Gas Connection Concept Design Report

Thurrock Flexible Generation Plant

Application document number A7.4

APFP Regulations reference 5(2)(q)

Document Title:

CONCEPTUAL DESIGN REPORT

12” (DN300) PIPELINE

Document No:

E-18110200-M-0501-001

Project Title:

THURROCK POWER – PIPELINE CONCEPTUAL DESIGN REPORT

Record of Issue:

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A	21 NOV 2018	FOR REVIEW	BT/DB	BT	DB
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D	21 JAN 2020	FOR REVIEW	BT	SC	DB

Change Control:

REVISION	CHANGES TO DOCUMENT
B	Section 5.1.2 and 5.1.7 updated.
C	Figure 1, Table 4 and Table 5 updated for adjusted route options. Length of pipeline adjusted where referenced in paragraphs.
D	Table 4 crossing methods updated.

Distribution List:

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Contents:

1 INTRODUCTION

Thurrock Power Ltd proposes to develop a flexible generation plant on land north of Tilbury Substation in Thurrock. The flexible generation plant will provide up to 600 megawatts (MW) of electrical generation together with up to 150 MW of battery storage capacity.

This report describes the Conceptual Design Study undertaken for the 12” (DN300) pipeline that conveys high pressure natural gas from a Minimum Offtake Connection off National Grid’s (NG) National Transmission System (NTS) to the power station gas receiving compound.

The pipeline route is approximately 2.1km in length with preliminary start and end point coordinates of E:568046, N:177356 and E:566434, N:176906 and includes a number of road, ditch and track crossings (see Figure 1 for overall pipe route).

The purpose of this report is to identify a constructible route for the pipeline and carry out sufficient design work to enable an order for line pipe to be placed and for long-lead items (LLIs) to be identified ready for the commencement of the detailed design phase.

The Environmental Statement report considers the environmental impact along the conceptual design pipeline route.

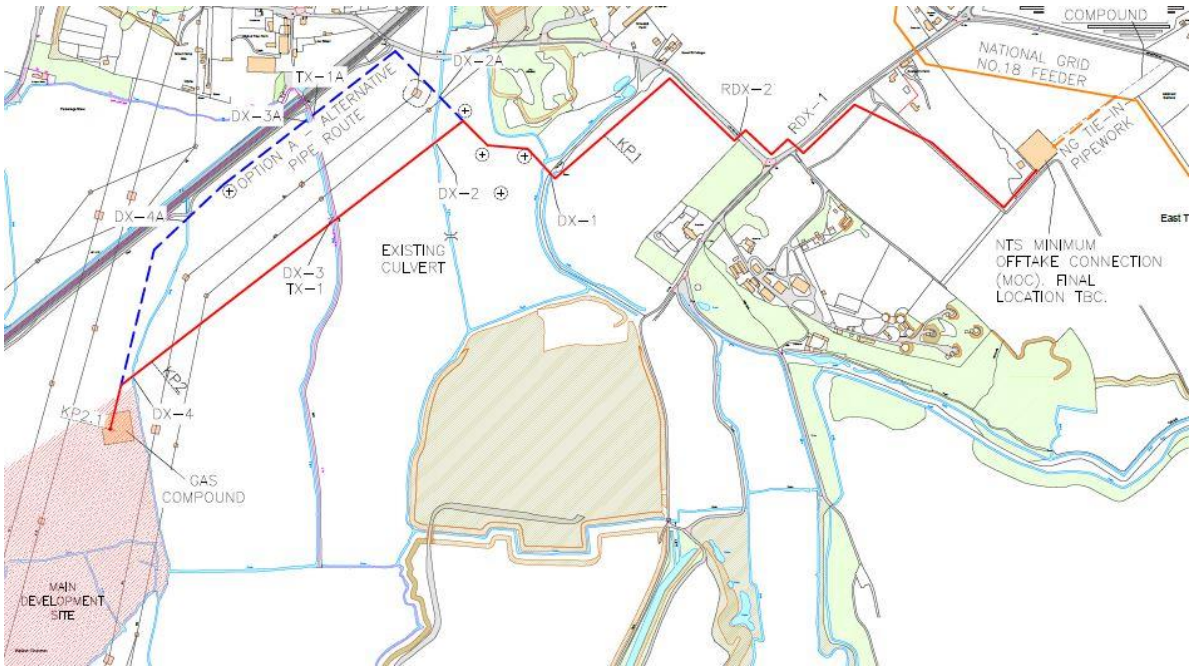

Figure 1 - Overall Pipe Route

This report should be read in conjunction with the following documents (see Appendix A):

E-18110200-M-0200-001	Overall Route Plan 300 Dia. Pipeline
E-18110200-M-0200-002	Pipeline Alignment Drawing 300 Dia. Pipeline Sheet 1 of 3
E-18110200-M-0200-003	Pipeline Alignment Drawing 300 Dia. Pipeline Sheet 2 of 3
E-18110200-M-0200-004	Pipeline Alignment Drawing 300 Dia. Pipeline Sheet 3 of 3
E-18110200-C-0209-001	General Arrangement Typical Crossing Ditch or Stream
E-18110200-C-0209-002	General Arrangement Typical Crossing Minor Road and Track
E-18110200-C-0209-003	General Arrangement Typical Pipeline Right of Way
E-18110200-M-0300-001	Wall Thickness Calculation Proximity Pipe
E-18110200-M-0300-002	Wall Thickness Calculation Line Pipe

2 DESIGN GENERAL

2.1 Legislation

The Preliminary Design of the pipeline has taken into consideration the relevant health and safety legislations and other relevant legislations where applicable, shown below:

- Gas Act 1986 (as amended 1995)
- The Pipelines Safety Regulations 1996
- The Construction (Design and Management) Regulations 2015
- Health and Safety at Work etc. Act 1974
- The Electricity at Work Regulations 1989
- The Pressure Systems Safety Regulations (PSSR) 2000
- The Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002
- The Public Gas Transporter Pipe-line Works (Environmental Impact Assessment) Regulations 1999
- Control of Substances Hazardous to Health Regulations 2002

2.2 Design codes and specifications

The pipeline, including special crossings, will be designed, constructed and tested to comply with the Institution of Gas Engineers and Managers publication, IGEM/TD/1 Edition 5, 2008 - 'Steel pipelines and associated installations for high pressure gas transmission' (plus supplements).

Throughout this document when IGEM/TD/1 is referred to it can be assumed that this is Edition 5 unless noted otherwise.

2.3 Design parameters

The pipeline design parameters are summarised in Table 1 and Table 2.

The designs have optimised pipe sizes to accommodate the worst-case simultaneous flow and pressure conditions.

Table 1 - 300NB Pipeline Design Parameters

PARAMETER	VALUE
Maximum operating pressure (MOP)	70.0 barg
Safe operating limit (SOL)	77 barg
Minimum operating pressure	38 barg
Design pressure	77 barg
Maximum flow	155,520 scmh
Temperature range	0°C to 50 °C
Design life	40 years

Table 2 - Cycling Pressure

PRESSURE RANGE (barg)	DIFFERENTIAL PRESSURE (barg)	NO. CYCLES
70 – 0	70	5
70 – 55	15	1000
70 – 64	6	8000
70 – 65	5	6000

HOLD – NG to provide historic operating data of the No. 18 feeder between Tilbury Thames North and Horndon.

3 PIPELINE DESIGN

3.1 Pipe material selection and wall thickness

It should be noted that although this section of the report deals with identifying those sections of the route that require line pipe (Type R areas) and proximity pipe (Type S areas), It is recommended that the entire route be installed as Type S (design factor 0.3). This is due to several factors not limited to:

- **A relatively short pipe route**
- **Small diameter pipeline**
- **Continuity of materials for construction, weld procedures / qualifications etc.**
- **Proximity pipe is required for over 50% pipe route**
- **Future proofs the design for encroaching proximity, population density, sensitive development issues**
- **Low differential for material / construction costs for line and proximity pipe**

This approach should be confirmed by Statera during detail design.

The pipe considered for this project, detailed in Table 3, has been selected to comply with IGEM/TD/1.

Table 3 - Pipe selection

PARAMETER		VALUE	
Pipeline outside diameter		323.90 mm	
Line pipe	Material grade	API 5L X52 PSL2	
	Wall thickness	6.35 mm	Sch. 20
Proximity pipe	Material grade	API 5L X52 PSL2	
	Wall thickness	12.7 mm	Sch. XS

Using the formula in IGEM/TD/1 section 6.4, calculations have been carried out (see calculations E-18110200-M-0300-001 & 002) for the above pipes to verify that their specifications are fit for purpose, based on the following assumptions:

a. The pipe will be 300NB (323.9mm outside diameter)

b. Pipeline design pressure is 77.0 barg

c. Pressure cycles are within the acceptance criteria set out in IGEM/TD/1section 6.5.3 (for a 70.0 barg MOP pipeline)

d. A manufacturer's under tolerance of minus 12.5% has been applied to the pipe wall thickness

e. No allowance for construction damage has been included for in the calculation

f. The resultant design factors used in the calculations are in accordance with IGEM/TD/1

g. Material grades and yield strength have been generally in accordance with API 5L / ISO 3183 (PSL2) Grade X52

Both combinations of wall thickness and material grade conform to the requirements of IGEM/TD/1.

IGEM/TD/1 clause 6.7.4 for Type R areas gives a maximum design factor, 'f', of 0.72. The calculated resultant factor, 'f', for the selected line pipe is 0.5 and therefore in accordance with the requirements of IGE/TD/1.

IGEM/TD/1 clause 6.7.5 for Type S areas gives a maximum design factor, 'f', of 0.3. The calculated resultant factor, 'f', for the selected proximity pipe is 0.25 therefore in accordance with the requirements of IGE/TD/1.

Therefore, the selected line pipe meets the requirements for operation in Type R areas and proximity pipe meets the requirements for operation in Type S areas and therefore is suitable.

3.2 **Pipeline routing**

The pipeline route corridor was initially detailed by RPS in the Preliminary Environmental Impact Report which led to the development of the conceptual pipeline route.

The route drawings referenced in Appendix A of this report show the conceptual design pipeline route which has been developed from the route provided by RPS / Statera. The pipeline route has been reviewed with respect to constructability, legislative, safety, environment and engineering.

During the preparation of these drawings, information has been gathered from other utility companies and where appropriate has been included on the drawings in order to determine the number of special crossings and finalise the amount of proximity pipe required.

During the next phase of the project, any 'fine tuning' of the pipeline route as a result of land owner negotiations will be incorporated into the pipeline design and the maps updated accordingly.

3.3 Building proximity calculations

The minimum building proximity distance (BPD) for both 'line pipe' and 'proximity pipe' has been extrapolated from Figures 5 and 6 of IGEM/TD/1 and verified using Equation 1 and Equation 2. They are based on the pipeline being 323.9mm [outside] diameter, having a MOP of 70.0 barg and wall thickness $\geq$ 11.91mm.

Equation 1 - Minimum building proximity distance (line pipe)

$$\begin{aligned} Minimum\ BPD_{LP} &= (C_1 \times MOP) + C_2 \\ &= (0.37 \times 70.0) + 10.48 \\ &= 32.88m \end{aligned}$$

Therefore from Equation 1, the BPD for line pipe is 33 metres (rounded to the nearest metre).

Equation 2 - Minimum building proximity distance (proximity pipe)

$$\begin{aligned} Minimum\ BPD_{PP} &= (C_1 \times MOP) + C_2 \\ &= (0 \times 70.0) + 3 \\ &= 3.0m \end{aligned}$$

Therefore from Equation 2, the BPD for proximity pipe is 3 metres.

3.4 Building proximity survey

Using the conceptual design pipeline route (document E-18110200-M-0201-001) as a basis, a check for any buildings within the BPD was made. A circle with a radius of 33m (BPD) was traversed, using AutoCAD, along the pipeline route. Any buildings inside the circle – either partially or wholly – were classed as being inside the BPD. Where buildings fall within one BPD of the pipe route, the pipeline shall be constructed using proximity pipe.

For the detail design a site review of buildings within the BPD circle of the pipeline should be undertaken to assess if they are habitable and where dwellings were found within the 1 BPD the route should be examined to check whether enough proximity pipe has been allowed for.

3.5 Population density calculations

To comply with IGEM/TD/1, a population density study must be carried out on a pipeline route to identify Type R and Type S areas in order to select the appropriate wall thickness of the pipeline.

In order to determine the precise boundary between Type R and Type S areas, the population density has to be calculated within circles whose diameter is 8 times the BPD. By considering such

circles in sequence along the pipeline route, the centre of the circle within which the population density first falls below the required number of dwellings (2.5 persons per hectare) is determined as the boundary.

In accordance with IGEM/TD/1 the allowable number of dwellings for a Type R Type area for the pipeline is as per Equation 3.

Equation 3 - Population density

From Equation 1; $BPD_{LP} = 33m$

Diameter for 'rolling circle' population density, $8BPD$; $8 \times 33 = 264m$

Area of the circle;

$$A_c = \pi r^2$$
$$A_c = \pi \left(\frac{264}{2}\right)^2$$
$$A_c = 54{,}739.11m^2$$
$$A_c = 5.47\ hectares$$

As per IGEM/TD/1 section 6.7.1.1, allowable number of persons per hectare is 2.5. Therefore, allowable number of persons within the rolling circle, C_P;

$$C_P = A_c 2.5$$
$$C_P = 5.47(2.5)$$
$$C_P = 13.68$$

Allowable number of persons per circle, C_P, has been rounded down to 13 persons for Type R area.

As per IGEM/TD/1 section 6.7.2.3, the occupancy of typical houses has been assumed to be 3 persons per dwelling. Therefore, allowable number of dwellings per circle, C_D;

$$C_D = \frac{C_P}{3}$$

$$C_D = \frac{13}{3}$$

$$C_D = 4.3$$

Allowable number of dwellings per circle C_D, has been rounded down to 4 dwellings for Type R area.

3.6 Population density survey

A population density study has been undertaken to assess the area classification as defined by IGEM/TD/1 section 6.7. This is a check on the areas identified as requiring proximity pipe. The method used for calculating the allowable population density figure is the 'rolling circle' method, as described in section 3.4, using a circle of diameter 264m. The technique used to check for any population density infringements is the same as for BPD infringements.

An overview of the amount of proximity pipe for population density is shown on pipeline alignment drawings E-18110200-M-0201-002/003/004, however there is a location that requires clarification due to the limited information of the maps to indicate its purpose, as follows:

- Drawing E-18110200-M-0200-002
  North east of the Poultry Farm, there is a cluster of buildings where it is not known whether or not they are occupied. It has been assumed, at this conceptual stage, that they are unoccupied.

3.7 Sensitive development survey

There are no 'sensitive' areas within the proximity of the pipeline that require further investigation at this stage.

Sensitive developments will need to be re-examined as part of the detailed design project phase.

3.8 Special crossings

All special crossings (road, track and ditches) are to be designed in accordance with IGEM/TD/1. The 1:1,250 pipeline alignment drawings (documents E-18110200-M-0200-002/003/004) show general compliance with the requirements.

A pipeline crossing schedule is included in Table 4.

Environmental constraints will be detailed within the Environmental Statement (ES). At the detailed design stage, the crossing methods will be considered in detail, including a review of all site works currently in progress.

During detail design all crossings will be designed in accordance with the requirements of IGEM/TD/1 section 6.10 and shall consider the effects of 'additional loads' (IGEM/TD/1, section 6.5).

Table 4 - Pipeline crossings schedule

PIPELINE ROUTE	CROSSING DETAILS			APPROXIMATE LOCATION (O.S. COORDINATES)	
	TYPE	TAG	CROSSING METHOD	EASTING	NORTHING
Proposed route	Road	RDX-1	Open Cut	567630	177396
	Road	RDX-2	Open Cut	567529	177415
	Ditch	DX-1	HDD	567200	177352
	Ditch	DX-2	HDD	566998	177404
	Track	TX-1	Open Cut	566825	177270
	Ditch	DX-3	HDD	566821	177267
	Ditch	DX-4	HDD	566473	176998
Route option A	Ditch	DX-2A	HDD	567007	177485
	Track	TX-1A	Open Cut	566784	177450
	Ditch	DX-3A	HDD	566779	177446
	Ditch	DX-4A	HDD	566568	177272

3.9 Material Take Off (MTO)

3.9.1 Pipeline material

The overall length of the proposed pipeline, measured from document E-18110200-M-0200-001, is approximately 2.14km. At this stage, it is assumed that approximately 1.09km of the pipeline will be line pipe (measured from document E-18110200-M-0200-002/003/004).

Pipe material for this project has been selected to comply with IGEM/TD/1.

3.9.2 Line bends

As per section 5.1.3, cold bends can be used subject to restrictions.

An assessment of the number of fabricated bends required for larger changes in direction and special crossings has been made during the conceptual design period as shown in Table 5.

Table 5 - Pipeline bend schedule

DESCRIPTION	QUANTITY
12" NB, 3D Radius, 45° bend, ASTM A860 WPHY 60 to suit SCH80 X52 pipe	4
12" NB, 3D Radius, 90° bend, ASTM A860 WPHY 60 to suit SCH80 X52 pipe	10

The bend quantities above are indicative only. There may be a requirement for additional bends including 22.5^{o} and 11.25^{o} fabricated bends. All bends should have a minimum bend radius of 3D (3 x pipe diameters).

There are a number of bends that could be considered "sharp" bends where 90^{o} bends are currently proposed. For changes of direction of this nature anchor blocks can be considered at the bend. This should be considered further during the detail design flexibility analysis. An alternative option would be to replace the 90 bends with 2 x 45 bends some distance apart.

3.9.3 Pipeline coatings

The pipeline materials should be coated in accordance with section 10.3 of IGEM/TD/1.

Wherever possible, coatings for pipes and fittings should be factory-applied. Materials used for coating on site shall be compatible with any factory applied coatings.
In the absence of project specific standards at this stage it can be assumed that the following NG company standards apply:

External
T/SP/CW/5 - Specification for Field Applied External Coatings for Buried Pipework and Systems
T/SP/CW/6 - Technical Specification for the External Protection of Steel Line Pipe and Fittings Using Fusion Bonded Powder and Associated Coating Systems: Parts 1 and 2

Internal
T/SP/CM/1 Specification for Internal Coating Operations for Steel Line Pipe and Fittings

3.10 Public utility liaison

Details of public utilities available at the time of the conceptual design have been overlaid onto the pipeline alignment drawings including ground penetrative radar (GPR) survey of Station Road (RDX-2).

Full details of all utilities along the pipeline route will be required during detail design and any additional crossing of a third-party utility should be added to the crossing schedule and considered in detail.

3.11 Cathodic protection

The pipeline will be protected from corrosion by a combination of pipe coating and cathodic protection (CP) in accordance with industry standards and international codes and standards.

Site surveys including soil resistivity readings along the pipeline route will be carried out during the detail design phase. It is envisaged that there will be a ground bed and CP transformer/rectifier unit at either of the sites at the end of the pipeline, most likely at the power station end. An electricity supply for a CP transformer/rectifier unit will be required.

There are sections of the pipeline route that run parallel with overhead high voltage power lines that could present a risk of AC corrosion as detailed in section 10.4.2 of IGEM/TD/1. The route has been selected to give the best possible separation from the OHLs however it is recommended to install mitigation measures for entire route as this is relatively low cost. Mitigation measures are detailed in section 10.4.3 of IGEM/TD1, testing can be completed post installation using the test posts which will confirm whether the mitigation measures are required to be connected.

4 HEALTH, SAFETY AND THE ENVIRONMENT

4.1 Safety statement

Health and Safety issues will be addressed throughout design and construction activities. The project will be executed in accordance with current health and safety legislation, including the Construction (Design and Management) Regulations 2015 and the Health and Safety at Work etc. Act 1974.

Appointments are to be made at the detailed design phase with respect to health, safety and the environment.

4.2 Environmental issues

The impact of the project on the environment has been, and will continue to be, considered at all stages throughout the design and engineering activities. Adequate provisions will be made to prevent (where possible) or otherwise, minimise potentially harmful effects identified at any stage of the project development.

The preliminary design aims to minimise the effects on the environment along the entire pipe route and at the installations at the start and end points of the pipeline.

Following desk and field studies to identify relevant landscape issues and the constraints that will be imposed by the natural landscape, the pipeline route was carefully selected to minimise any adverse environmental effects. The route chosen has, wherever practicable, been selected to avoid damage to landscape features, such as woodlands and hedgerows. On completion of the pipeline construction, the working width will be reinstated to replace any features affected. At road crossings and field boundaries, any hedges which require removal, will be reinstated.

The Environmental Impact Assessment (EIA) supporting the project will be undertaken by RPS to provide the necessary information for interested parties to objectively assess the project in relation to likely effects on the environment.

The EIA will be a representation of the collation and culmination of a series of studies and surveys and discussions to:

- identify the nature of the existing environment;
- identify the impacts of the proposals;
- predict the likely magnitude and significance of those impacts on the environment; and

- allow the formulation of mitigation measures.

It will assist Statera and NG in ensuring that the construction and operation of the pipeline is carried out in a manner which will minimise effect on the environment.

The EIA will form only part of the environmental assessment process. Environmental assessments will continue throughout the detail design, construction and operation of the pipeline to ensure that the environment is appropriately protected.

4.3 Designer risk register

The Designer Risk Register can be found in ***[HOLD – currently not included at this stage]*** It identifies various hazards that might affect the route of the pipeline. By its nature the Preliminary Design Risk Register identifies generic risks and will be expanded at the Detailed Design stage.

5 CONSTRUCTION

5.1 Pipeline construction

5.1.1 General

The pipeline will be constructed in compliance with IGEM/TD/1 and current legislation.

5.1.2 Working width

In all circumstances, the limits of the working width shall be marked clearly. Temporary fencing should be provided throughout the period of construction along each side of the working width, to protect landscape and habitat features from disturbance and also to close off the working width at all points of access from public roads. This should be stock-proof where stock is kept on adjoining land.

GA Drawing E-18110200-C-0209-003 provides typical pipeline right of way details.

5.1.3 Depth of cover

The minimum depth of cover over a pipeline shall be in accordance with Table 6. The depth of cover shall be measured from the lowest ground surface level to the top of the pipe, including coatings and attachments.

Table 6 - Minimum depth of cover

LOCATION	MINIMUM DEPTH OF COVER (m)
Rural	1.2
Minor Road & Tracks (1)	2.0
Water courses (ditch or stream)	1.7m (2)

Note 1: Measured from the true clean bottom of adjacent drainage ditches.
Note 2: Measured from the lowest anticipated true clean bed level.

5.1.4 Field bending

In accordance with section 7.10 of IGEM/TD/1 pipes may be bent cold in the field. Bending shall be performed, without wrinkling, on a suitable machine.
An internal mandrel should be used, particularly for larger diameters.
In the finished bend, the angular deflection measured along any axial length equal to the diameter of the pipe shall not exceed 1.5^{o}.

Note: This corresponds to the minimum ratio of radius (measured from the inside of the bend) to diameter of the pipe being in the order of 40 to 1.

Each pipe that is bent shall incorporate a minimum length of 1.25 m of straight pipe before and after the bent portion.

A bend shall not be made within two pipe diameters of a girth weld, which has already been made.

When longitudinally welded pipes are used, the weld shall be at about 45^{o} to the plane of the bend and longitudinal welds of consecutive cold bends shall not coincide.

Before any bend is incorporated in the pipeline, it shall be tested for ovality with a gauging plate of diameter not less than 95% of the nominal bore, subject to a minimum clearance of 25 mm.

Coating and wrapping applied before bending shall be examined and any damage made good.

5.1.5 Protection of existing services

Due to the anticipated number and location of existing services which will necessitate crossing by the new pipeline, some temporary and permanent service protection work will be required to allow the necessary proposed construction works to be carried out. An assessment will need to be performed as part of the Detailed Design phase.

5.1.6 Welding

All welded joints shall be made and inspected in accordance with the BS 4515-1:2009 'Specification for welding of steel pipelines on land and offshore. Carbon and carbon manganese steel pipelines'

As the pipeline from the NG minimum offtake to the gas compound is essentially an extension of the National Transmission System the detail design should consider the requirements of NG Engineering Specification T/SP/P/2 'Technical Specification for Welding of Land Pipelines Designed to Operate at Pressures Greater than 7 bar'.

All mainline mechanised welds shall have 100% automatic ultrasonic testing; all others, including tie-ins will have 100% radiographic inspection.

5.1.7 Pipeline hydrotesting / Dewatering

The pipeline will be tested to demonstrate fitness for purpose in compliance with IGEM/TD/1 and current legislation. This will take the form of hydrostatic pressure testing which must be fully documented. Witnessed records detailing all hydrostatic tests (inc. test pressure charts, pig and pig run register, fill and pressurisation records, discharge records, durations, test pressure calculations, etc.) shall be collated for permanent retention as part of the handover documentation.

Before testing, the pipeline will be cleaned and internally checked using cleaning and gauging pigs driven by compressed air.

As discussed in section 3.1 it is assumed at this stage that the entire route will be designed to a design factor of 0.3 and therefore in accordance with Table 10 of IGEM/TD/1 the pipeline should be hydrotested to 1.5 x MOP = 1.5 x 70 barg = 105 barg.

The test medium will be clean fresh water. Approximately 200m^3 of water will be required for the test.

On completion of a hydrotest, the pipeline will be de-pressurised under controlled conditions and the water discharged accordingly. Any water abstraction or discharge will require an Abstraction Licence from the appropriate statutory authority which may contain restrictions on extraction flow rates, return water quality, etc. Subsequent to the section being drained of water, the section will be swabbed to remove residual water by passing through specially designed 'pigs' propelled by compressed air. All pigs used, and pig run details shall be noted in the pig run register.

It is highly important that all traces of water are removed to ensure dry gas is transported on commissioning. This will be achieved by dry air drying or vacuum drying or similar as described in IGEM/TD/1, section 9.4 'Drying, Purging and Gassing Up'.

5.1.8 Commissioning

Commissioning of all new equipment shall be carried out in accordance with an approved procedure. Purge rates for commissioning of the pipeline and plant will have to be agreed with NG and follow the requirements of IGE/SR/22 – 'Purging Operations for Fuel Gases in Transmission, Distribution and Storage'. All commissioning operations involving live gas will be under the control of NG personnel using a non-routine operation procedure produced by NG. Statera and/or their MWC will provide assistance to NG as required.

5.2 Records and documentation

All record information, documentation, certification of materials and components and any other appropriate information that can be used as a permanent record of 'fitness for purpose' (see note 1), shall be preserved as required by relevant standards, specifications, or local or statutory requirements. All plant, equipment and bulk material items shall have sufficient documentation to provide 'full' traceability. For example, Regulation 13 of the Pressure Systems Regulations 'keeping of records etc.', details specific requirements for the examination of records.

For pressure systems which will be subject to schemes of examination, there is a requirement to retain sufficient information concerning the design, construction, examination, operation and maintenance of an installation.

Records shall typically include:

a. fully detailed "as built" drawings
b. welding and fabrication records
c. full material certification
d. equipment data sheets
e. selected suppliers returns - e.g. purchase orders
f. inspection reports
g. weld acceptance certificates
h. weld procedures
i. letters of conformity
j. design calculations
k. pressure test records
l. functional test records

All items of plant, equipment and bulk materials items shall be indelibly marked with a unique identification number and be recorded in a suitable register with the suppliers’ order numbers to ensure ‘full’ traceability.

Note 1: The definition of ‘fitness for purpose’ of a gas supply system is that an item of equipment or combination of items of equipment, which together comprise an installation or pipeline system, has been designed, constructed, tested and commissioned to appropriate legislation, standards and procedures relative to the operating conditions. Continued ‘fitness for purpose’ in service requires that an operating philosophy, maintenance policy, repair procedure, modification procedure and revalidation schedules are established and maintained which will demonstrate that the pipeline system or installation is suitable for operation within the original or revised design criteria.

APPENDIX A – REFERENCE DOCUMENTS

E-18110200-M-0200-001	Overall Route Plan 300 Dia. Pipeline
E-18110200-M-0200-002	Pipeline Alignment Drawing 300 Dia. Pipeline Sheet 1 of 3
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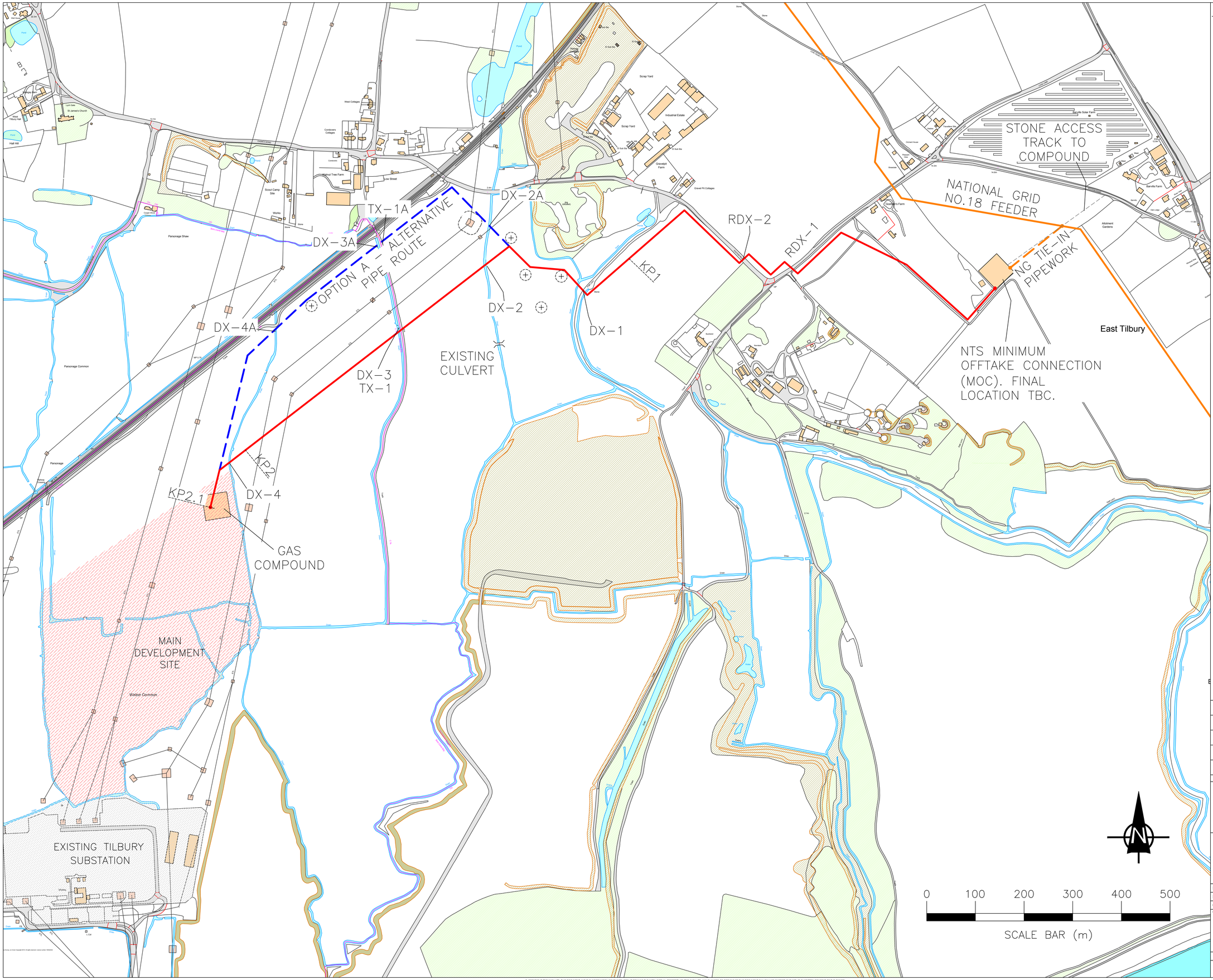

NOTES

1) INDICATIVE PIPE ROUTE:

PROPOSED ROUTE – (APPROX 2.14km)
ROUTE OPTION A – (APPROX 2.35km)

PROPOSED ROUTE CROSSING COUNT

ROAD CROSSING (RDX)	II
DITCH CROSSING (DX)	IV
TRACK CROSSING (TX)	I

OPTION A CROSSING COUNT

ROAD CROSSING (RDX)	II
DITCH CROSSING (DX)	IV
TRACK CROSSING (TX)	I

2) KEY COORDINATES:

START POINT	EASTING: 568046 NORTHING: 177356
END POINT	EASTING: 566434 NORTHING: 176906

⊕ LV POWER POLES

REFERENCE DRAWINGS

PLOT PLANS

E–18110200–M–0200–002 PLOT PLAN (SHT 1 OF 3)
E–18110200–M–0200–003 PLOT PLAN (SHT 2 OF 3)
E–18110200–M–0200–004 PLOT PLAN (SHT 3 OF 3)

REV	DATE	DESCRIPTION	BY	CHK	APP
D	30.09.19	FOR APPROVAL	BT	RW	DB
C	04.12.18	FOR APPROVAL	BT	RW	DB
B	04.12.18	FOR APPROVAL	BT	RW	DB
A	09.11.18	FOR REVIEW	BT	RW	DB

STATERA ENERGY

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W. www.technicaltd.com

DRAWN BY	B. TURNER	PROJECT No	18110200
DATE	09.11.18	CLIENT REF	
CLIENT	STATERA ENERGY		

TITLE

THURROCK POWER
OVERALL ROUTE PLAN
300 DIA PIPELINE

SCALE	DRAWING NUMBER	REVISION
1:3500	E–18110200–M–0200–001	D

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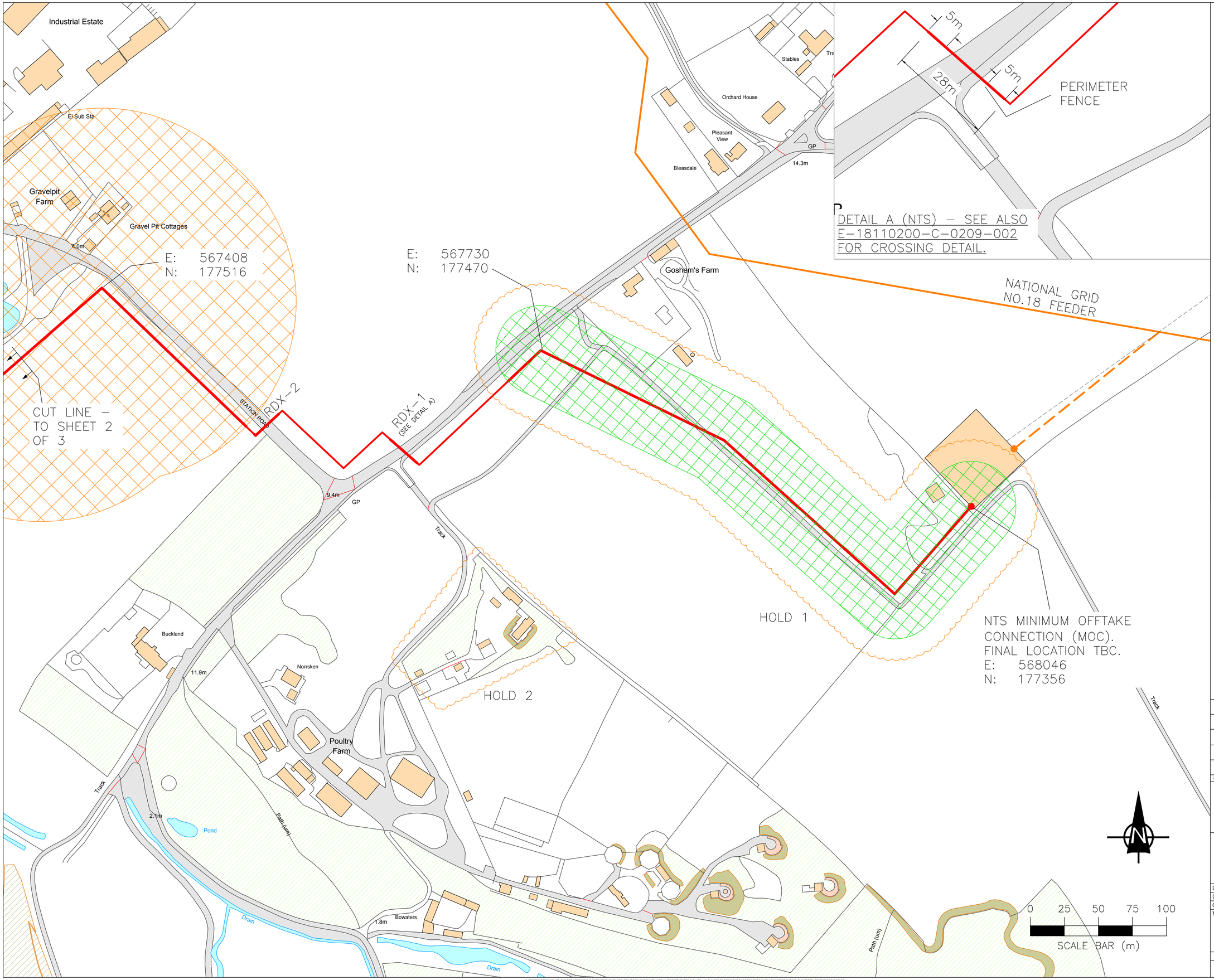

KEY

- LINE PIPE (6.35mm WT)
- HEAVY WALL PIPE (12.7mm WT)
- ROUTE OPTION A
- BPD TYPE 'S' (3M RADIUS)
- BPD TYPE 'R' (33M RADIUS)
- POPULATION DENSITY >13 PERSONS PER HECTARE

NOTES

1) 1.09KM LINEPIPE (6.35mm WT), 1.05KM HEAVY WALL PIPE (12.7mm WT) REQUIRED FOR COMPLETE ROUTE.

HOLDS

1) BOUNDARY OF GOSHEM'S FARM TBC. HEAVY WALL MAY NOT BE REQUIRED.
2) AREA WITHIN 'POPULATION DENSITY STUDY' ZONE HAS BEEN ASSUMED TO BE UNPOPULATED THEREFORE HEAVY WALL PIPE WITHIN PROXIMITY IS NOT REQUIRED. FURTHER CLARIFICATION MAY BE CONSIDERED.

REFERENCE DRAWINGS

PLOT PLAN

E-18110200-M-0200-001

PIPELINE ALIGNMENT DRAWINGS

E-18110200-M-0200-002 SHT 1 OF 3
E-18110200-M-0200-003 SHT 2 OF 3
E-18110200-M-0200-004 SHT 3 OF 3

REV	DATE	DESCRIPTION	BY	CHK	APP
C	30.09.19	FOR APPROVAL	BT	RW	DB
B	13.12.18	FOR APPROVAL	BT	RW	DB
A	09.11.18	FOR REVIEW	BT	RW	DB

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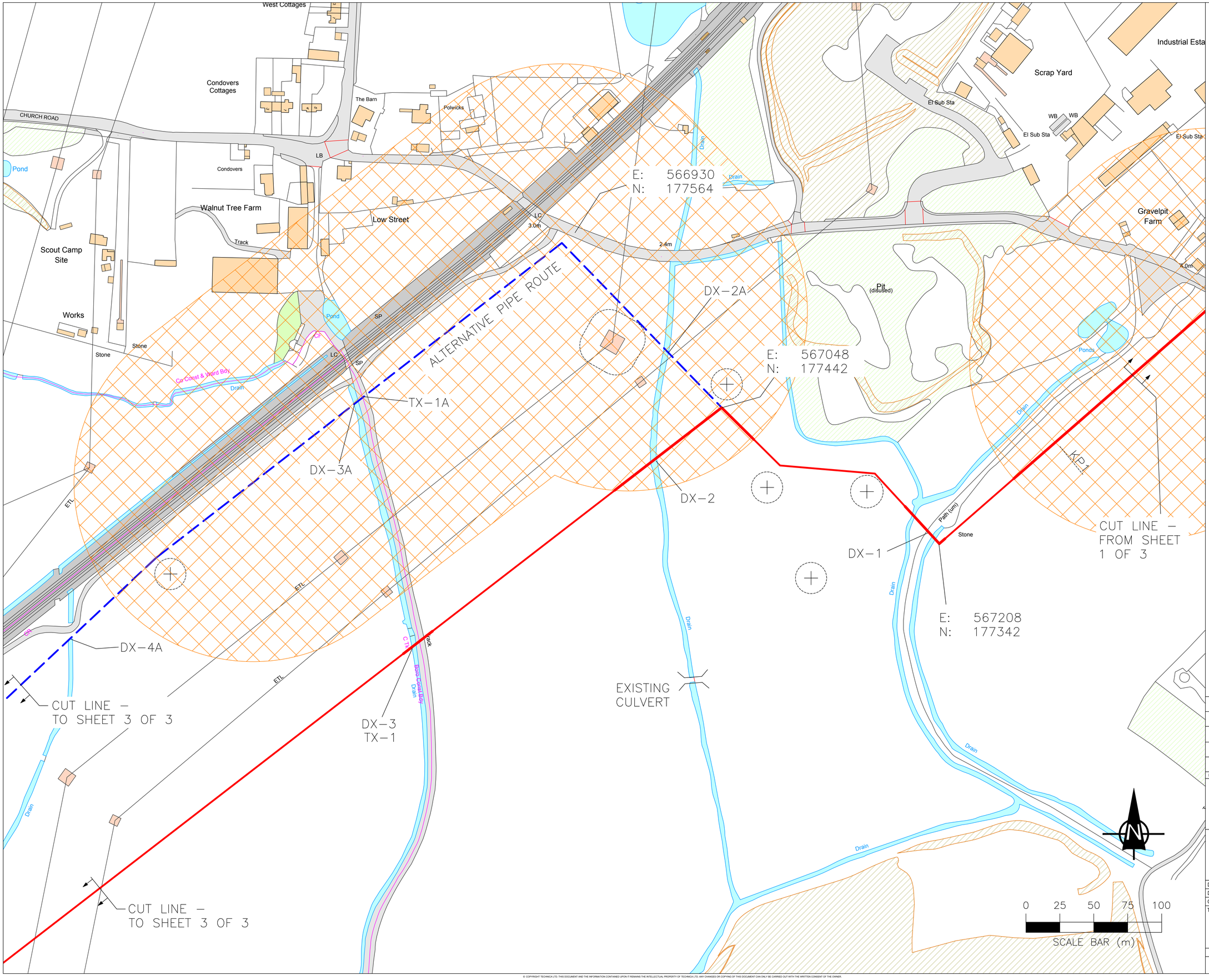
DATE	09.11.18	CLIENT REF	
CLIENT	STATERA ENERGY		

TITLE

PIPELINE ALIGNMENT DRAWING
300 DIA PIPELINE
SHT 1 OF 3

SCALE	DRAWING NUMBER	REVISION
1:1250	E-18110200-M-0200-002	C

(A1 SIZED)



KEY

- LINE PIPE (6.35mm WT)
- HEAVY WALL PIPE (12.7mm WT)
- ROUTE OPTION A
- BPD TYPE 'S' (3M RADIUS)
- BPD TYPE 'R' (33M RADIUS)
- POPULATION DENSITY >13 PERSONS PER HECTARE

NOTES

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E-18110200-M-0200-001

PIPELINE ALIGNMENT DRAWINGS

E-18110200-M-0200-002 SHT 1 OF 3
E-18110200-M-0200-003 SHT 2 OF 3
E-18110200-M-0200-004 SHT 3 OF 3

REV	DATE	DESCRIPTION	BY	CHK	APP
C	30.09.19	FOR APPROVAL	BT	RW	DB
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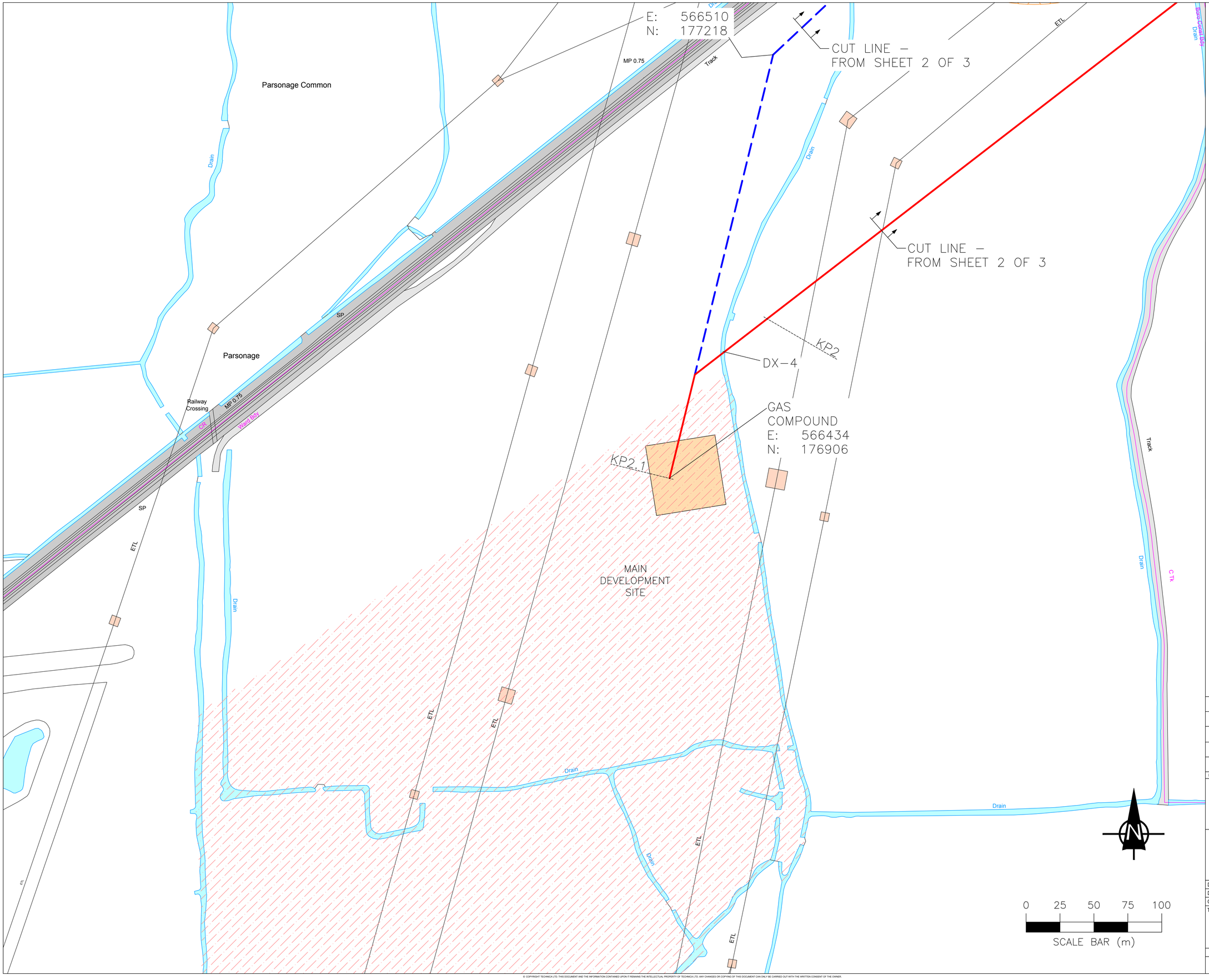
TITLE

PIPELINE ALIGNMENT DRAWING
300 DIA PIPELINE
SHT 2 OF 3

SCALE	DRAWING NUMBER	REVISION
1:1250	E-18110200-M-0200-003	C

(A1 BORDER)



KEY

- LINE PIPE (6.35mm WT)
- HEAVY WALL PIPE (12.7mm WT)
- ROUTE OPTION A
- BPD TYPE 'S' (3M RADIUS)
- BPD TYPE 'R' (33M RADIUS)
- POPULATION DENSITY >13 PERSONS PER HECTARE

NOTES

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REFERENCE DRAWINGS

PLOT PLAN

E–18110200–M–0200–001

PIPELINE ALIGNMENT DRAWINGS

E–18110200–M–0200–002 SHT 1 OF 3
E–18110200–M–0200–003 SHT 2 OF 3
E–18110200–M–0200–004 SHT 3 OF 3

REV	DATE	DESCRIPTION	BY	CHK	APP
C	30.09.19	FOR APPROVAL	BT	RW	DB
B	13.12.18	FOR APPROVAL	BT	RW	DB
A	09.11.18	FOR REVIEW	BT	RW	DB

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CLIENT	STATERA ENERGY		

TITLE

PIPELINE ALIGNMENT DRAWING
300 DIA PIPELINE
SHT 3 OF 3

SCALE	DRAWING NUMBER	REVISION
1:1250	E–18110200–M–0200–004	C

(A1 BORDER)

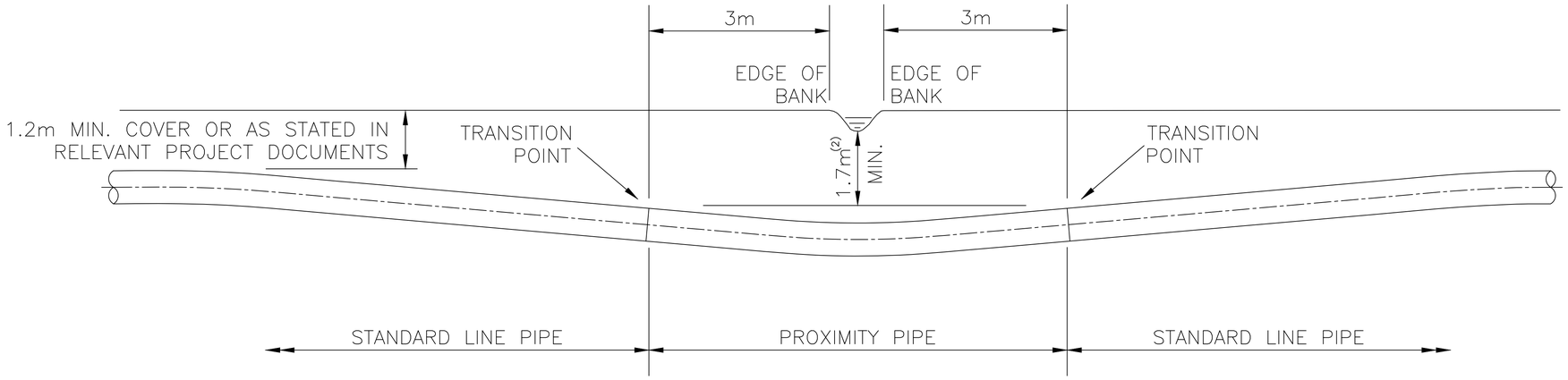

FIGURE 1: MINOR DITCH OR STREAM CROSSING

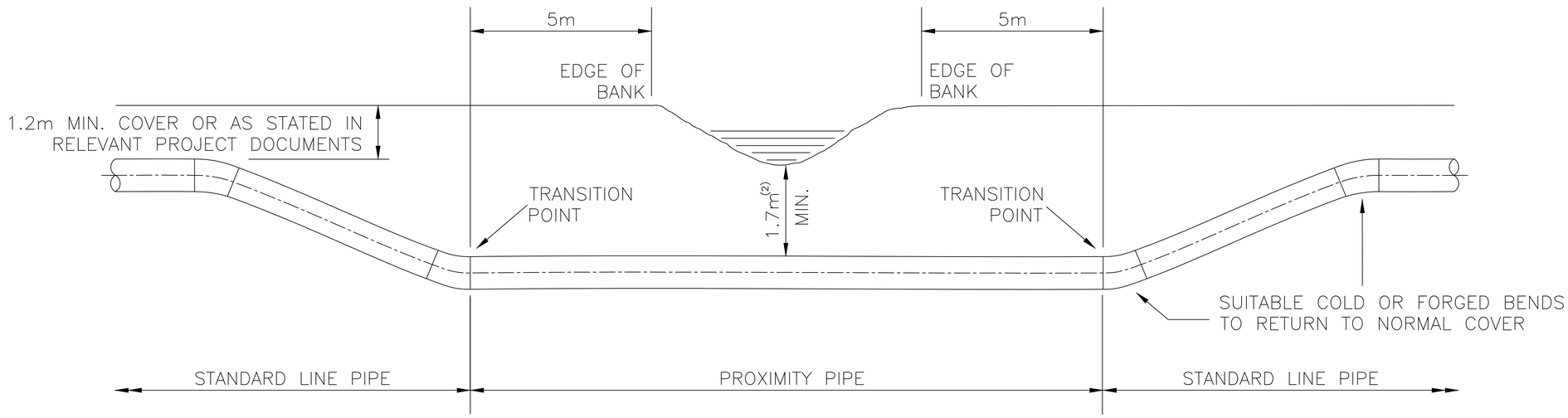

FIGURE 2: MAJOR DITCH OR STREAM CROSSING

NOTES

1) ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
2) MINIMUM DEPTH OF COVER TO BE 1.7m FROM TRUE CLEAN BOTTOM OF DITCH. MINIMUM DEPTH MAY BE INCREASED DUE TO WATER AUTHORITY OPERATING REQUIREMENTS.
3) BANKS TO BE REINSTATED TO FORMER CONDITION, INCLUDING PREVENTATIVE EROSION CONTROL METHOD, AS APPLICABLE, WHERE REQUIRED BY AUTHORITY HAVING JURISDICTION OVER THE CROSSING.
4) BACKFILL MATERIAL TO CONTAIN NO ROCK OR STONE THAT MIGHT DAMAGE THE COATING WITHIN 300mm OF THE PIPE.
5) BUSH, ROOTS AND OTHER VEGETATION MATTER THAT HAS BEEN CLEARED FROM THE R.O.W. IS NOT TO BE USED AS BACKFILL MATERIAL.
6) SLOPE OF THE TRENCH AND WIDTH AT THE TOP TO SUIT CONTRACTOR'S CONSTRUCTION METHOD. SAFE ANGLE OF THE TRENCH SHALL BE ADJUSTED TO SUIT ACTUAL LOCAL SOIL CONDITION.
7) THE BOTTOM OF THE TRENCH SHALL BE UNIFORMLY GRADED AND FREE FROM OBJECTS WHICH MIGHT DAMAGE THE PIPE OR THE COATING.
8) IF PERSONNEL MUST ENTER THE PIPE TRENCH, CONTRACTOR SHALL PROVIDE SAFE WORKING TRENCH DETAILS TO CLIENT APPROVAL FOR CONSTRUCTION.
9) WARNING TAPE SHALL BE OF PVC MATERIAL SUITABLE FOR THE REQUIRED BURIED GROUND CONDITIONS WITH WARNING TEXT PRINTED BLACK–OVER–YELLOW, STATING: "DANGER: BURIED HIGH PRESSURE NATURAL GAS PIPELINE".
10) WARNING SIGN INDICATING GAS PIPELINE CROSSING SHALL BE INSTALLED ON EITHER SIDE OF THE DITCH/STREAM.
11) CATHODIC PROTECTION DESIGN AND INSTALLATION AT EACH CROSSING SHALL BE SUBMITTED FOR CLIENT APPROVAL PRIOR TO CONSTRUCTION.

REV	DATE	DESCRIPTION	BY	CHK	APP
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DATE	27.11.18	CLIENT REF	
CLIENT	STATERA ENERGY		

TITLE
GENERAL ARRANGEMENT
TYPICAL CROSSING
DITCH OR STREAM

SCALE	DRAWING NUMBER	REVISION
NTS	E–18110200–C–0209–001	A

(A1 BORDER)

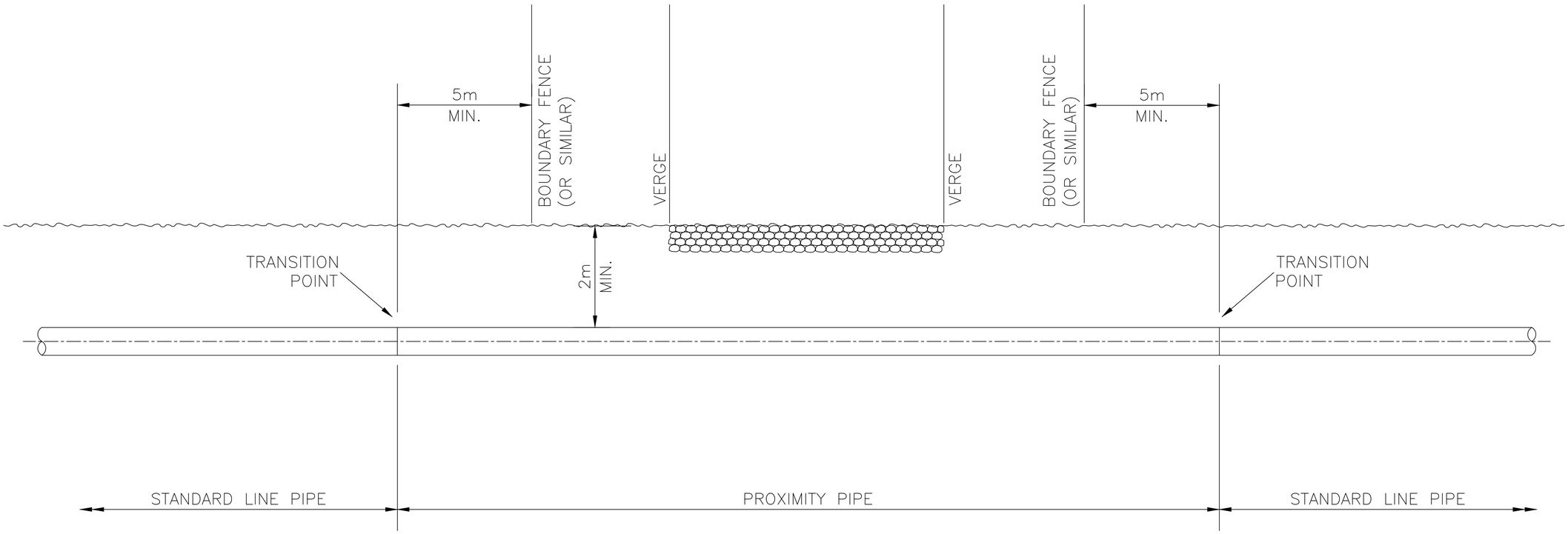

FIGURE 1: MINOR ROAD AND TRACK CROSSING

NOTES

1) ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
2) PIPELINE CONSTRUCTION ACTIVITIES SHALL BE, AS A MINIMUM, IMPLEMENTED STRICTLY IN COMPLIANCE WITH THE LATEST REVISION OF THE PROJECT SPECIFICATION FOR THE PIPELINE CONSTRUCTION, RELEVANT CONTRACTOR DOCUMENTS AND ALL CONCERNED THIRD PARTIES, LOCAL AND/OR NATIONAL AUTHORITIES LAW AND REGULATIONS.
3) CONTRACTOR SHALL OBTAIN CLIENT AND RELEVANT ROAD AUTHORITY OR OWNER PERMISSION PRIOR TO CONSTRUCTION.
4) CROSSING TO BE AS CLOSE TO PERPENDICULAR AS POSSIBLE AND SHOULD NOT BE LESS THAN 30 DEGREES.
5) CONTRACTOR SHALL REPAIR AND REINSTATE ROAD TO PRE-CONSTRUCTION CONDITIONS AND TO THE ACCEPTANCE OF RELEVANT ROAD OWNER/AUTHORITY.
6) CONTRACTOR SHALL VERIFY DEPTH AND SIZE OF ALL UNDERGROUND PIPELINES, UTILITIES, SERVICES AND/OR STRUCTURES PRIOR TO CONSTRUCTION.
7) CONTRACTOR SHALL DETERMINE ALL BENDS REQUIRED AT SITE.
8) CONTRACTOR SHALL SUBMIT DETAILED CALCULATIONS AND CONSTRUCTION PROCEDURES, BASED ON ACTUAL SITE CONDITIONS, TO CLIENT FOR APPROVAL PRIOR TO CONSTRUCTION.
9) SAFE TRAFFIC FLOW SHALL BE MAINTAINED BY CONTRACTOR AT ALL TIMES AND IN ACCORDANCE WITH ROAD AUTHORITY PERMIT REQUIREMENTS.
10) MINIMUM DEPTH OF COVER SHALL BE AS SHOWN AND COMPLY WITH RELEVANT ROAD AUTHORITY OR OWNER REQUIREMENT.
11) FOR TYPICAL TRENCH AND BACKFILL DETAILS, REFER TO DRAWING E-18110200-C-0209-003.
12) WARNING SIGN INDICATING GAS PIPELINE CROSSING SHALL BE INSTALLED ON EITHER SIDE OF THE ROAD.
13) CATHODIC PROTECTION DESIGN AND INSTALLATION AT EACH CROSSING SHALL BE SUBMITTED FOR CLIENT APPROVAL PRIOR TO CONSTRUCTION.

REV	DATE	DESCRIPTION	BY	CHK	APP
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DATE	28.11.18	CLIENT REF	
CLIENT	STATERA ENERGY		

TITLE
GENERAL ARRANGEMENT
TYPICAL CROSSING
MINOR ROAD AND TRACK

SCALE	DRAWING NUMBER	REVISION
NTS	E-18110200-C-0209-002	A

(A1 BORDER)

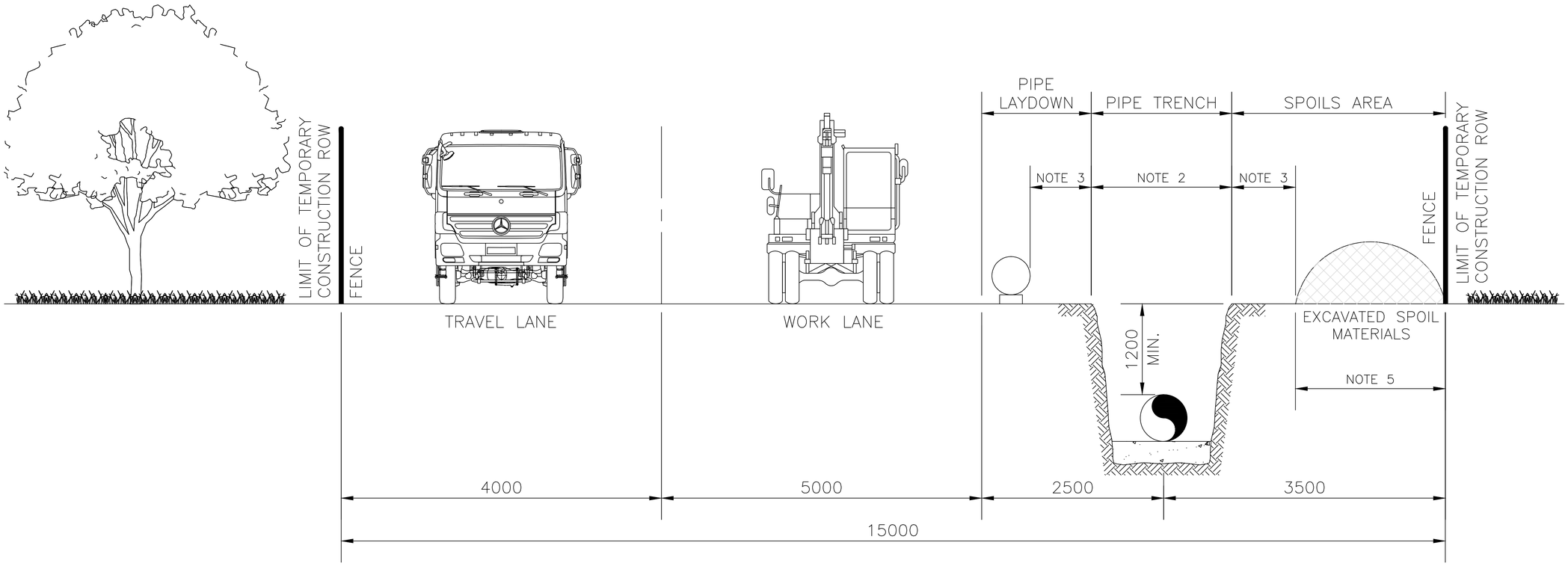

FIGURE 1: TYPICAL TEMPORARY PIPELINE CONSTRUCTION RIGHT–OF–WAY

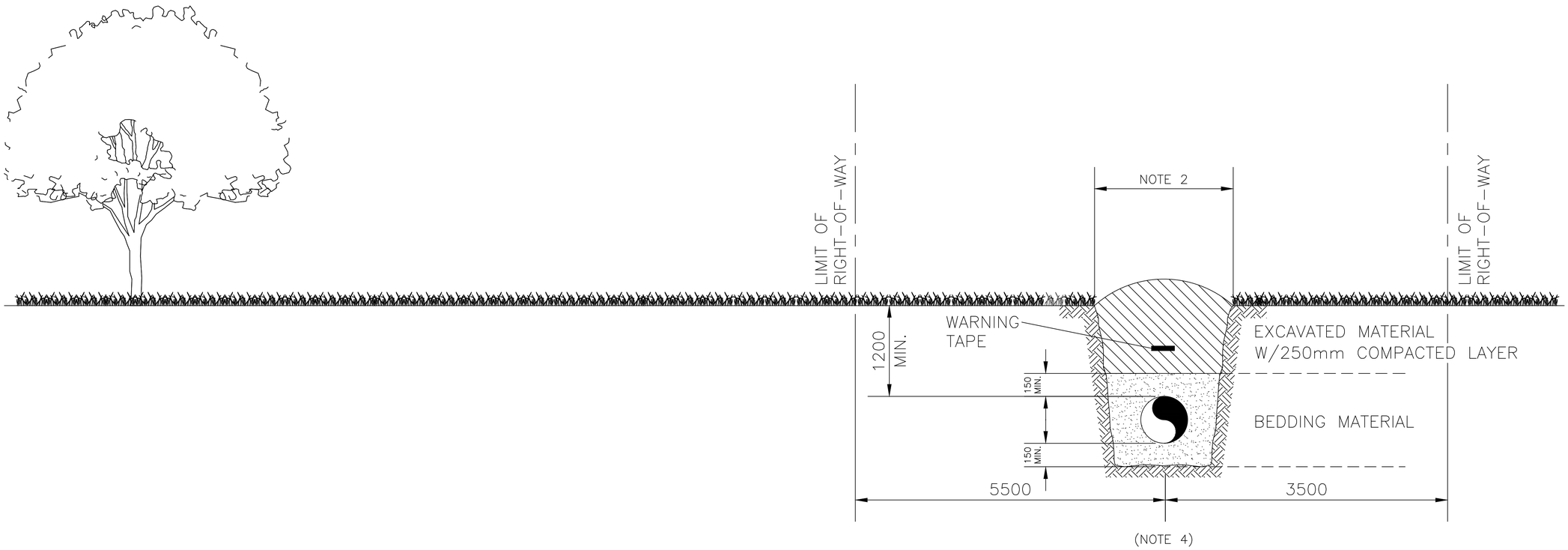

FIGURE 2: PERMANENT GAS PIPELINE RIGHT–OF–WAY (R.O.W.)

NOTES

1) ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
2) SLOPE OF THE TRENCH AND WIDTH AT THE TOP MAY VARY TO SUIT CONTRACTOR'S CONSTRUCTION METHOD. SAFE ANGLE OF THE TRENCH WALLS SHALL BE MAINTAINED AND ADJUSTED TO SUIT LOCAL SOIL CONDITIONS.
3) SAFE DISTANCE SHALL BE MAINTAINED TO AVOID COLLAPSE OF TRENCH.
4) IN CASE OF POPULATED BUILDINGS AND/OR PUBLIC TRANSPORTATION INFRASTRUCTURES COMING ALONG OR ADJACENT TO THE EDGE OF GAS PIPELINE RIGHT–OF–WAY, SAFE SEPARATION DISTANCE/MEASURES BETWEEN PIPELINE AND ANY POPULATED BUILDINGS AND/OR PUBLIC TRANSPORTATION INFRASTRUCTURES SHALL BE VERIFIED AND INCREASED TO AN ACCEPTABLE LEVEL, BASED ON ESTABLISHED RISK ASSESSMENT METHODOLOGY AND IN COMPLIANCE WITH RELEVANT LOCAL/NATIONAL LAWS AND REGULATIONS.
5) IF SPACE IS LIMITED, SPOILS ARE TO BE REMOVED TO AN APPROVED AREA BY THE CONTRACTOR.

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DATE	29.11.18	CLIENT REF	
CLIENT	STATERA ENERGY		

TITLE
GENERAL ARRANGEMENT
TYPICAL PIPELINE RIGHT–OF–WAY

SCALE	DRAWING NUMBER	REVISION
NTS	E–18110200–C–0209–003	A

(A1 BORDER)

REV	DATE	DESCRIPTION	BY	CHK	APP
A	30/11/18	FOR REVIEW	BT	RW	DB

STATERA ENERGY

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PROJECT:	THURROCK POWER - PIPELINE & PRI CONCEPTUAL DESIGN
TITLE:	WALL THICKNESS CALCULATION HEAVY WALL (PROXIMITY) PIPE TO IGEM/TD/1

DRAWN BY	B. TURNER	PROJECT No.	18110200	SIZE	DOCUMENT NUMBER	REVISION
DATE	30 NOV 2018	CLIENT REF.		A3	E-18110200-M-0300-001	A
CLIENT	STATERA ENERGY					

Wall Thickness Calculation to TD1
$t=PD(20fs)^{-1}$

Pipe Material: API 5L X52

P	Design pressure at relevant design temperature (bar)	70	
D	OD of pipe (mm)	323.9	12"
s	Specified minimum yield strength (Nmm^{-2})	360	
f	Maximum design factor	0.3	Type S area
t	Design wall thickness of pipe, incl. manufacturer's under tolerance (mm)	**11.81**	
	Manufacturer's under thickness tolerance	12.5%	
	Selected pipe wall thickness	**12.7**	mm
	Design Factor (rearranging calculation for 'f')	**0.25**	

IGEM/TD/1 TABLE 5
Minimum nominal wall thickness of linepipe for handling purposes

Outside diameter of pipe (mm)		Nominal wall thickness (mm)
Exceeding	Not exceeding	
0	168.3	4.7
168.3	457	6.3
457	610	7.9
610	914	9.5
914	1067	11.9
1067	1219	12.5

Area Types		Design Factor (f)
R	Rural areas with a population density not exceeding 2.5 persons per hectre	0.72
S	Areas which may be extensively developed with residential properties, schools, shops etc.	0.3

IGEM/TD/1 TABLE 4 (extract)
API 5L material grades and SMYS

Grade	SMYS (Nmm^{-2})
B	245
X42	290
X46	320
X52	360
X56	390
X60	415
X65	450
X70	485
X80	555

REV	DATE	DESCRIPTION	BY	CHK	APP
A	30/11/18	FOR REVIEW	BT	RW	DB

STATERA ENERGY

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PROJECT:	THURROCK POWER - PIPELINE & PRI CONCEPTUAL DESIGN
TITLE:	WALL THICKNESS CALCULATION LINE PIPE TO IGEM/TD/1

Notes

DRAWN BY	B. TURNER	PROJECT No.	18110200	SIZE	DOCUMENT NUMBER	REVISION
DATE	30 NOV 2018	CLIENT REF.		A3	E-18110200-M-0300-002	A
CLIENT	STATERA ENERGY					

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Pipe Material: API 5L X52

P	Design pressure at relevant design temperature (bar)	70	
D	OD of pipe (mm)	323.9	12"
s	Specified minimum yield strength (Nmm^{-2})	360	
f	Maximum design factor	0.72	Type R area
t	Design wall thickness of pipe, incl. manufacturer's under tolerance (mm)	**4.92**	
	Manufacturer's under thickness tolerance	12.5%	
	Selected pipe wall thickness	**6.35**	mm
	Design Factor (rearranging calculation for 'f')	**0.50**	

IGEM/TD/1 TABLE 5

Minimum nominal wall thickness of linepipe for handling purposes

Outside diameter of pipe (mm)		Nominal wall thickness (mm)
Exceeding	Not exceeding	
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168.3	457	6.3
457	610	7.9
610	914	9.5
914	1067	11.9
1067	1219	12.5

Note: Calculated wall thickness value is lower than that given in Table 5, therefore ***6.3mm shall be used****.*

Area Types		Design Factor (f)
R	Rural areas with a population density not exceeding 2.5 persons per hectre	0.72
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