0.6 metres. In special circumstances this distance may be reduced at the discretion of the NGN responsible person on site.

6.4 Crossing Below a Pipeline

Where a service is to cross below the pipeline a clearance distance of 0.6 metres between the crown of the service and underside of the pipeline shall be maintained.

The exposed pipeline should be suitably supported. Where lengths of pipeline greater than 5 metres are to be exposed and unsupported the NGN responsible person shall be consulted and a stress analysis shall be required in order to establish support requirements. The stress analysis should be carried out by individuals with demonstrated expertise in this area, NGN can be consulted for advice on suitable specialists. NGN may request a copy of the stress analysis to confirm its adequacy. Such supports must be removed prior to backfilling. The exposed pipelines must be protected by matting and suitable timber cladding.

6.5 Cathodic Protection

Cathodic Protection is applied to all of NGN's above 7 bar gauge buried steel pipelines and is a method of protecting pipelines with damaged coatings from corrosion by maintaining an electrical potential difference between the pipeline and anodes placed at strategic points along the pipeline.

Where a new service is to be laid and similarly protected, NGN will undertake interference tests to determine whether the new service is interfering with the cathodic protection of the NGN pipeline.

Should any cathodic protection posts or associated apparatus need moving to facilitate third party works reasonable notice, typically 7 days, should be given to NGN. NGN will undertake this work and any associated costs will be borne by the third party.

Section 7
Construction traffic

Where existing roads cannot be used construction traffic should only cross the pipeline at previously agreed locations. All crossing points will be fenced on both sides with a post and wire fence and with the fence returned along the easement for a distance of 6 metres. The pipeline shall be protected at the crossing points by temporary rafts of either sleeper, reinforced concrete construction or bog mats, constructed at ground level. The NGN responsible person will review ground conditions, vehicle types and crossing frequencies to determine the type and construction of the raft required.

Section 8
Specific activities

This section details the precautions that need to be taken when carrying out certain prescribed activities in the vicinity of the pipeline. Consult NGN if you are intending to undertake one of the listed prescribed activities and/or you require further advice on whether the work that you are intending to undertake has the potential to affect the pipeline.

8.1 No-Dig Techniques

Where the contactor intends using no dig techniques then a formal method statement must be produced for all work that would encroach (either above or below ground) within the pipeline easement. This method statement must be formally agreed with NGN prior to the commencement of the work. NGN may wish to be present when the work is being carried out and must therefore be given adequate advance notice before the commencement of the work.

8.2 Increase in Cover

A pipeline integrity assessment must be provided for situations involving a final cover depth exceeding 2.5 metres. This assessment should take due account of both soil 'dead' loading and ground settlement due to earthworks. Embankment design and construction over pipelines must give consideration to prevention of any instability. Expert advice may need to be sought which can be arranged through NGN.

8.3 Piling

No piling will be allowed within 15 metres of a pipeline without an assessment of the vibration levels at the pipeline. The peak particle velocity at the pipeline should be limited to a maximum level of 75 mm/sec. Where the peak particle velocity is predicted to exceed 50 mm/sec, the ground vibration shall be monitored by the contractor and the results available to the NGN responsible person at their request.

Where ground conditions are of submerged granular deposits of silt and sand, an assessment of the effect of vibration on settlement and liquefaction at the pipeline shall be made.

Expert advice may need to be sought which can be arranged through NGN.

8.4 Demolition

No demolition should be allowed within 150 metres of a pipeline without an assessment of the vibration levels at the pipeline. The peak particle velocity at the pipeline must be limited to a maximum level of 75 mm/sec. Where the peak particle velocity is predicted to exceed 50 mm/sec, the ground vibration shall be monitored by the contractor and the results available to the NGN responsible person at their request.

Where ground conditions are submerged granular deposits of silt or sand, an assessment of the effect of vibration on settlement and liquefaction at the pipeline shall be made.

Expert advice may need to be sought which can be arranged through NGN.

8.5 Blasting

No blasting should be allowed within 250 metres of a pipeline without an assessment of the vibration levels at the pipeline. The peak particle velocity at the pipeline must be limited to a maximum level of 75 mm/sec. Where the peak particle velocity is predicted to exceed 50 mm/sec, the ground vibration must be monitored by the contractor and the results available to the NGN responsible person at their request.

Where ground conditions are of submerged granular deposits of silt or sand, an assessment of the effect of vibration on settlement and liquefaction at the pipeline shall be made.

Expert advice may need to be sought which can be arranged through NGN.

8.6 Surface Mineral Extraction

An assessment must be carried out on the effect of surface mineral extraction activity within 100 metres of a pipeline. Consideration should also be given to extraction around ground beds and other pipeline associated plant and equipment.

Where the mineral extraction extends up to the pipeline easement, a stable slope angle and stand-off distance between the pipeline and slope crest must be determined by NGN. The easement strip should be clearly marked by a suitable permanent boundary such as a post and wire fence, and where appropriate, slope indicator markers shall be erected to facilitate the verification of the recommended slope angle as the slope is formed, by the contractor. The pipeline easement and slope needs to be inspected periodically to identify any signs of developing instability. This may include any change of slope profile including bulging, the development of tension cracks on the slope or easement, or any changes in drainage around the slope. The results of each inspection should be recorded.

Where surface mineral extraction activities are planned within 100 metres of the pipeline but do not extend up to the pipeline easement boundary, an assessment, by NGN must be made on whether the planned activity could promote instability in the vicinity of the pipeline. This may occur where the pipeline is routed across a natural slope or the excavation is deep. A significant cause of this problem is where the groundwater profile is affected by changes in drainage or the development of lagoons. Where the extraction technique involves explosives the provisions of section 8.5 apply.

8.7 Deep Mining

Pipelines routed within 1 km of active deep mining may be affected by subsidence resulting from mineral extraction. The determination of protective or remedial measures will normally require expert assistance, which can be arranged through NGN.

8.8 Landfilling

The creation of slopes outside of the pipeline easements may promote instability within the vicinity of the pipeline. An assessment should therefore be carried out, by NGN, on the effect of any landfilling activity within 100 metres of a pipeline. The assessment is particularly important if landfilling operations are taking place on a slope in which the pipeline is routed.

8.9 Pressure Testing

Hydraulic pressure testing will not be permitted within 8 metres of the pipeline unless suitable precautions have been taken against the effects of a burst. These precautions should include limiting of the design factor to 0.3 for the third party pipeline for a distance of 6 metres either side of the NGN pipeline, and the use of mill tested pipe or sleeving.

8.10 Seismic Surveys

NGN must be advised of any seismic surveying work in the vicinity of pipeline that will result in NGN's pipeline being subjected to peak particle velocities in excess of 50 mm/sec. The ground vibration near to the pipeline shall also be monitored by the contractor whilst the survey work is being carried out. Where the peak particle velocity is predicted to exceed 50 mm/sec, the ground vibration should be monitored by the contractor and the results available to the NGN responsible person at their request.

8.11 Hot Work

The NGN responsible person on site should supervise all welding, burning or other 'hot work' that takes place within the easement.

8.12 Excessive Loading

Cranes and lifting equipment must not be sited or moved above the pipeline unless written authority has been given by the NGN responsible person. Permission will only be granted after a load displacement assessment is carried out by a suitably qualified organisation.

Protective measures including the installation of concrete slab protection should be installed over or near to the NGN pipeline with prior permission from NGN. NGN will need to agree the material, the dimensions and method of installation of the proposed protective measure. The method of installation must be confirmed through the submission of a formal written method statement from the contractor to NGN.

8.13 Drainage/Sewerage Work

The promoter of any works working within a pipelines easement or within 3m of a pipeline, intending to carry out drainage/sewerage works at a depth greater than the pipeline, must provide NGN with details of the proposed works including a method statement of how the work is intended to be carried out. Special consideration

should be given to the hazards associated with deep excavations. The HSE website provides further guidance, particularly at http://www.hse.gov.uk/construction/safetytopics/excavations.htm.

Work must not go ahead until formal written consent has been given by NGN. This will include details of NGN's protection requirements, contact telephone numbers and the emergency telephone number. On acceptance of NGN's requirements the promoter of the works must give NGN 7 working days' notice, or shorter only if agreed with NGN, before commencing work on site.

8.14 Ditch maintenance

NGN must be notified about ditch maintenance using mechanical excavators and an NGN responsible person must attend site to locate the pipeline and to discuss the work to be carried out and to ascertain the depth of material to be removed from the ditch. If it is reasonably practicable to do so the ditch should be maintained by hand excavation across the danger zones.

Section 9
Backfilling

Third parties must provide NGN with 48 hours' notice, or shorter notice only if agreed with NGN, of the intent to backfill over, under or alongside the pipeline. This requirement should also apply to any backfilling operations alongside the pipeline within 3 metres of the pipeline. Any damage to the pipeline or coating must be reported to the NGN responsible person in order that damage can be assessed and repairs can be carried out. Minor damage to pipe coating and test leads shall be repaired by NGN free of charge.

No backfilling should be undertaken without NGN agreement to proceed. The NGN responsible person will stipulate the necessary consolidation requirements. If the pipeline has been backfilled without the knowledge of the NGN responsible person then he will require the material to be re-excavated in order to enable the condition of the pipeline coating to be confirmed.

Section 10
Action in the case of damage to the pipeline

If the NGN pipeline is damaged, even slightly, and even if no gas leak has occurred then the following precautions must be taken immediately:

Step 1
Shut down all **plant and machinery** and extinguish any potential sources of ignition.

Step 2
Evacuate all **personnel** from the vicinity of the pipeline.

Step 3
Notify NGN using the free 24 hour emergency telephone number **0800 111 999**. All calls are recorded and may be monitored.

Step 4
Notify the **NGN responsible person** immediately using the contact telephone number provided.

Step 5
Ensure no one approaches the **pipeline**.

Step 6
Do not try to stop any **leaking gas**.

Section 11
References

NRSWA: New Roads & Street Works Act

HS(G)47: Avoiding Danger from Underground Services

IGE/SR/18: Safe Working Practices to Ensure the Integrity of Gas Pipelines and Associated Installations

Section 12
Glossary of terms

Contractor: The person, firm or company with whom NGN enters into a contract to which this specification applies, including the Contractor's personal representatives, successors and permitted assigns.

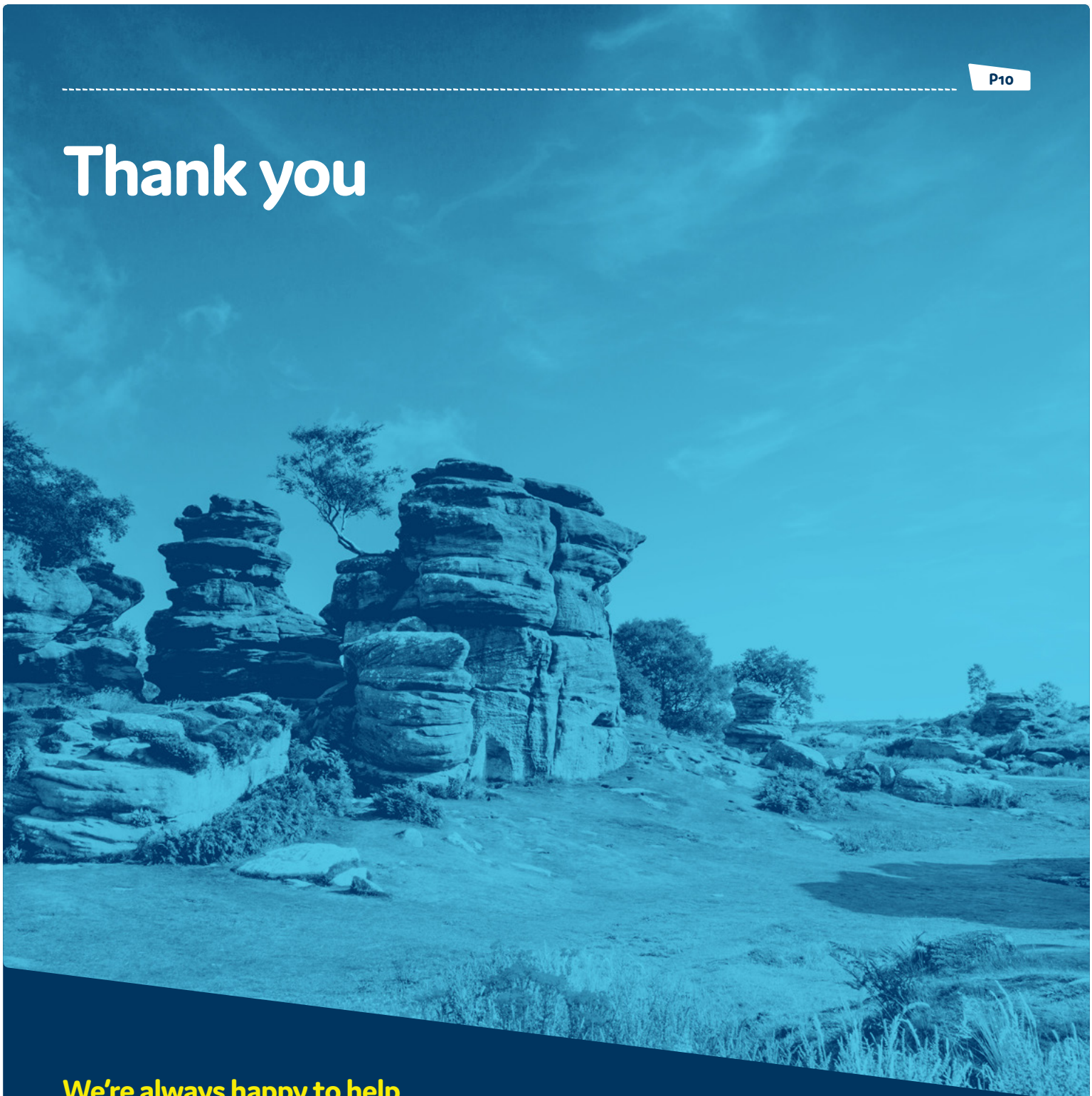
Easement: Easements are negotiated legal entitlements between NGN and landowner and allow NGN to lay, operate and maintain pipelines within the easement strip. Easement strips may vary in width typically between 6 and 25 metres depending on the diameter and pressure of the pipeline. Consult NGN for details of the extent of the easement strip where work is intended.

Liquefaction: Liquefaction is a phenomenon in which the strength and stiffness of the soil is reduced by earthquake shaking or other rapid loading. Liquefaction occurs in saturated soils, that is, soils in which the space between individual particles is completely filled with water. When liquefaction occurs, the strength of the soil decreases and the ability of the soil to support pipelines or other components is reduced.

Promoter of new works: The person or persons, firm, company or authority for whom new services, structures or other works in the vicinity of existing NGN pipelines and associated installations operating above 7 bar gauge are being undertaken.

NGN responsible person: The person or persons appointed by NGN with the competencies required to act as the NGN representative for the purpose of the managing the particular activity.

Thank you



We're always happy to help

If you have any comments or queries about the technical content of this document, please quote SSW22 and send them to:

Before You Dig, Northern Gas Networks,
1st Floor, 1 Emperor Way, Doxford
International Business Park, Sunderland
SR3 3XR

Call: **0800 040 7766**

Or send an email to the
Before You Dig team at:
beforeyoudig@northerngas.co.uk

we are the network

TREE PLANTING GUIDELINES

TREE PLANTING GUIDELINES

Large growing species of:
Poplars and Willows

10.0 m

Large Conifers and Deciduous Forest Trees

Scots Pine	Horse Chestnut	Apple
Black Pine	Sweet Chestnut	Pear
Cedar	London Plane	Plum
Larch	Hornbeam	Cherry
Ash	Lime Alder	Lime
Beech	Elm	
Sycamore	Oak	

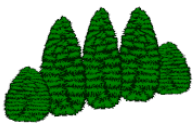
6.0 m

Dwarf Stock Fruit Trees

Amenity Trees **Ornamental Trees**

Field Maple	Mountain Ash
Wild Cherry	Whitebeam
Crab Apple	Cockspur Thorn
Cobnut	False Acacia
Birch	Lawsons Cypress
Elder	

3.0 m



Shrub Planting **Fruit Bushes**

Holly	Dogwood	Gooseberries
Laurel	Spindle	Raspberries
Privet	Guelderrose	Currants
Rhododendron		Roses
Christmas Trees		Loganberries

1.5 m

Hedgeplants and Groundcovers
Hedgeplants only where necessary over the pipeline, road and field crossings etc.

Ground Cover: Hawthorn, Blackthorn, Heathers, Snowberry, Berberis, Cotoneaster

Distance from Pipeline

Northern Gas Networks

NGN/SP/GM/4

SPECIFICATION FOR

THE PROTECTION OF STEEL PIPELINES OPERATING AT PRESSURES ABOVE 7 BAR SUBJECTED TO VIBRATIONS CAUSED BY BLASTING, PILING OR DEMOLITION

AUGUST 2004

CONTENTS

FOREWORD

This procedure was approved by GNSEC for use by managers, engineers and supervisors throughout Northern Gas Networks Limited (NGN).

NGN documents are revised, when necessary, by the issue of new editions. Users should ensure that they are in possession of the latest edition by referring to the NGN Register of safety and engineering documents available on the company Intranet.

Compliance with this safety and engineering document does not confer immunity from prosecution for breach of statutory or other legal obligations.

Contractors and other users external to NGN should direct their requests for further copies of NGN engineering documents to the department or group responsible for the initial issue of their contract documentation.

DISCLAIMER

This safety and engineering document is provided for use by NGN and such of its contractors as are obliged by the terms and conditions of their contracts to comply with this document. Where this document is used by any other party it is the responsibility of that party to ensure that this document is correctly applied.

MANDATORY AND NON-MANDATORY REQUIREMENTS

In this document:

must: indicates a mandatory requirement.

should: indicates best practice and is the preferred option. If an alternative method is used then a suitable and sufficient risk assessment must be completed to show that the alternative method.

This NGN Specification 'Protection of Steel Pipelines Operating at Pressures above 7 bar subjected to Vibrations Caused by Blasting, Piling or Demolition' is part of the suite of Specifications listed below:

NGN/SP/GM1 External Loading on Steel Pipelines.

NGN/SP/GM2 Assessment of Slopes adjacent to Steel Pipelines).

NGN/SP/GM3 Integrity Assessment of Pipelines from Subsidence.

NGN/SP/GM/4 Protection of Steel Pipelines Operating at Pressures above 7 bar subjected to Vibrations Caused by Blasting, Piling or Demolition Vibration.

NGN/SP/GM5 Assessment of Pipeline Buoyancy.

NGN/SP/GM6 Protection of Pipelines from Frost Heave.

NGN/SP/GM7 Pipeline Protection and Remedial Action.

NGN/SP/GM8 Assessment of Pipeline Integrity by Monitoring.

NGN/SP/GM9 Determination of Construction Stress for Pipeline Integrity.

BRIEF HISTORY

First published as NGN/SP/GM4 Editorial update to comply with GRM	October 2002 August 2004
Amended into NGN format	July 2007

SPECIFICATION FOR

THE PROTECTION OF STEEL PIPELINES OPERATING AT PRESSURES ABOVE 7 BAR SUBJECTED TO VIBRATIONS CAUSED BY CONSTRUCTION, MINING OR DEMOLITION

INTRODUCTION

This specification is intended to protect steel pipelines from the adverse effects of vibration arising from construction or mining activities. Vibration disturbance is a transient ground displacement loading which can generate longitudinal and circumferential stresses in pipelines. Vibration disturbance can also lead to permanent ground settlements in certain ground types. The effect of the transient and permanent loads are considered with the existing pipeline loads of pressure, temperature and construction loading to determine the pipeline stress state and establish if the pipeline is operating within safe limits.

1. SCOPE

The specification only applies to pipelines which meet the requirements of P2 *Specification for Welding of Land Pipelines and Installations Designed to Operate at Pressures Greater than 7 ba*r.

The common sources of ground vibrations generated by construction, mining and demolition activities which are covered in the specification are,

- Blasting.
- Piling.
- Demolition

The affect of other sources of vibration on pipelines such as vibro-compaction or by mechanical equipment such as large construction plant, can be assessed by reference to section 3.4. Seismic vibration caused by earthquake activity is not covered by the specification.

The specification covers the assessment of the two main effects of vibration disturbance on pipelines.

- The response of the pipeline to the transient ground displacements associated with the vibration disturbance.
- Pipeline loading from permanent ground loadings or pipeline settlement due to soil densification or liquefaction.

A pro forma to assist in the identification and recording of site data is included in appendix A.

2. DEFINITIONS

Alluvial soil: river flood plain deposit, commonly sand or gravel.

Bored pile: piles formed by boring a hole into the soil and filling it with concrete.

Charge per delay: the detonation of the total explosive charge separated from other charge detonations by at least 200 milliseconds.

Densification: increase in the density of the soil by vibration disturbance.

Liquefaction: loss of shear resistance in soil from increase in pore pressure due to vibration disturbance resulting in behaviour similar to liquid.

Non-plastic silt: Soil with grain size between clay and sand which is non-cohesive and exhibits no plastic properties.

Peak particle velocity (ppv): the maximum particle velocity attained due to the vibration event.

Pile jacking: insertion of a pile by hydraulic jacking reducing vibration disturbance.

Relative density: the density of a natural granular soil compared to its maximum and minimum density

Structure impact area: area over which the demolished structure impacts the ground surface. This is normally taken as the footprint area of the structure unless unusual circumstances covering the demolition process or structure shape apply.

3. ASSESSMENT OF VIBRATION DISTURBANCE

3.1 Blasting

No blasting involving charge weights per delay of less than 200kg shall be allowed within 250m of a pipeline without an assessment of vibration and stress levels at the pipeline. Where charge weights per delay are greater than 200kg, an assessment of the pipeline vibration and stress levels must be carried out for distances up to 500m from the pipeline.

An upper bound estimate of the peak particle velocity at a pipeline due to a blasting event located at a distance R from the pipeline is provided by equation 1. This assumes no reinforcement of vibrations due to the detonation sequence and is therefore applicable only to cases where the delay is acceptable e.g. greater than 200 milliseconds.

$$v = \frac{850}{\left(\frac{R}{\sqrt[3]{W}}\right)} \qquad \text{equation 1}$$

where

v = peak particle velocity (mm/s)

R = the distance (m) between the explosive charge and the pipeline.

W = total weight of explosive charge per delay (kg)

An upper bound estimate of the stress induced in a pipeline from a blasting event is provided by equation 2 where the peak particle velocity is either given by equation 1 or by an upper bound estimate to measured data at the site.

$$\Delta\sigma = 0.3v \qquad \text{equation 2}$$

where

$\Delta\sigma$ = cyclic stress (N/mm^2)

v = peak particle velocity (mm/s)

The factor of 0.3 is an empirically derived constant with units which are consistent with stress and velocity.

3.2 Piling

No piling shall be allowed within 15m of the pipeline without an assessment of the vibration or stress levels at the pipeline.

An upper bound estimate of peak particle velocity at a pipeline due to piling activities located at a distance R from the pipeline is provided by equation 3.

$$v = \frac{C.\sqrt{W_j}}{R} \qquad \text{equation 3}$$

where

v = peak particle velocity (mm/s).

R = the distance (m) between the piling operation and the pipeline.

C = vibration prediction factor dependent on ground conditions (refer to table 1). Units are consistent with energy, velocity and length.

W_j = energy of piling activity (joules) per blow or per cycle.

An upper bound estimate of stress induced in a pipeline due to piling activities is provided by equation 4 where the peak particle velocity is either given by equation 3 or by an upper bound estimate to measured data at the site.

$$\Delta\sigma = 0.3v \qquad \text{equation 4}$$

where

$\Delta\sigma$ = cyclic stress (N/mm^2).

v = peak particle velocity (mm/s)

The factor of 0.3 is an empirically derived constant with units which are consistent with stress and velocity.

The vibration prediction factor depends on the driving method and ground conditions and recommended values are presented in Table 1.

Table 1 Vibration Prediction Factors

Driving Method	Ground Conditions	C
Impact	Very stiff cohesive soils, dense granular media, rock fill with large solid obstructions	1.0
	Stiff cohesive soils, medium dense granular soils, compact fill	0.75
	Soft cohesive soils, loose granular media, loose fill, organic soils.	0.5
Vibratory	All soil conditions	1.0

3.3 Demolition

No demolition shall be allowed within 150m of the pipeline, or 400m for a structure mass greater than 10000 tonnes, without an assessment of the vibration or stress levels at the pipeline. The measured distance extends from the edge of the area affected by falling material to the pipeline.

An upper bound estimate of the peak particle velocity at a pipeline due to demolition located at distance R from the pipeline is provided by equation 5.

$$v = 290\left(\frac{Q}{A}\right).R^{-0.8} \qquad \text{equation 5}$$

where

v = peak particle velocity (mm/s)

R = the distance (m) between the demolition area and the pipeline.

A = structure impact area (m^2)

Q = structure mass (tonnes)

An upper bound estimate of the stress induced in a pipeline due to demolition is provided by equation 6 where the peak particle velocity is either given by equation 5 or by a bounding estimate to measured data.

$$\Delta\sigma = 0.3v \qquad \text{equation 6}$$

where

$\Delta\sigma$ = cyclic stress (N/mm^2)

v = peak particle velocity (mm/s)

The factor of 0.3 is an empirically derived constant with units which are consistent with stress and velocity.

3.4 Other Sources of Vibration

Other sources of vibration arising from construction activities which are not covered in sections 3.1 to 3.3 can also be evaluated for their effect on the integrity of adjacent pipelines.

Predictions of the peak particle velocity must be provided in advance of the site works and include the calculation methodology and supporting theory. Alternatively, previous measurements of vibration levels may be used to estimate the likely affect on the pipeline provided.

(i) the vibration source is essentially the same for the historical data and the proposed site works.

(ii) the range of distances between the measurement location and vibration source for the historical data bounds the distances from the proposed vibration source to the pipeline.

(iii) the ground conditions for the historical data are similar to the proposed site where the pipeline is located.

This information should be provided and evaluated in advance of site works.

In circumstances where prediction methods or historical data are not available, site trials or measurements should be carried out. This is covered in section 6.

An estimate of stress in the pipeline from the vibration activity is provided by equation 7. Upper bound estimates of peak particle velocity should be used whenever possible and caution should be applied to the predicted stresses for low peak particle velocity sample sizes.

$$\Delta\sigma = 0.3v \qquad \text{equation 7}$$

where

$\Delta\sigma$ = cyclic stress (N/mm^2)

v = peak particle velocity (mm/sec)

The factor of 0.3 is an empirically derived constant with units which are consistent with stress and velocity. Unless it can be reliably demonstrated that the likely vibration level will not exceed 40mm/s, it is recommended that measurements of peak particle velocity are taken for vibration disturbance by sources not covered in sections 3.1, 3.2 and 3.3. In circumstances where significant doubt exists over the predicted magnitudes of vibration, direct monitoring of pipeline stress levels by the installation of strain gauges should be considered in addition to measurements of the peak particle velocity.

4. ASSESSMENT OF PIPELINE SETTLEMENT

Pipelines may be at risk of loading from permanent settlement displacements under the action of a vibration disturbance which leads to the densification of the soil or the liquefaction of the soil.

The potential for settlement due to vibration disturbance generally applies only to non-cohesive soils.

For liquefaction to occur, the soil needs to be in a saturated condition. This may apply to soils located below the pipe depth.

Sands are susceptible to vibratory densification or liquefaction if they have any of the following characteristics: narrowly graded or single sized, clean sands with less that 10% fines (silt and clay fraction), and relative densities of less than 60%.

Non-plastic silts are susceptible to vibratory densification or liquefaction if they have a uniform grain size.

An assessment of the likelihood and magnitude of permanent settlement displacements should be carried out if the soil is considered susceptible to densification or liquefaction from vibration effects. Soils that may be at risk of vibration induced settlement typically include recent (post-glacial) deposits especially alluvial soils in river valleys and estuaries. In addition to site records of ground conditions, geological and geotechnical information at a site can be obtained from 1:50000 and 1:10000 scale geological maps and associated memoirs available from the British Geological Survey. Sources of additional geological and geotechnical information are given in BS 5930.

The difficulties of theoretical predictions of settlement make laboratory tests on soil samples the most reliable method of predicting vibratory induced settlement. The sample is subjected to the anticipated initial stresses and dynamic loadings as a result of the vibrations. Field measurements of settlement provide a practical alternative to establishing the magnitude of potential settlement affecting the pipeline (section 6.3).

The effect of predicted or measured settlement on the pipeline integrity should be investigated by an appropriate technique such as numerical stress analysis. The analysis should account for the pipeline configuration, dimensional properties, steel grade, internal loads of pressure and temperature, construction stress and soil restraints. The calculation of the pipeline integrity should follow specification NGN/SP/GM1.

5. ACCEPTANCE LIMITS

5.1 Vibration Loads

A peak particle velocity limit of 75mm/s shall apply to pipelines without the need for a carrying out an assessment of the pipeline stress state and the incremental effect of the vibration disturbance.

Where the peak particle velocity is predicted or measured to exceed 75mm/s, the stress acceptance criteria for the operating, depressurised and occasional load cases in specification NGN/SP/GM1 shall apply. The vibration loads must be considered as additional to all other relevant static and transient loads affecting the pipeline.

Where the stress increments from vibration loads are predicted using equations 2, 4 or 6 in section 3, these should be considered as longitudinal and circumferential bending stresses. The stress increments should be considered to act in the most adverse combination when calculating the pipeline stress state.

For situations where direct measurements of pipeline stress are available, the maximum simultaneous incremental values of longitudinal and circumferential stress should be combined with the existing stress components.

The maximum allowable stress increment from the vibration loading can be determined based on calculations of the pipeline stress state prior to any vibration event. The stress increment can be converted to an equivalent maximum allowable value of peak particle velocity by rearrangement of equations 2, 4 or 6. This provides a control value for use in monitoring schemes involving the measurement of ppv outlined in section 6.2.

The acceptance limit for cyclic loading in specification NGN/SP/GM1 should be met.

5.2 Settlement loads

Pipeline stresses arising from settlement loads must meet the acceptance criteria set out in specification NGN/SP/GM1.

6. MONITORING REQUIREMENTS

6.1 General

Monitoring should be considered in the following situations,

- Where the peak particle velocity is predicted to exceed 50mm/s.
- Where the proposer of the work is unable to demonstrate sufficient experience or familiarity with the prediction effects of vibration disturbance.
- Where the vibration disturbance event is not covered by the prediction methods in sections 3.1 to 3.3 or there is doubt over the predicted magnitude of the vibration.
- Where the pipeline is located in unusual or sensitive locations such as slopes, adjacent to retaining walls, routed through civil structures (e.g. bridges and bridge abutments) or located in suburban (“S”) areas as defined in TD1 *Steel Pipelines for High Pressure Gas Transmission*.
- Where ground conditions are considered to be unusual or particularly variable.
- Where the extent of the proposed activity is considered to be significantly larger than previously experienced such as the demolition of a large structure (over 20000 tonnes) or involving significant quantities of high explosive (over 250kg per delay).

- Where it is proposed to carry out blasting in a ditch or trench installation or for tunnelling excavations such that there is a restricted size of free face to dissipate the explosive energy.

In addition to monitoring the vibration disturbance, ground surveys must be carried out where soil or rock movement is predicted as a result of the vibration loading (section 6.3). The stability of slopes should also be considered for specialist investigation where pipelines may be affected in these locations.

For further guidance on suitable equipment and techniques, the specification NGN/SP/GM8 should be consulted.

6.2 VIBRATION MONITORING

6.2.1 Peak Particle Velocity

Monitoring of vibration disturbance is most conveniently achieved by measuring peak particle velocity (ppv).

A monitoring scheme for ppv will involve the installation of one or more geophones preferably in direct contact with the pipeline. Where this is not possible, the geophone should be placed in firm contact with the ground surrounding, or in the vicinity of the pipeline. Measurements taken within the topsoil are considered unreliable.

The geophone should ideally have the capability of measuring the particle velocity in three orthogonal directions. Where only one direction of measurement is possible, this should be the vertical orientation.

Interpretation of the data will generally involve consideration of the resultant of the maximum in plane values of particle velocity unless there is sufficient information to determine the maximum resultant of the simultaneous orthogonal values of particle velocity.

Where the scheme or activity allows, site trials or measurements should be undertaken in advance of the closest approach of the disturbance source to the pipeline in order to improve the prediction technique. This may include calibration of equation 1, 3 or 5 to reflect the site specific data.

6.2.2 Pipeline Stress Levels

Direct monitoring of the pipeline stress levels by strain gauges should be carried out where it is not possible to modify the proposed site activities in order to protect the pipeline, without affecting the scheme viability or where concern exists over the predicted magnitudes of vibration likely to affect the pipeline.

A supported or battered excavation with sufficient clearance allowing access around the pipeline is required. Foil resistance strain gauges are attached to the prepared pipeline surface following removal of the pipe coating. The gauges are aligned to measure changes in longitudinal or circumferential strains as a result of the vibration loading. The sampling rate for strain changes needs to be sufficiently rapid to record the peak strains. A decision on the trigger mechanism for recording the event is required and generally involves either a manual setting or continuous monitoring with a threshold strain level to invoke recording.

Where permanent strains may be developed, vibrating wire strain gauges and thermistors or platinum resistance thermometers are recommended.

Care must be taken over the installation of strain gauges in the trench environment because of difficulties in achieving a clean prepared surface, in protecting the gauges in the trench, and in protecting the lead wires between the trench and the recording location.

In all situations where the pipeline stress is monitored, measurements of the peak particle velocity must also be carried out.

Where the scheme allows site trials or site measurements, these should be commenced as early as possible prior to the closest approach of the disturbance source to the pipeline in order to provide site specific validation of the prediction methods and techniques. This may involve calibration of equations 2, 4 or 6 to reflect the site specific data.

6.3 Settlement Monitoring

Where pipelines are considered to be at risk of permanent settlement displacements due to densification or the liquefaction of the soil, monitoring of the soil or pipeline movement should be carried out.

Suitable surveying methods include precise levelling and total station techniques or alternatively satellite methods involving the Global Positioning System (GPS) may be considered.

Where possible, it is preferable to monitor ground settlements in advance of the pipeline becoming affected in order to determine the requirement for, and implementation of protective measures.

The design of the monitoring scheme should take into account the extent of pipeline likely to be affected by settlement, the frequency of measurement and threshold values which invoke remedial work such as uncovering the pipeline.

Where the ground is susceptible to liquefaction, direct monitoring of the pipeline settlement should be considered because of the potential for differential movement between the ground surface and the pipeline.

7. MITIGATION ACTIVITIES

7.1 General

Cut-off trenches between the source and pipeline will reduce the direct transmission of vibrations. The most effective use of cut-off trenches is made when they are located close to the energy source or the pipeline. The trench depth should equal or exceed the depth of the base of the pipeline. For trenches located close to the pipeline consideration should be given to the potential for movement of the excavation wall.

7.2 Piling

Disturbance can be minimized by careful consideration of the piling method and the selection of a technique appropriate for the ground conditions such as bored pile installation or the use of pile jacking systems in sensitive locations.

Pre-boring or excavation of a starter trench will reduce disturbance during penetration of the near surface soils.

Reduction of the driving energy may be considered. However, this may extend the period over which the pile installation takes place.

Use of water or bentonite can reduce the penetration resistance for some methods of pile installation.

Additional considerations for reducing the disturbance from piling operations are covered in BS5228 part 4.

7.3 Blasting

Reduction of the charge weight per delay will reduce the vibration disturbance although this inevitably increases the number of blast events required. Where a reduction of the charge weight is needed for example in a quarry in order to maintain the vibration loading on a nearby pipeline within acceptable levels, this may require the quarry face to be split into two or more working benches. Where alteration to the blast design is likely to incur significant cost, consideration should be given to direct monitoring of the stress in the pipeline by installation of strain gauges.

The direction of quarry excavation and hence the blast hole array orientation can reduce the vibration effects on the pipeline. Positioning the array with the dominant number of holes orientated perpendicular to the pipeline axis should be considered.

8. REPORTING REQUIREMENTS.

The report on the assessment of the effect of vibration on a pipeline should include:

- A plan of the construction or mining activity at a suitable scale showing the pipeline location and vibration source or sources.
- Identification of the distance between the pipeline and the vibration source.
- The ground conditions encountered or assumed at the site.
- The predicted peak particle velocity and method used.
- The assessment of the pipeline stress state and acceptability to NGN/SP/GM1.
- The required protection action.
- Details of any monitoring schemes installed for the pipeline protection including a plan drawing.
- The results of monitoring schemes.

9. REFERENCES

NGN/SP/P2 (2000) *Specification for Welding of Land Pipelines and Installations Designed to Operate at Pressures Greater than 7 Bar*.

IGE/TD/1 Edition 4 (2001) *Steel Pipelines for High Pressure Gas Transmission*, Recommendations on Transmission and Distribution Practice, Institution of Gas Engineers.

BS5930:1999 *Code of Practice for Site Investigations*, British Standards Institution.

BS5228 Part 4:1992 *Noise Control on Construction and Open Sites – Part 4 : Code of Practice for Noise and Vibration Control Applicable to Piling Operations*, British Standards Institution.

APPENDIX A

PROTECTION FROM VIBRATION LOADS - SHEET 1

Project:_____ **Date**_____

GENERAL:

Location_____

Grid Reference_____

Period of proposed activity_____

CONTACT INFORMATION:

LDZ_____

LDZ Contact_____

Tel_____

Contractor_____

Contractor Contact_____

Tel_____

PIPELINE INFORMATION:

Pipeline name_____

Pipeline diameter_____mm

Wall thickness_____mm

Grade_____

MOP_____

Depth of cover_____m

Year of construction_____

Pipeline meets the requirements of P2

Ground condition:_____(Known / presumed)

Report reference:_____

Disturbance type:

☐ Blasting

No blasting allowed within 250m of pipeline below 200kg, or 500m above 200kg without assessment.

Charge weight_____Kg

☐ Piling

No piling allowed within 15m of pipeline without assessment.

Driving method_____

(from BS 5228-4)

Energy per blow_____J

Ground condition factor, C (table 1)_____

☐ Demolition

No demolition allowed within 150m of pipeline, or 400m for a structure mass greater 10000 tonnes without assessment.

Structure contact area_____m^2

Structure mass _____tonnes

☐ Other

Describe

Distance from source to pipeline (m)_____

Predicted PPV (mm/s)_____

Monitoring required ☐

Stress assessment required ☐

Sketch of site layout:

PROTECTION FROM VIBRATION LOADS - SHEET 2

Project_____ Date_____

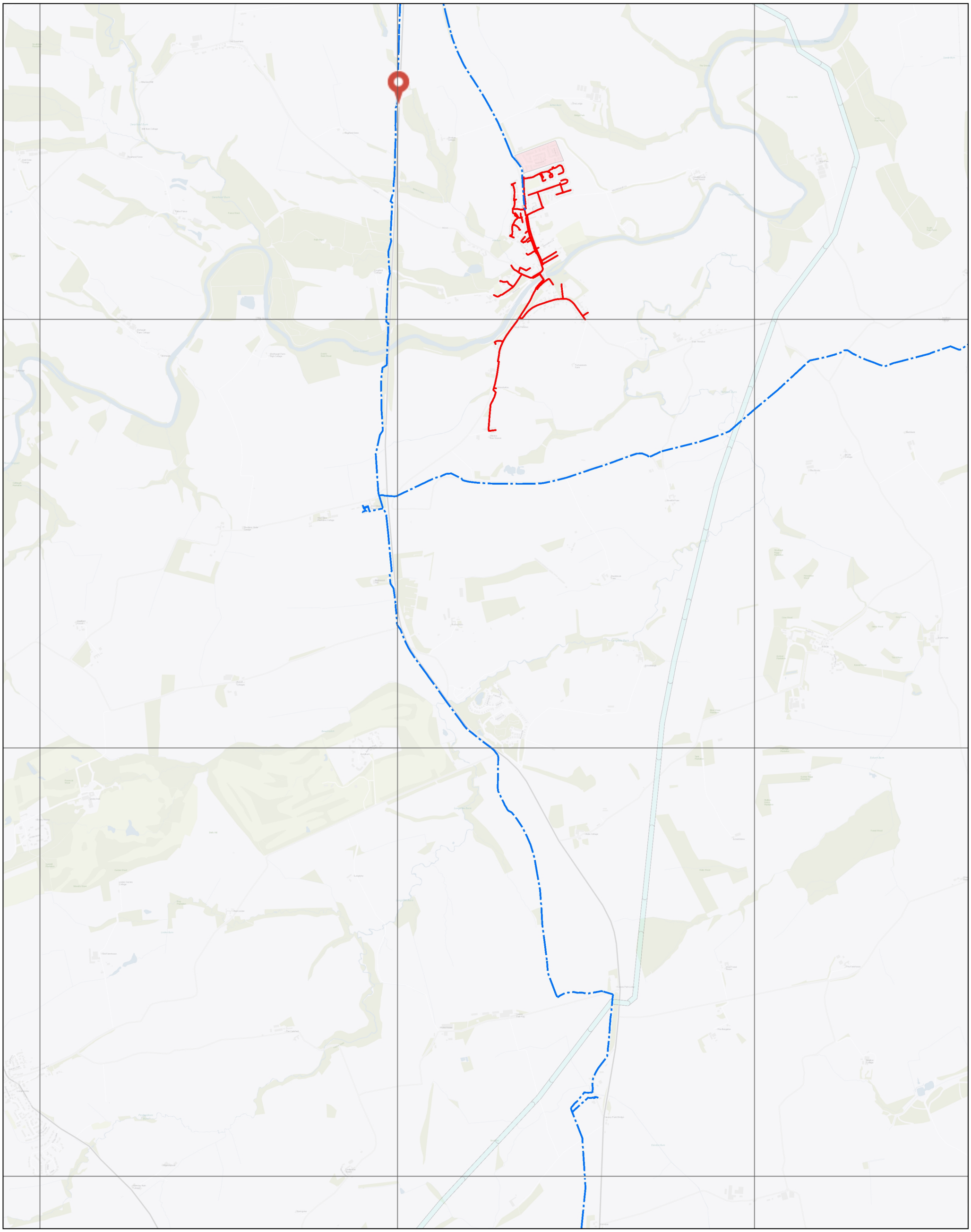
Sketch of monitoring locations:

Location	Date	Distance	PPV (mm/s)	Stress (N/mm^2)

Felton To Morpeth A1 Map 1

415,000 417,500 420,000

600,000 597,000 594,000



415,000 417,500 420,000

Legend

Pipes
- Intermediate Pressure
- Medium Pressure
- Low Pressure

Transmission Pipe
- Regional High Pressure

Asset Protection
- Cathodic
- Slabbed
- Sleeved

Network Plant
- Flow Stop - Open
- Flow Stop - Closed
- Valve - Open
- Valve - Closed
- Transmission Valve - Open
- Transmission Valve - Closed

Network Asset
- CP Point
- Dip Point
- Drain Point
- End Closure
- Flow Measure
- Gas Conditioner
- Governor
- MEG Point
- Meter
- OMR
- Oiling Point

Network Asset (continued)
- Pig Trap
- Pipe Joint
- Pressure Measurement
- Purge Point
- Reducer
- Stand Pipe
- Syphon
- Tee
- Test Point

Non-Network Asset
- Outlet
- Inlet
- Depth of Cover
- Crossover Connection
- Change in Material
- Change in Diameter

- NTS

IGT Area
- IGT Site
- Infill Site
- LPG Site
- OMR's

Pipeline
- Contact Zone

Environment
- SAM
- SSSI

1: 25,000

0 500

Meters

Disclaimer Information

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User ID	Jameson Bwanali
Date	23/10/2020
Grid Ref	418117 / 597922

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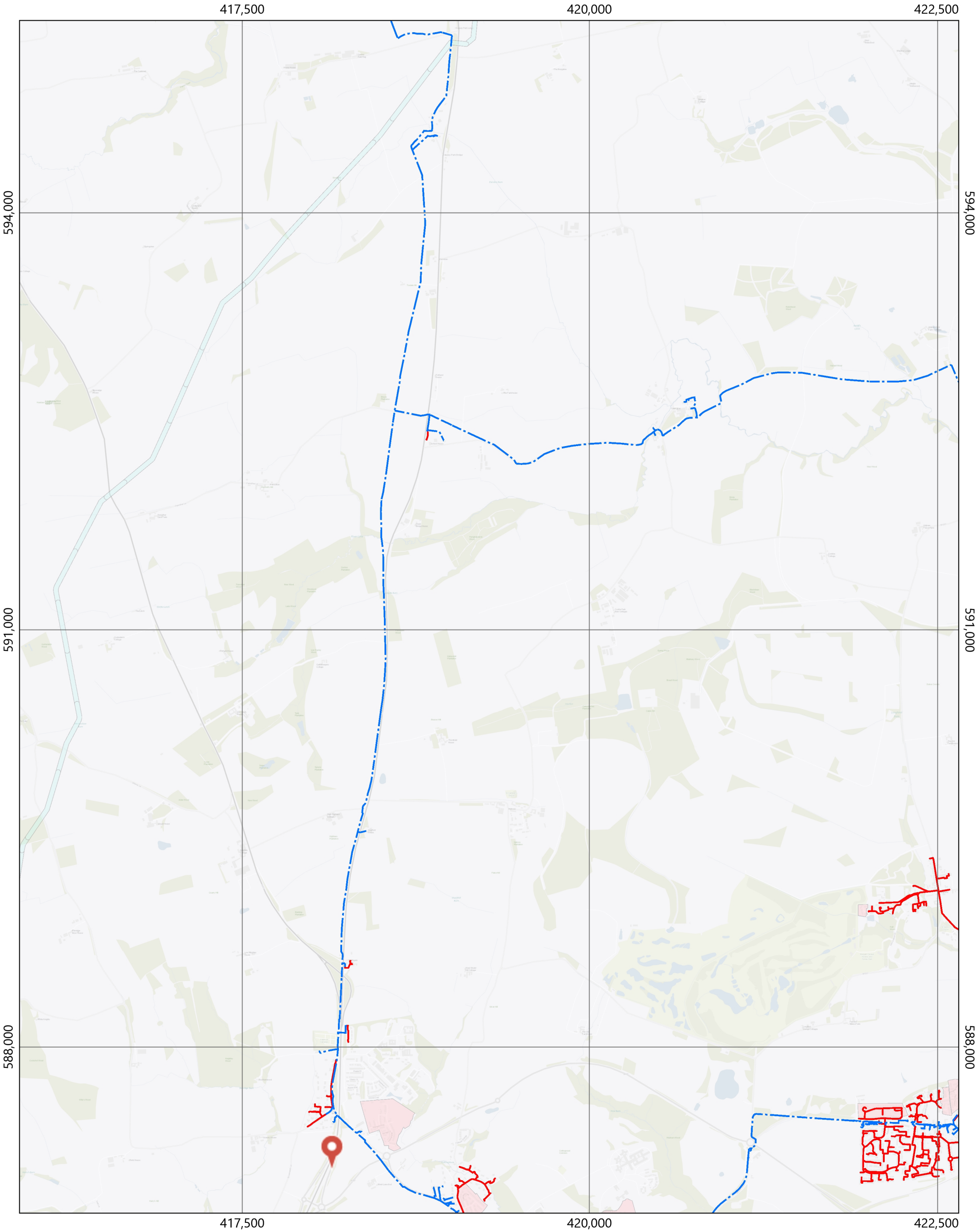
Felton To Morpeth A1 Map 2



Legend

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0 500

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Date	23/10/2020
Grid Ref	419274 / 591095

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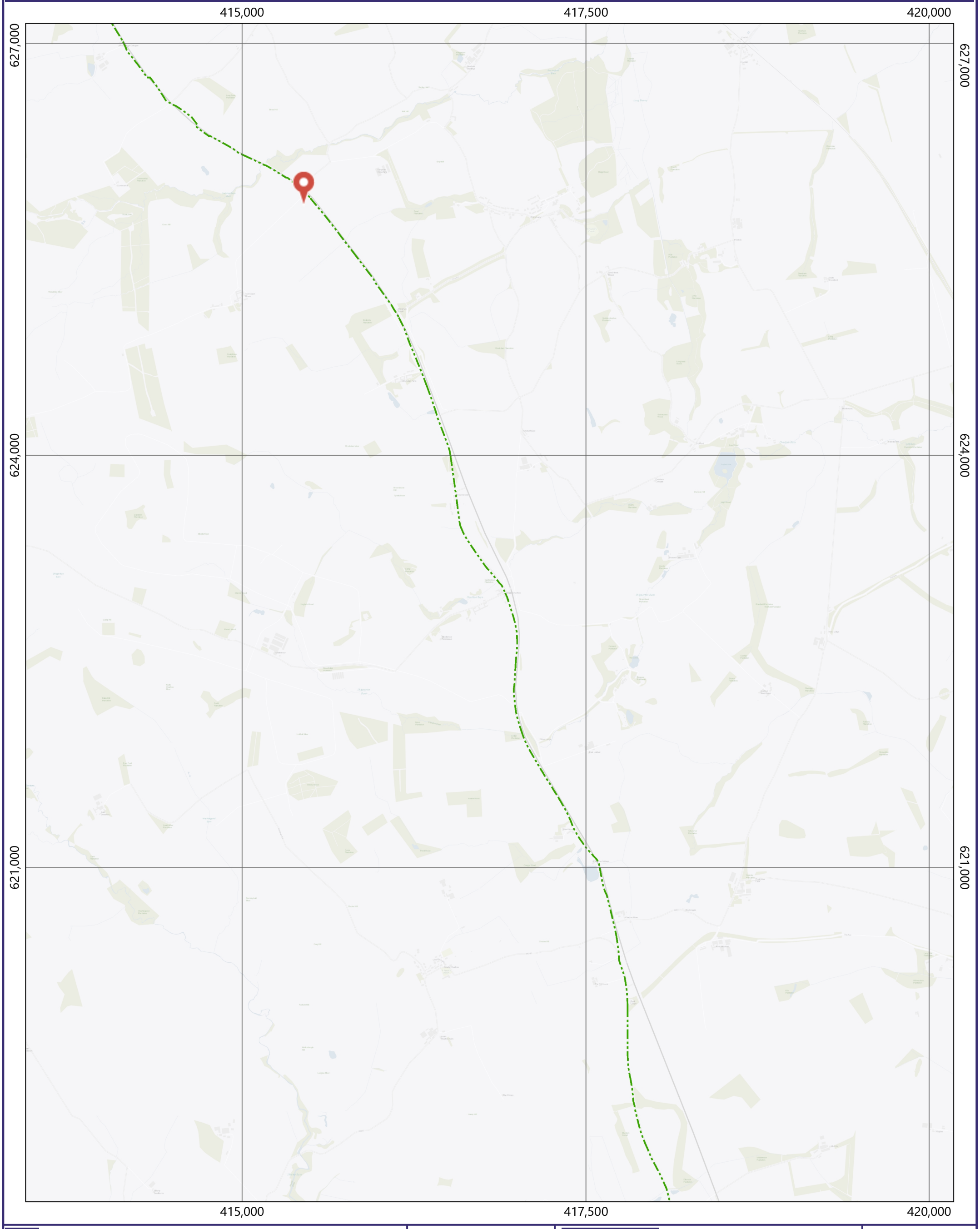
Alnwick to Ellingham A1 Map



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0 500

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User ID	Jameson Bwanali
Date	23/10/2020
Grid Ref	416801 / 622856

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Alnwick to Ellingham A1 Map 2

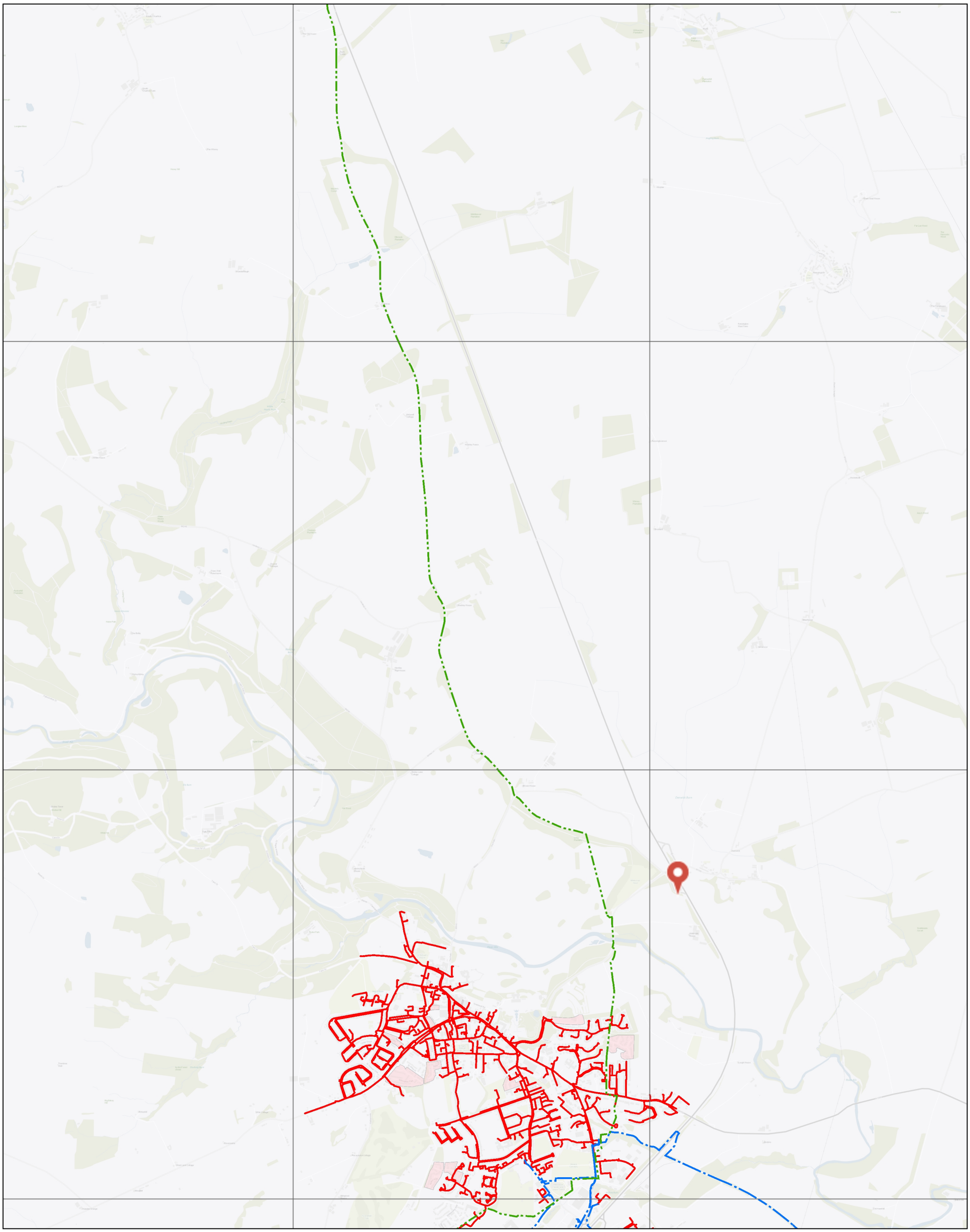
417,500

420,000

618,000

615,000

612,000



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Grid Ref	418845 / 616076

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