A12.2 Peat Assessment

1 Introduction

Background

1.1 Following on from the 2016 Preliminary Ground Investigation (GI) for the A96 Dualling, Inverness to Nairn (including Nairn Bypass), data from the GI has been used to identify areas within CPO boundaries which will be affected by peat deposits that may require to be excavated and replaced with suitable fill. This is due to the extra land required for the working area and slopes that will be formed during the construction works. The following assessment considers the estimated volume of peat affecting the proposed Scheme.

Peat Assessment - Gollanfield

Background

1.2 The following peat assessment considers the estimated volume of peat within pre-determined areas of peat in the Gollanfield area that were identified from geological maps prior to the ground investigation works. All other localised peat encountered during the preliminary GI are considered in the Localised Peat Areas Assessment section below.

Ground Investigation Data

1.3 A peat probing survey was carried out during the 2016 GI to obtain information on the thickness of peat in the vicinity of the proposed Scheme. The peat probing was carried out in seven areas (A to G) where peat deposits, identified on the geological map, are within close proximity to the proposed Scheme. Peat probe areas were further refined based on possible peat identified from aerial photography and where peat was identified during the site walkover inspection. The peat probes were undertaken on a 20m grid as defined in the GI Contract Drawings (Appendix A).

1.4 The results of the peat probing survey (Appendix B) indicate that the greatest thickness of peat (4.43m) is located in Area D. In some areas, particularly in Area F and Area G, negligible thicknesses of peat were recorded with average probe penetration only 0.08m and 0.02m respectively. Although 2.24m of peat was recorded in one probe in Area F, due to the surrounding probes encountering less than 0.1m of peat and the fact that the probe is located 42m away from the proposed Scheme footprint, this is considered to be an irrelevant result. Furthermore, this probe is located at a lower level than the proposed Scheme adjacent to a large pond and is not consistent with the ground conditions encountered in the vicinity of the proposed Scheme footprint. Due to the factors noted above, this single probe has been discounted from the average thickness calculations for Area F. A probe depth of 0.90m was recorded in Area G. This probe is also considered to be irrelevant due to its excessive distance (approximately 80m) from the proposed Scheme footprint. As such, this probe has been excluded from the average depth calculation for Area G. Consequently, Area F and Area G have been excluded from the remainder of the assessment. A summary of the thickness of peat encountered in each area is provided in Table 1.

1.5 Further information in relation to the thickness of peat in the vicinity of the peat probing areas was obtained from the exploratory hole logs. A summary of the boreholes and trial pits that recorded peat is given in Table 2. The locations of the exploratory holes are indicated on the contract drawings in Appendix A. The majority of the boreholes encountering Peat are located at Gollanfield, however, localised peat was encountered at Culblair (BHP0905) and at Milton of Boath (BHP2107). Note that the thicknesses of peat recorded in Table 2 include the surface topsoil layer which has a typical thickness of 0.4-0.6m.

Table 1 : Summary of Peat thickness in each Peat probing area

Peat Probing Area	Number of Probes Undertaken	Max Probe Penetration[1] (m)	Min Probe Penetration (m)	Average Probe Penetration (m)
A	41	0.48	0.00	0.20
B	38	0.45	0.00	0.20
C	27	3.20	0.20	1.00
D	102	4.43	0.05	1.07
E	24	1.12	0.12	0.48
F	123	0.47 (discounting irrelevant result of 2.24m)	0.00	0.08 (discounting irrelevant result of 2.24m)
G	133	0.36 (discounting irrelevant result of 0.90m)	0.00	0.02 (discounting irrelevant result of 0.90m)

Notes:

[1]Assumed to be the base of the Peat deposits

Table 2 : Details of Peat recorded in exploratory holes

Exploratory Hole No. (Peat probing Area if relevant)	Depth to base of Peat (m)	Thickness of Peat (m)	Groundwater Details[1]	Description of Peat
TPP1408 (Area D)	2.50	2.10	Strike at 1.60mbgl (heavy ingress noted)	Pseudofibrous plastic PEAT with occasional fragments of timber and medium root content (From 0.4m to 1.3m, reworked Peat)
TPP1409 (Area D)	2.60	2.00	Strike at 2.80mbgl	Fibrous plastic and spongy PEAT with pockets of sand and high root content
TPP1410 (Area D)	2.90	2.30	Strike at 2.85mbgl (heavy ingress noted)	Fibrous plastic PEAT with high root content
TPP1501 (Area D)	3.70	3.25	Strike at 3.80mbgl	Fibrous plastic PEAT with high root content and boulder sized fragments of wood
BHP1405 (Area C)	2.20	1.3	Unknown – Installation damaged	Gravelly pseudo-fibrous PEAT with occasional rootlets
BHP1408 (Area D)	2.70	2.45	Strike at 1.10mbgl. Artesian in rock (head <1.0m above GL)	Pseudofibrous PEAT with medium root and wood content
BHP1409 (Area D)	3.90	3.9	Strike at 2.66mbgl. Monitoring recorded 0.12-0.37mbgl	Slightly gravelly slightly sandy PEAT with occasional vegetation

Notes:

[1]Groundwater monitoring information includes readings up to July 2016

Peat Thickness Contouring

1.6 Depths recorded during peat probing along with the peat thickness information from exploratory hole logs has been plotted using GIS. The peat thickness information has been contoured to show the anticipated thickness of the peat in the vicinity of the proposed Scheme footprint. Due to the low probe penetrations achieved in areas F and G (see Appendix B), it is considered that there is no peat or very small thicknesses of peat in these areas. As such, this material will be treated as topsoil. Any small areas of Peat encountered can likely be mixed with topsoil and re-used as landscaping fill or for top-soiling earthworks. As such, the material to be excavated and disposed of in areas F and G is considered to be negligible and the peat probe data for these areas has not been contoured. The contoured peat depths for Areas A to E are shown on Figure 12.3 (Environmental Statement Volume 3: Figures).

1.7 As shown on the contoured plans, the deposits of peat appear to be relatively shallow in areas A, B and E whereas pockets of thicker Peat are recorded in areas C and D. This is consistent with the areas of Peat indicated on the published geological maps. The localised deposits of thicker peat in Areas C and D are likely due to the formation of peat within localised depressions formed within the underlying glacial deposits. Furthermore, it was intimated by a local farmer (Mr MacKintosh, Blackcastle Farm), that when the existing A96 was constructed, the peat was excavated beneath the alignment and is understood to have been deposited locally which may potentially explain the thicker deposits encountered in this area as well as the re-worked peat encountered in TPP1408.

Peat Volume Assessment

1.8 At present, it is assumed that the majority of the Peat will be excavated and the resulting excavation will be infilled with engineered fill. An exception to this is proposed at Gollanfield Railway Bridge where a piled load transfer platform could be considered to support the eastern embankment. This would negate the requirement to excavate beneath a 100m length of the proposed Scheme footprint between the northern railway bridge abutment and a portion of the proposed Scheme to the north and east. This area is located at approximate ch16290 to 16390 as indicated on Diagram 1.1. This design solution could be used to eliminate the requirement to excavate peat in the immediate vicinity of the railway, which is anticipated to have been constructed directly over the peat deposits. Excavation of peat in this area could therefore have the potential to drain the peat beneath the railway track leading to settlement. However, further assessment and investigation is required in this area. The peat appears to be very localised beneath the southern railway bridge abutment and embankment, and no special measures are proposed in this area at present.

1.9 In order to facilitate the excavation of the peat in the remaining areas, it has been assumed that permanent slopes will be formed at 1V:2H and temporary working slopes will be formed at 1V:1H as shown in the schematic diagram in Diagram 1.2. The estimated peat volumes within the peat probing areas have been calculated using the GIS contoured surfaces as shown in Figure 12.3 (Environmental Statement Volume 3: Figures).

1.10 The volumes of Peat requiring excavation have been estimated using GIS using the assumptions noted above, and are presented in Table 3. Details of the methodology used in the assessment is provided in Appendix C.

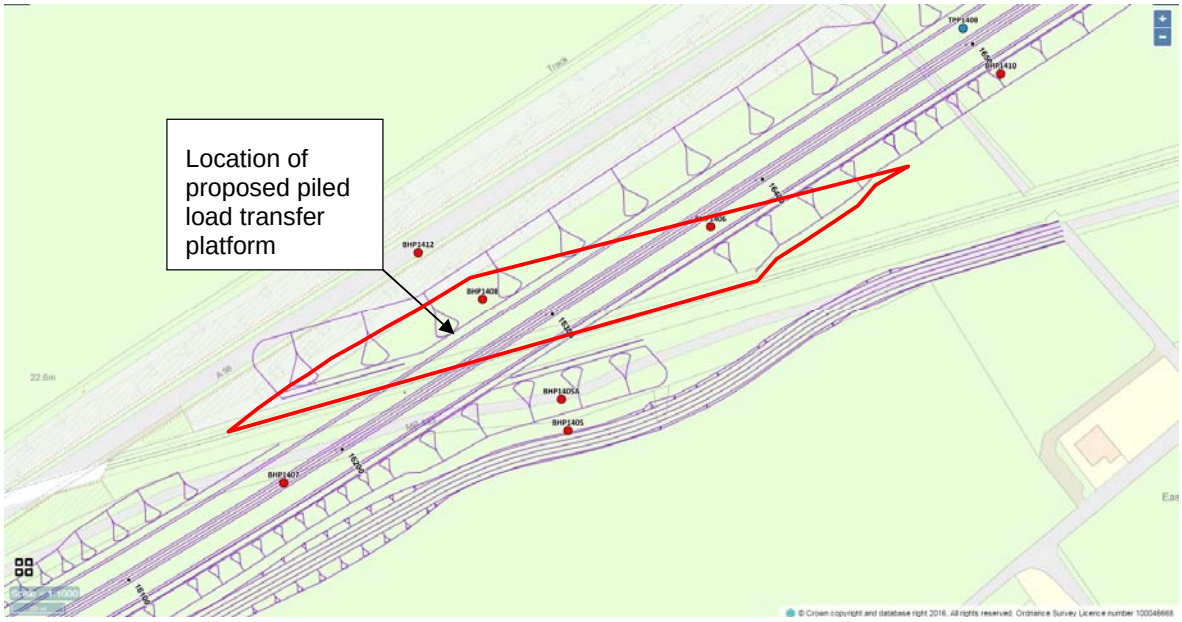

Diagram 1.1: Location of proposed Load Transfer Platform

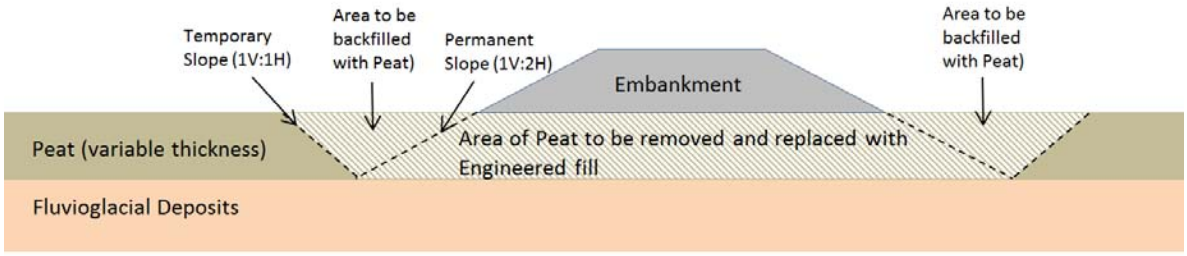

Diagram 1.2: Schematic diagram showing area beneath earthwork where Peat will be dug-out and replaced

Table 3: Volumes of Peat requiring excavation

Peat location	Estimated volume under design footprint (m^3)	Estimated volume saved by design solutions (m^3)	Estimated total Peat dig-out required (m^3)
Area A	1,500	0	1,500
Area B	2,500	0	2,500
Area C	6,500	0	6,500
Area D	53,000	-29,500[1]	23,500
Area E	5,000	0	5,000
Total	**68,500**	**-29,500**	**39,000**
Notes: [1]*Piled load transfer platform*			

2 Localised Peat Assessment

2.1 This assessment considers the localised areas of peat that were encountered in exploratory holes located outside of the main peat probing areas (Areas A to F) near Gollanfield. These localised areas of peat may also require excavation and replacement during construction works due to their poor engineering properties.

Ground Investigation Data

2.2 Two localised areas of buried peat were identified during the 2016 GI. These areas are located at Culblair and Milton of Boath. Details of the peat encountered in these areas are given in Table 4 below. The locations of these exploratory holes are shown on the GI Contract drawings provided in Appendix A.

Table 4: Localised Peat deposits encountered during the preliminary GI

Exploratory Hole No.	Depth (mbgl)	Groundwater	Soil Description
BHP0905 (Culblair)	1.00-1.60	Monitoring Results: 0.37-1.97mbgl	Dark brown PEAT with some vegetation
BHP2107 (Milton of Boath)	1.20-2.00	Monitoring Results: 0.50-0.69mbgl	Dark greyish brown to black sandy PEAT with some vegetation
	2.00-2.50		Dark greyish brown to black very sandy gravelly PEAT with some vegetation

Peat Volume Assessment

2.3 The estimated extents of the localised peat deposits at Culblair and Milton of Boath are shown on Diagrams 1.3 and 1.4 respectively and an estimate of the volume of peat in each area is presented in Table 5. Calculations indicate that an estimated 1,500m3 of peat will have to be considered for removal in these localised areas. It should be noted that the peat in these localised areas has been found within alluvial material and as such it likely that the peat will be removed along with the soft alluvial material and not as a distinct horizon.

The Geological map (NH75SE) indicates Glaciofluvial Deposits within the vicinity of BHP0905. No peat deposits were identified in surrounding TPs/BHs indicating that the peat deposits are localised.

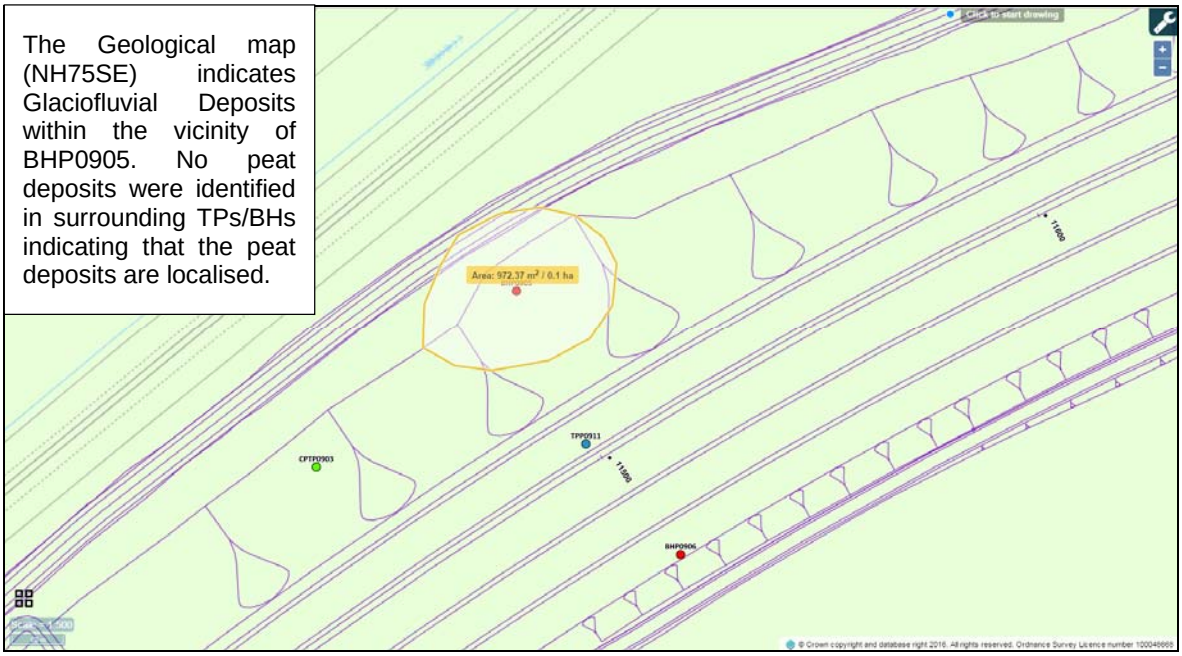

Diagram 1.3: Estimated area of soft deposits to be addressed at Culblair

The Geological map (NH95NW) indicates Alluvium within the vicinity of BHP2107. No peat deposits were identified in surrounding TPs/BHs indicating that the peat is localised in this area.

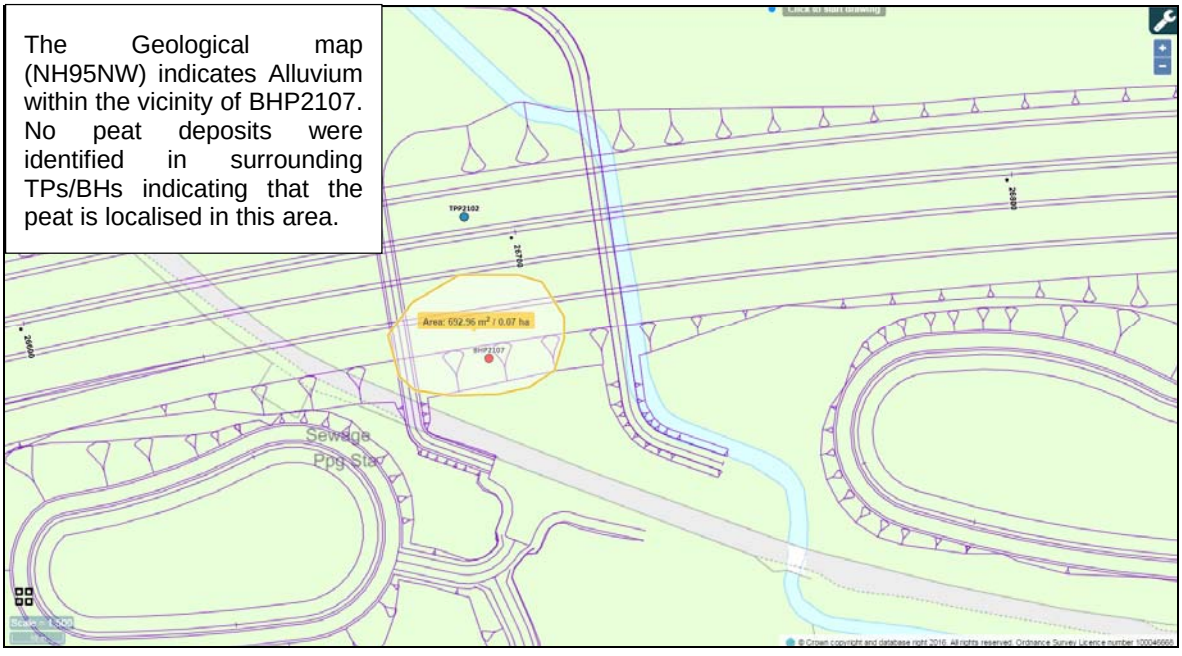

Diagram 1.4: Estimated area of peat deposits to be addressed at Milton of Boath

Table 5: Results of localised peat volume assessment

Chainage (location)	Relevant exploratory holes	Estimated Thickness of localised peat deposits (m)	Estimated area of peat deposits (m^2)	Estimated volume of peat deposits potentially requiring dig-out (m^3)
ch11500 (Cublair)	BHP0905	0.6m	1,000	600
ch26650-26720 (Milton of Boath)	TPP2107 (Milton of Boath)	1.3m	700	910
			Total Volume:	**1,510**

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Appendix A: Relevant GI Drawings showing Peat Probe Locations

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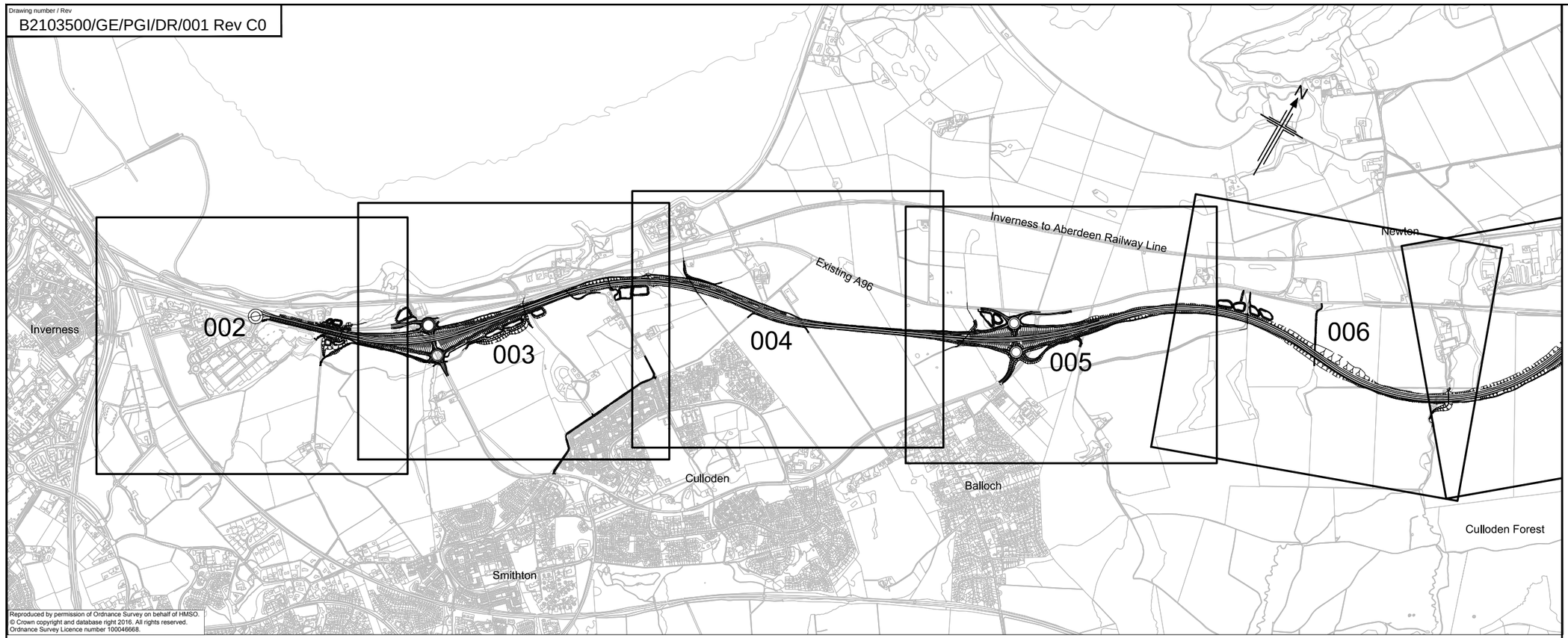
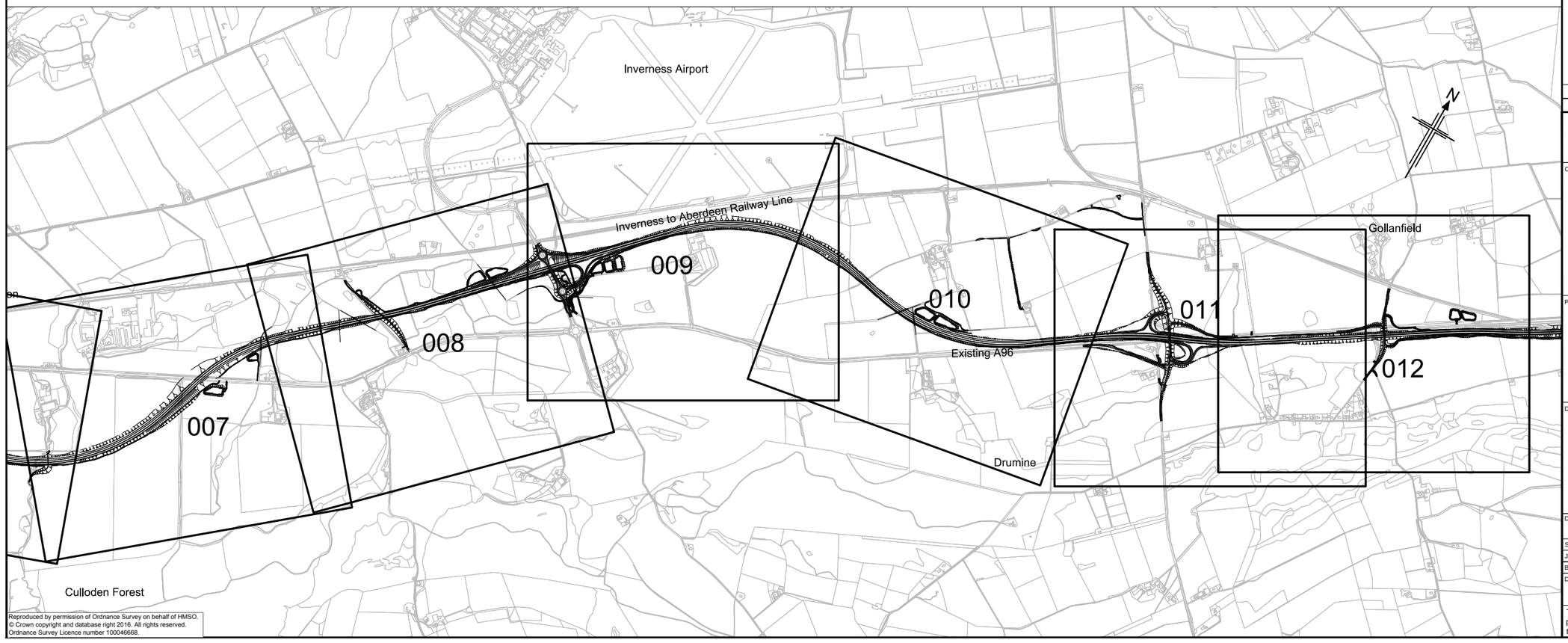
Drawing number / Rev

B2103500/GE/PGI/DR/001 Rev C0





Notes:

1. The OS Mastermap shown was obtained in November 2015 and is for illustrative purposes only.
2. This drawing is to be read in conjunction with Drawing no's B1103500/GE/PGI/DR/002-012.

Site Location Plan
Not to Scale

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
C0	18/02/16	For Construction	HR	IWM	SJD	EHB

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Project

A96 DUALLING
INVERNESS TO NAIRN
(Incl. Nairn Bypass)

Drawing title

INVERNESS TO GOLLANFIELD PRELIMINARY GROUND INVESTIGATION KEY PLAN

Drawing status

FOR CONSTRUCTION

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Jacobs No.	B2103500	
BIM no.		

Drawing number: B2103500/GE/PGI/DR/001 Rev C0

Drawing number / Rev

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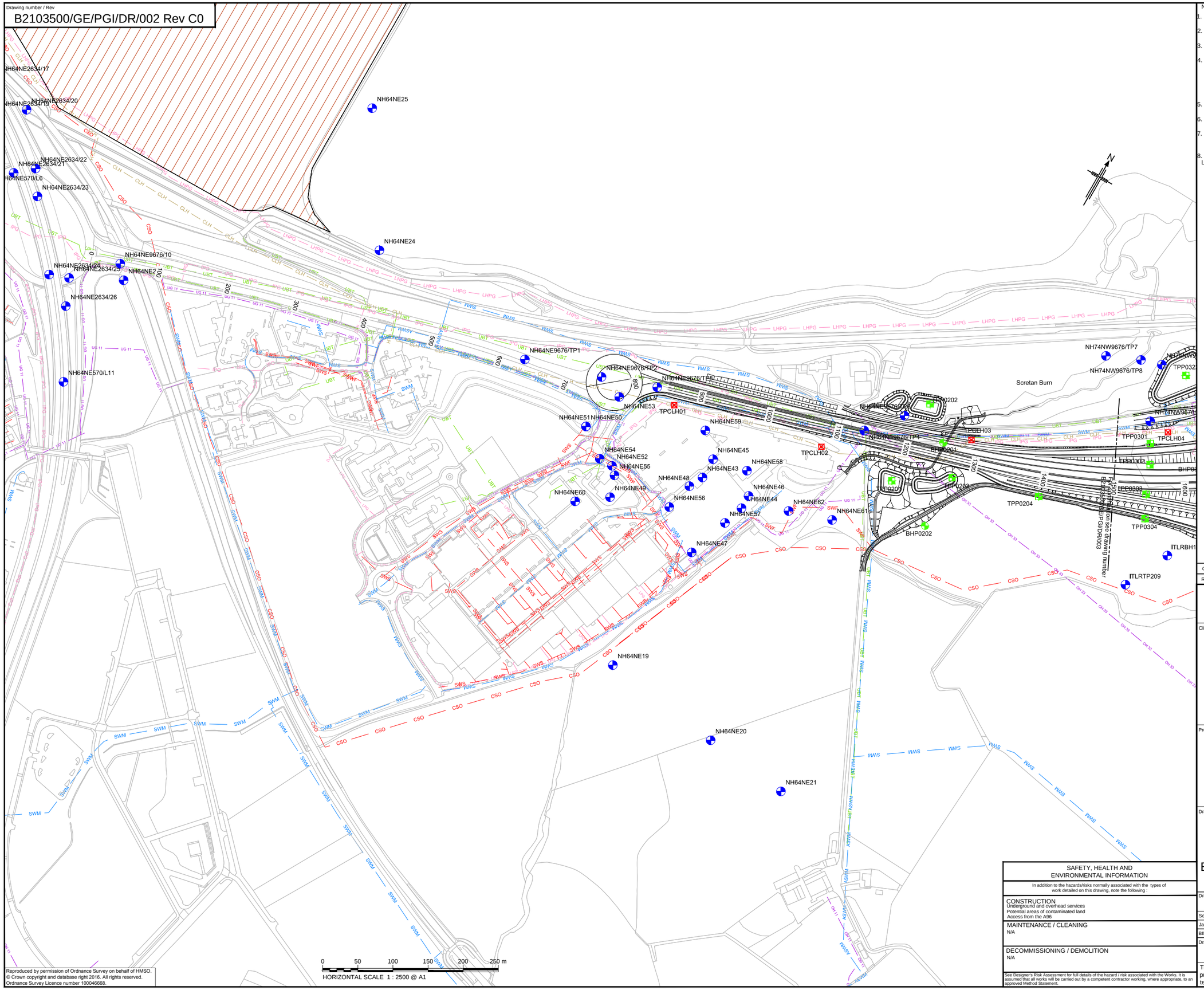

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8. Boundaries of areas of worked and made ground are conjectural.

Legend:

Priority 1 Exploratory Holes (Phase 1 of Site Operations)
- Proposed Borehole Location
- Proposed Hand Dug Trial Pit Location

Priority 2 Exploratory Holes
- Proposed Borehole Location
- Proposed Machine Excavated Trial Pit Location
- Proposed Static Cone Penetration Test Location

Existing Information
- Historical Exploratory Hole Location
- Area of Made Ground
- Area of Worked Ground

*Services Information

British Telecom
- OBT — Existing Overhead Cable
- UBT — Existing Underground Cable

SGN
- IPG — Existing Intermediate Pressure Main
- LPG — Existing Low Pressure Main
- LHPG — Existing Local High Pressure Main
- MPG — Existing Medium Pressure Main

Vodafone
- VODA — Existing Vodafone Cable

Scottish Water - Sewer
- CSO — Existing Combined Sewer Outfall
- SWF — Existing Foul Water Sewer
- SWS — Existing Surface Water Sewer

Scottish Water - Supply
- ASWM — Abandoned Water Main
- SWM — Existing Water Main
- TSWM — Existing Trunk Water Main
- PRIV — Existing Private Water Main
- Possible Private Water Supply

CLH Pipeline System
- CLH — Existing CLH Pipeline**

Scottish and Southern Energy - Distribution
- 0H 11 — Existing 11kV Overhead Cable
- UG 11 — Existing 11kV Underground Cable
- 0H 33 — Existing 33kV Overhead Cable

Scottish and Southern Energy - Transmission
- 0H 132 — Existing 132kV Overhead Cable

Scottish and Southern Energy - Telecom
- UGT — Existing Underground Cable

*Please note service information is provided for information only and no certainty is given to its accuracy. The Contractor shall undertake his own search in relation to utility information and satisfy himself on the location of all services.

**Any information regarding the location of the CLH pipeline shall not be shared with outside parties.

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C0	18/02/2016	For Construction	HR	IWM	SJD	EHB

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Project: A96 DUALLING INVERNESS TO NAIRN (incl. Nairn Bypass)

Drawing title

INVERNESS TO GOLLANFIELD PRELIMINARY GROUND INVESTIGATION PROPOSED EXPLORATORY HOLE LOCATIONS SHEET 1 OF 11

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION
Underground and overhead services
Potential areas of contaminated land
Access from the A96

MAINTENANCE / CLEANING
N/A

DECOMMISSIONING / DEMOLITION
N/A

See Designer's Risk Assessment for full details of the hazard / risk associated with the Works. It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved Method Statement.

Drawing status: FOR CONSTRUCTION

Scale	1:2,500 @ A1	DO NOT SCALE
Jacobs No.	B2103500	
BIM no.		
Drawing number	B2103500/GE/PGI/DR/002	Rev C0

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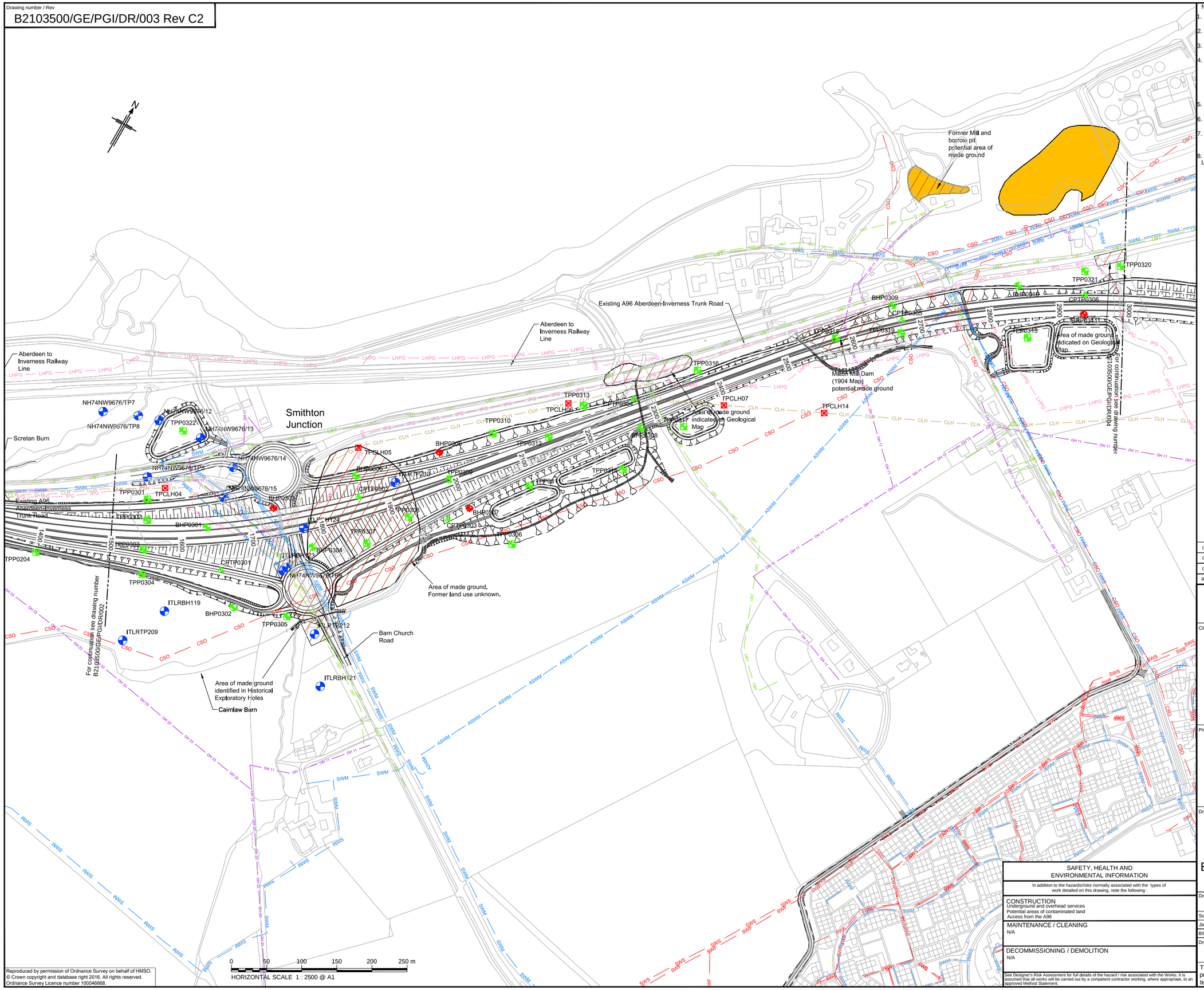

Notes:

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Legend:

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SGN
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Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
C2	13/04/16	For Construction	HR	IWM	SJD	EHG
C1	06/04/16	For Construction	GMcA	IWM	SJD	EHG
C0	18/02/2016	For Construction	HR	IWM	SJD	EHB

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Project: A96 DUALLING INVERNESS TO NAIRN (incl. Nairn Bypass)

Drawing title

INVERNESS TO GOLLANFIELD PRELIMINARY GROUND INVESTIGATION PROPOSED EXPLORATORY HOLE LOCATIONS SHEET 2 OF 11

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION
Underground and overhead services
Potential areas of contaminated land
Access from the A96

MAINTENANCE / CLEANING
N/A

DECOMMISSIONING / DEMOLITION
N/A

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Drawing status: FOR CONSTRUCTION

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Jacobs No.	B2103500	
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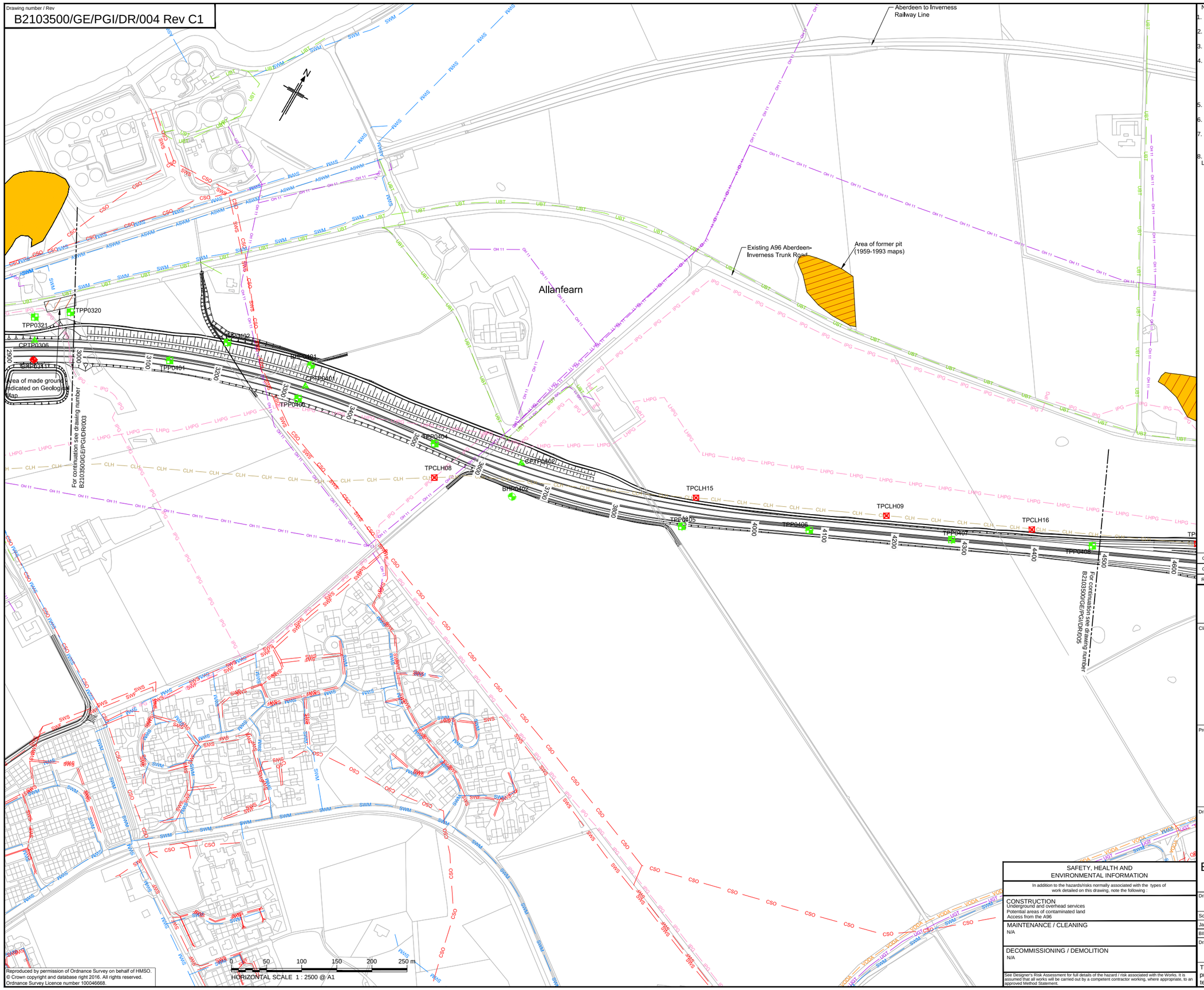

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Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
C1	13/04/16	For Construction	HR	IWM	SJD	EHG
C0	18/02/2016	For Construction	HR	IWM	SJD	EHB

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Drawing title

INVERNESS TO GOLLANFIELD PRELIMINARY GROUND INVESTIGATION PROPOSED EXPLORATORY HOLE LOCATIONS SHEET 3 OF 11

Drawing status: FOR CONSTRUCTION

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Drawing number	B2103500/GE/PGI/DR/004
Rev	C1

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION
Underground and overhead services
Potential areas of contaminated land
Access from the A96

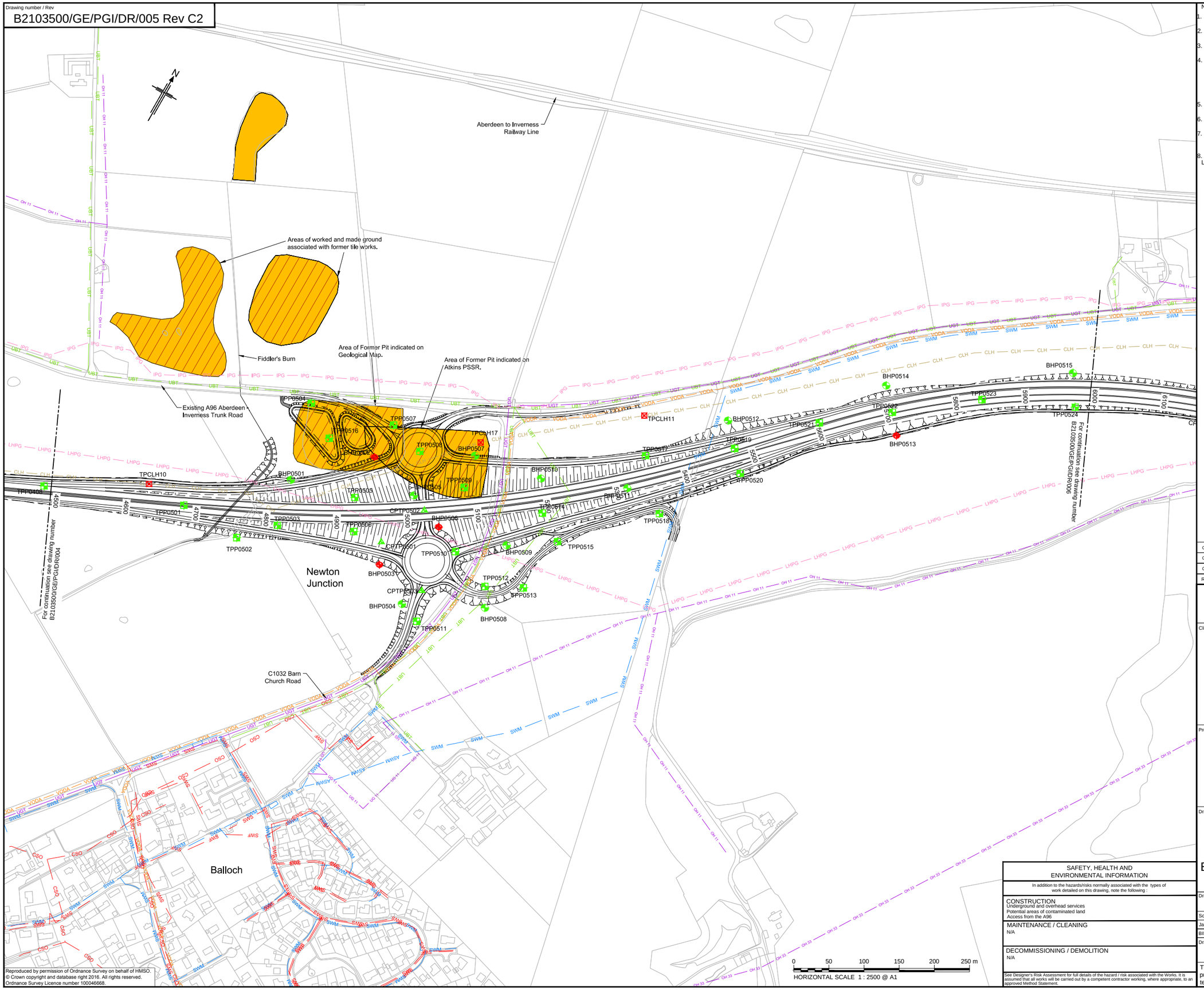
MAINTENANCE / CLEANING
N/A

DECOMMISSIONING / DEMOLITION
N/A

See Designer's Risk Assessment for full details of the hazard / risk associated with the Works. It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved Method Statement.

Drawing number / Rev

B2103500/GE/PGI/DR/005 Rev C2



Notes:

1. The exploratory hole locations are based on the developed preferred option (February 2016).
2. The OS Mastermap shown was obtained in November 2015 and is for illustrative purposes only.
3. All positions are to be agreed with the Engineer and the Contractor's Ecological Clerk of Works on site prior to commencement.
4. Drawings to be read in conjunction with A96 Dualling Inverness to Nairn (including Nairn Bypass) Preliminary Ground Investigation Contract Documents, Jacobs UK Ltd and the Transport Scotland Multi-Supplier Framework Agreement for Ground Investigation Work and the Ground Investigation Environmental Assessment, Environmental Report, Jacobs UK Ltd.
5. The Contractor shall not take access to exploratory holes until the relevant Schedule 6 Landowner Agreement has been signed by all parties.
6. Supply of the services information does not relieve the Contractor of the responsibility to undertake his own search with regard to services.
7. It is the responsibility of the Contractor to ensure that all services have been cleared and protected and are not damaged as a result of the site operations.
8. Boundaries of areas of worked and made ground are conjectural.

Legend:

Priority 1 Exploratory Holes (Phase 1 of Site Operations)
- Proposed Borehole Location
- Proposed Hand Dug Trial Pit Location

Priority 2 Exploratory Holes
- Proposed Borehole Location
- Proposed Machine Excavated Trial Pit Location
- Proposed Static Cone Penetration Test Location

Existing Information
- Historical Exploratory Hole Location
- Area of Made Ground
- Area of Worked Ground

*Services Information

British Telecom
- OBT — Existing Overhead Cable
- UBT — Existing Underground Cable

SGN
- IPG — Existing Intermediate Pressure Main
- LPG — Existing Low Pressure Main
- LHPG — Existing Local High Pressure Main
- MPG — Existing Medium Pressure Main

Vodafone
- VODA — Existing Vodafone Cable

Scottish Water - Sewer
- CSO — Existing Combined Sewer Outfall
- SWF — Existing Foul Water Sewer
- SWS — Existing Surface Water Sewer

Scottish Water - Supply
- ASWM — Abandoned Water Main
- SWM — Existing Water Main
- TSWM — Existing Trunk Water Main
- PRIV — Existing Private Water Main
- Possible Private Water Supply

CLH Pipeline System
- CLH — Existing CLH Pipeline**

Scottish and Southern Energy - Distribution
- ON 11 — Existing 11kV Overhead Cable
- UG 11 — Existing 11kV Underground Cable
- ON 33 — Existing 33kV Overhead Cable

Scottish and Southern Energy - Transmission
- ON 132 — Existing 132kV Overhead Cable

Scottish and Southern Energy - Telecom
- UGT — Existing Underground Cable

*Please note service information is provided for information only and no certainty is given to its accuracy. The Contractor shall undertake his own search in relation to utility information and satisfy himself on the location of all services.

**Any information regarding the location of the CLH pipeline shall not be shared with outside parties.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
C2	13/04/16	For Construction	HR	IWM	SJD	EHG
C1	06/04/16	For Construction	GMcA	IWM	SJD	EHG
C0	18/02/2016	For Construction	HR	IWM	SJD	EHB

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www.jacobs.com

Client: TRANSPORT SCOTLAND / CÒMHDHAIL ALBA

Project: A96 DUALLING INVERNESS TO NAIRN (Incl. Nairn Bypass)

Drawing title

INVERNESS TO GOLLANFIELD PRELIMINARY GROUND INVESTIGATION PROPOSED EXPLORATORY HOLE LOCATIONS SHEET 4 OF 11

Drawing status: FOR CONSTRUCTION

Scale	1:2,500 @ A1	DO NOT SCALE
Jacobs No.	B2103500	
BIM no.		
Drawing number	B2103500/GE/PGI/DR/005	Rev C2

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION
Underground and overhead services
Potential areas of contaminated land
Access from the A96

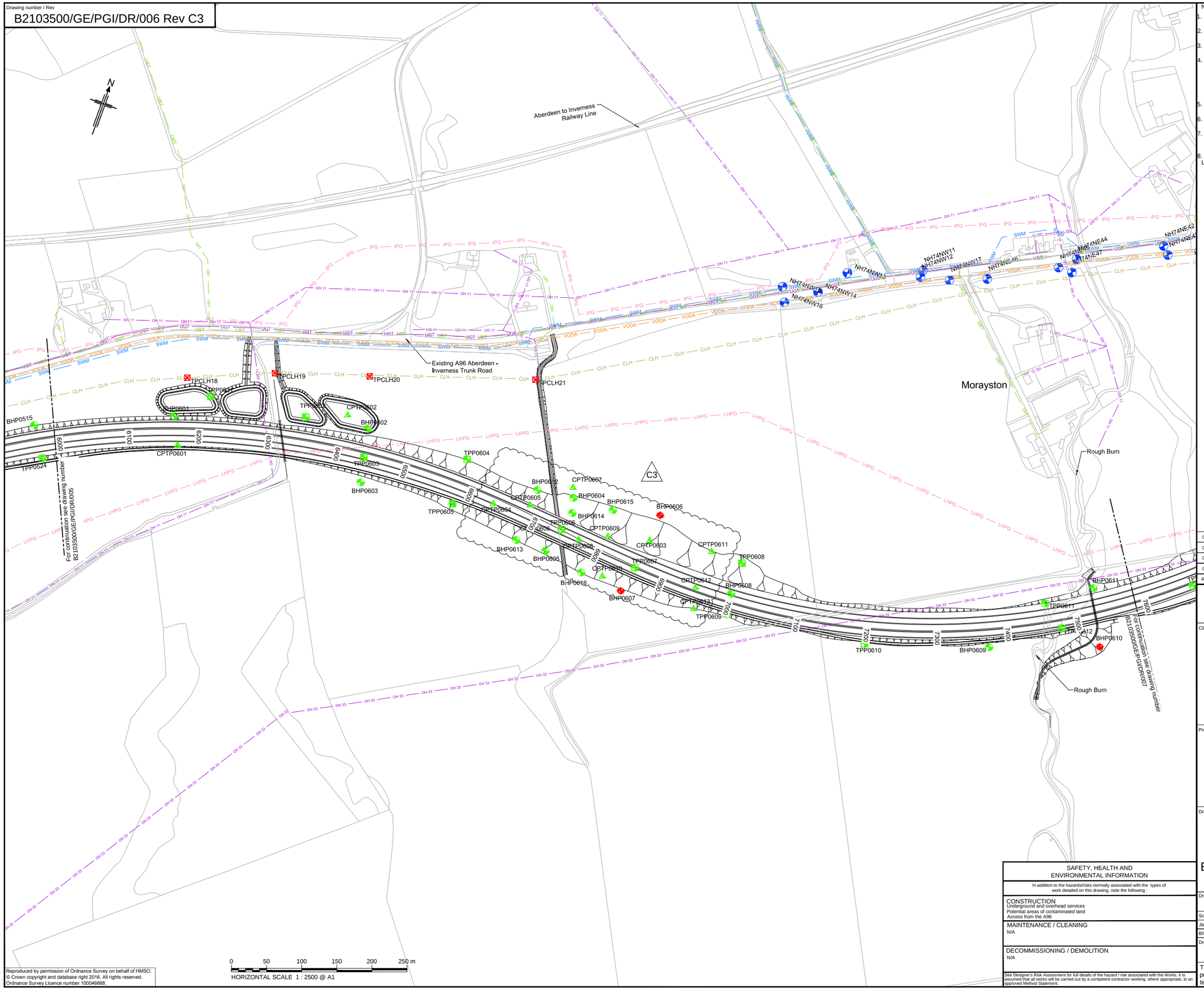
MAINTENANCE / CLEANING
N/A

DECOMMISSIONING / DEMOLITION
N/A

See Designer's Risk Assessment for full details of the hazard / risk associated with the Works. It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved Method Statement.

Drawing number / Rev

B2103500/GE/PGI/DR/006 Rev C3



Notes:

1. The exploratory hole locations are based on the developed preferred option (February 2016).
2. The OS Mastermap shown was obtained in November 2015 and is for illustrative purposes only.
3. All positions are to be agreed with the Engineer and the Contractor's Ecological Clerk of Works on site prior to commencement.
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8. Boundaries of areas of worked and made ground are conjectural.

Legend:

Priority 1 Exploratory Holes (Phase 1 of Site Operations)
- Proposed Borehole Location
- Proposed Hand Dug Trial Pit Location

Priority 2 Exploratory Holes
- Proposed Borehole Location
- Proposed Machine Excavated Trial Pit Location
- Proposed Static Cone Penetration Test Location

Existing Information
- Historical Exploratory Hole Location
- Area of Made Ground
- Area of Worked Ground

*Services Information

British Telecom
- OBT — Existing Overhead Cable
- UBT — Existing Underground Cable

SGN
- IPG — Existing Intermediate Pressure Main
- LPG — Existing Low Pressure Main
- LHPG — Existing Local High Pressure Main
- MPG — Existing Medium Pressure Main

Vodafone
- VODA — Existing Vodafone Cable

Scottish Water - Sewer
- CSO — Existing Combined Sewer Outfall
- SWF — Existing Foul Water Sewer
- SWS — Existing Surface Water Sewer

Scottish Water - Supply
- ASWM — Abandoned Water Main
- SWM — Existing Water Main
- TSWM — Existing Trunk Water Main
- PRIV — Existing Private Water Main
- Possible Private Water Supply

CLH Pipeline System
- CLH — Existing CLH Pipeline**

Scottish and Southern Energy - Distribution
- OH 11 — Existing 11kV Overhead Cable
- UG 11 — Existing 11kV Underground Cable
- OH 33 — Existing 33kV Overhead Cable

Scottish and Southern Energy - Transmission
- OH 132 — Existing 132kV Overhead Cable

Scottish and Southern Energy - Telecom
- UGT — Existing Underground Cable

*Please note service information is provided for information only and no certainty is given to its accuracy. The Contractor shall undertake his own search in relation to utility information and satisfy himself on the location of all services.

**Any information regarding the location of the CLH pipeline shall not be shared with outside parties.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
C3	17/05/16	For Construction - addition of CPT0604-CPT0613	HR	IWM	SJD	EHG
C2	06/05/15	For Construction - addition of BHP0612-BHP0615	HR	IWM	SJD	EHG
C1	13/04/16	For Construction	HR	IWM	SJD	EHG
C0	18/02/2016	For Construction	HR	IWM	SJD	EHB

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION
Underground and overhead services
Potential areas of contaminated land
Access from the A96

MAINTENANCE / CLEANING
N/A

DECOMMISSIONING / DEMOLITION
N/A

See Designer's Risk Assessment for full details of the hazard / risk associated with the Works. It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved Method Statement.

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www.jacobs.com

Client: TRANSPORT SCOTLAND / CÒMHDHAIL ALBA

Project: A96 DUALLING INVERNESS TO NAIRN (Incl. Nairn Bypass)

Drawing title

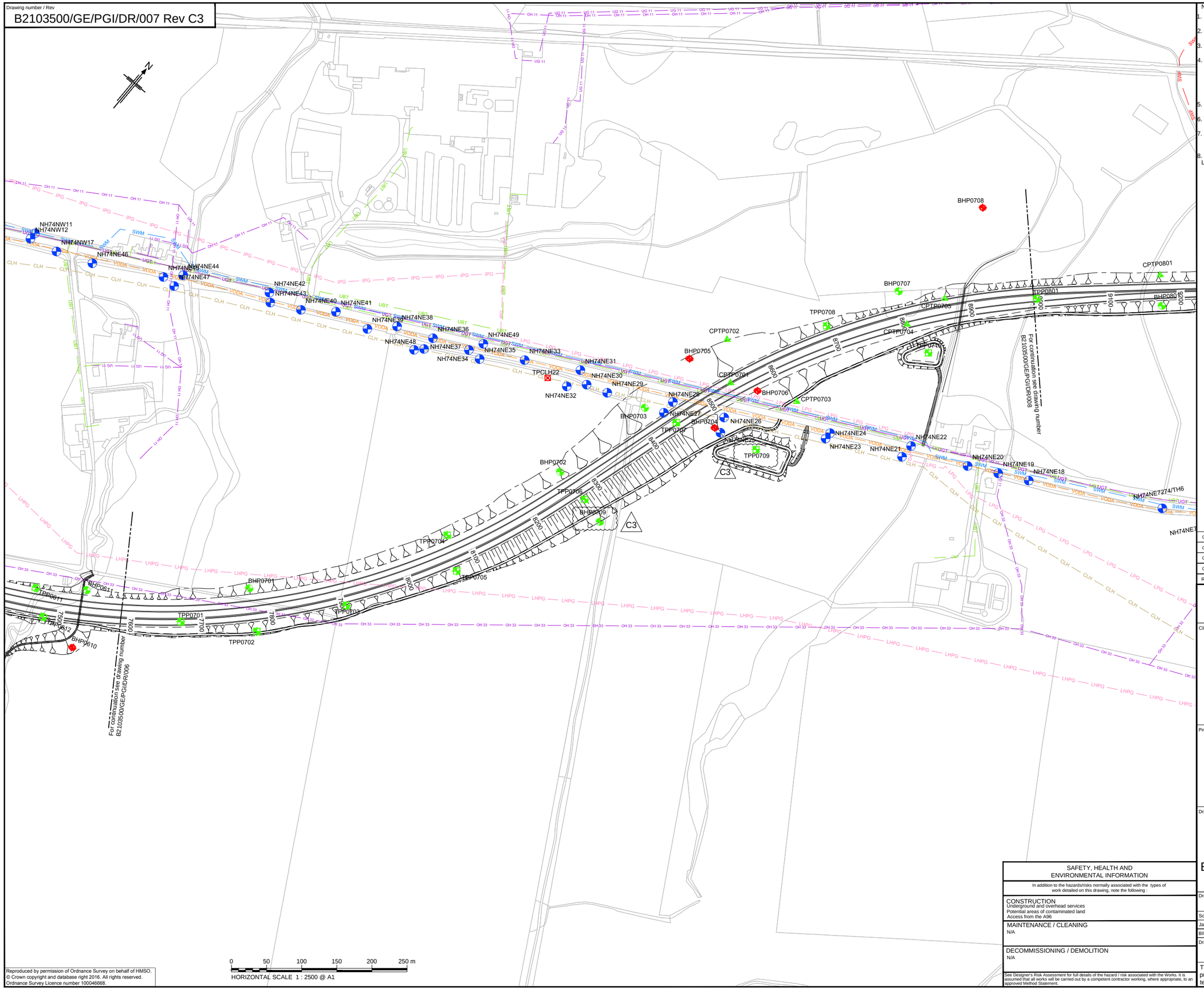
INVERNESS TO GOLLANFIELD PRELIMINARY GROUND INVESTIGATION PROPOSED EXPLORATORY HOLE LOCATIONS SHEET 5 OF 11

Drawing status: FOR CONSTRUCTION

Scale	1:2,500 @ A1 — DO NOT SCALE
Jacobs No.	B2103500
BIM no.	
Drawing number	B2103500/GE/PGI/DR/006
Rev	C3

Drawing number / Rev

B2103500/GE/PGI/DR/007 Rev C3



Notes:

1. The exploratory hole locations are based on the developed preferred option (February 2016).
2. The OS Mastermap shown was obtained in November 2015 and is for illustrative purposes only.
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8. Boundaries of areas of worked and made ground are conjectural.

Legend:

Priority 1 Exploratory Holes (Phase 1 of Site Operations)
- Proposed Borehole Location
- Proposed Hand Dug Trial Pit Location

Priority 2 Exploratory Holes
- Proposed Borehole Location
- Proposed Machine Excavated Trial Pit Location
- Proposed Static Cone Penetration Test Location

Existing Information
- Historical Exploratory Hole Location
- Area of Made Ground
- Area of Worked Ground

*Services Information

British Telecom
- OBT — Existing Overhead Cable
- UBT — Existing Underground Cable

SGN
- IPG — Existing Intermediate Pressure Main
- LPG — Existing Low Pressure Main
- LHPG — Existing Local High Pressure Main
- MPG — Existing Medium Pressure Main

Vodafone
- VODA — Existing Vodafone Cable

Scottish Water - Sewer
- CSO — Existing Combined Sewer Outfall
- SWF — Existing Foul Water Sewer
- SWS — Existing Surface Water Sewer

Scottish Water - Supply
- ASWM — Abandoned Water Main
- SWM — Existing Water Main
- TSWM — Existing Trunk Water Main
- PRIV — Existing Private Water Main
- Possible Private Water Supply

CLH Pipeline System
- CLH — Existing CLH Pipeline**

Scottish and Southern Energy - Distribution
- OH 11 — Existing 11kV Overhead Cable
- UG 11 — Existing 11kV Underground Cable
- OH 33 — Existing 33kV Overhead Cable

Scottish and Southern Energy - Transmission
- OH 132 — Existing 132kV Overhead Cable

Scottish and Southern Energy - Telecom
- UGT — Existing Underground Cable

*Please note service information is provided for information only and no certainty is given to its accuracy. The Contractor shall undertake his own search in relation to utility information and satisfy himself on the location of all services.

**Any information regarding the location of the CLH pipeline shall not be shared with outside parties.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
C3	20/04/16	For Construction	HR	IWM	SJD	EHG
C2	13/04/16	For Construction	HR	IWM	SJD	EHG
C1	06/04/16	For Construction	GMcA	IWM	SJD	EHG
C0	18/02/2016	For Construction	HR	IWM	SJD	EHB

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www.jacobs.com

Client: TRANSPORT SCOTLAND / CÒMHDHAIL ALBA

Project: A96 DUALLING INVERNESS TO NAIRN (Incl. Nairn Bypass)

Drawing title

INVERNESS TO GOLLANFIELD PRELIMINARY GROUND INVESTIGATION PROPOSED EXPLORATORY HOLE LOCATIONS SHEET 6 OF 11

Drawing status: FOR CONSTRUCTION

Scale	1:2,500 @ A1	DO NOT SCALE
Jacobs No.	B2103500	
BIM no.		
Drawing number	B2103500/GE/PGI/DR/007	Rev C3

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION
Underground and overhead services
Potential areas of contaminated land
Access from the A96

MAINTENANCE / CLEANING
N/A

DECOMMISSIONING / DEMOLITION
N/A

See Designer's Risk Assessment for full details of the hazard / risk associated with the Works. It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved Method Statement.

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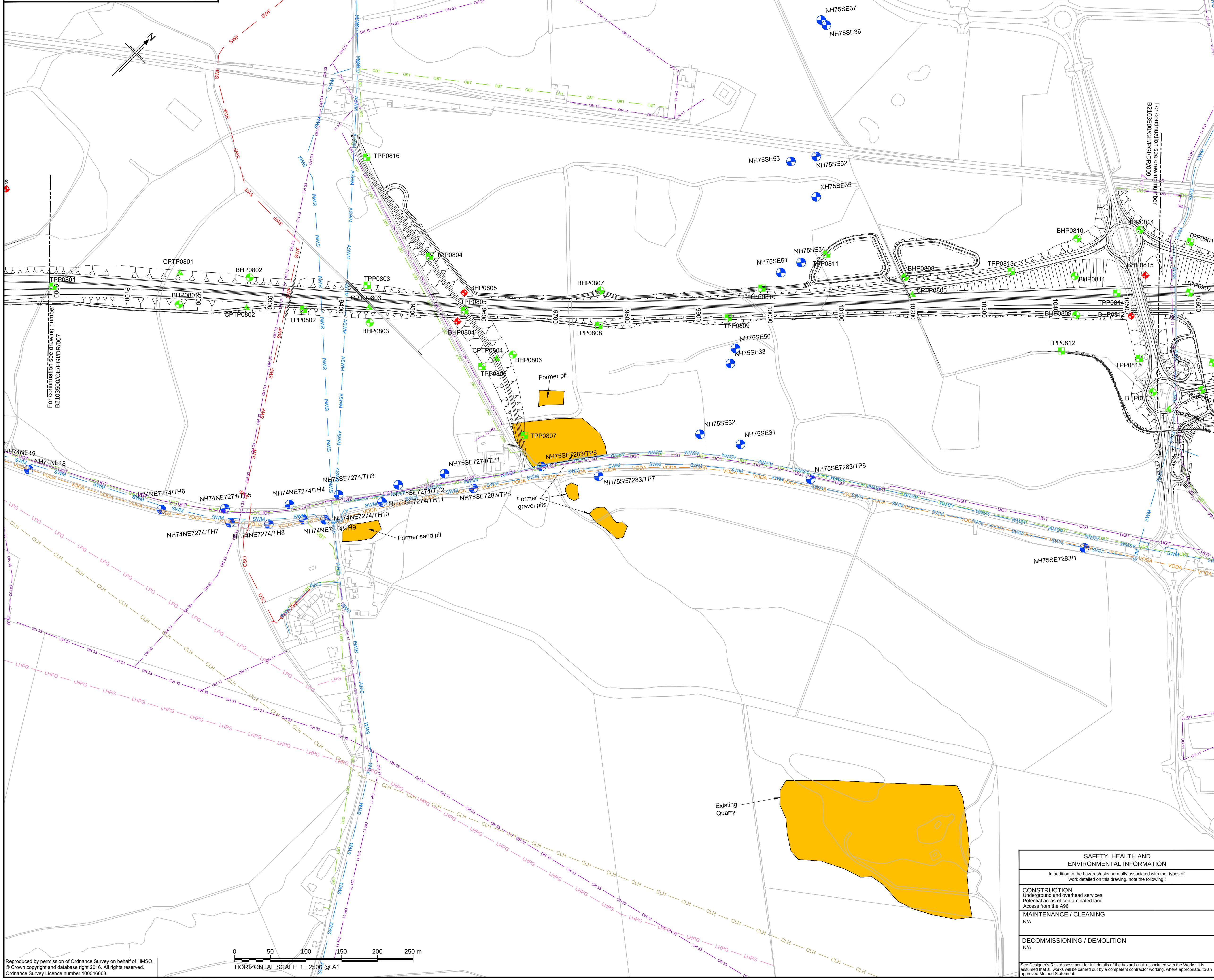
HORIZONTAL SCALE 1 : 2500 @ A1

Drawing number / Rev

B2103500/GE/PGI/DR/008 Rev C1



Notes:

1. The exploratory hole locations are based on the developed preferred option (February 2016).
2. The OS Mastermap shown was obtained in November 2015 and is for illustrative purposes only.
3. All positions are to be agreed with the Engineer and the Contractor's Ecological Clerk of Works on site prior to commencement.
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8. Boundaries of areas of worked and made ground are conjectural.

Legend:

Priority 1 Exploratory Holes (Phase 1 of Site Operations)
- Proposed Borehole Location
- Proposed Hand Dug Trial Pit Location

Priority 2 Exploratory Holes
- Proposed Borehole Location
- Proposed Machine Excavated Trial Pit Location
- Proposed Static Cone Penetration Test Location

Existing Information
- Historical Exploratory Hole Location
- Area of Made Ground
- Area of Worked Ground

*Services Information

British Telecom
- OBT — Existing Overhead Cable
- UBT — Existing Underground Cable

SGN
- IPG — Existing Intermediate Pressure Main
- LPG — Existing Low Pressure Main
- LHPG — Existing Local High Pressure Main
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Vodafone
- VODA — Existing Vodafone Cable

Scottish Water - Sewer
- CSO — Existing Combined Sewer Outfall
- SWF — Existing Foul Water Sewer
- SWS — Existing Surface Water Sewer

Scottish Water - Supply
- ASWM — Abandoned Water Main
- SWM — Existing Water Main
- TSWM — Existing Trunk Water Main
- PRIV — Existing Private Water Main
- Possible Private Water Supply

CLH Pipeline System
- CLH — Existing CLH Pipeline**

Scottish and Southern Energy - Distribution
- OH 11 — Existing 11kV Overhead Cable
- UG 11 — Existing 11kV Underground Cable
- OH 33 — Existing 33kV Overhead Cable

Scottish and Southern Energy - Transmission
- OH 132 — Existing 132kV Overhead Cable

Scottish and Southern Energy - Telecom
- UGT — Existing Underground Cable

*Please note service information is provided for information only and no certainty is given to its accuracy. The Contractor shall undertake his own search in relation to utility information and satisfy himself on the location of all services.

**Any information regarding the location of the CLH pipeline shall not be shared with outside parties.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
C1	06/04/16	For Construction	GMcA	IWM	SJD	EHG
C0	18/02/2016	For Construction	HR	IWM	SJD	EHB

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www.jacobs.com

Client: Transport Scotland / Còmhdhail Alba

Project: A96 Dualling Inverness to Nairn (Incl. Nairn Bypass)

Drawing title

INVERNESS TO GOLLANFIELD PRELIMINARY GROUND INVESTIGATION PROPOSED EXPLORATORY HOLE LOCATIONS SHEET 7 OF 11

Drawing status: FOR CONSTRUCTION

Scale	1:2,500 @ A1	DO NOT SCALE
Jacobs No.	B2103500	
BIM no.		

Drawing number: B2103500/GE/PGI/DR/008 — Rev: C1

This drawing is not to be used in whole or part other than for the intended purpose and project as defined on this drawing. Refer to the contract for full terms and conditions.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION
Underground and overhead services
Potential areas of contaminated land
Access from the A96

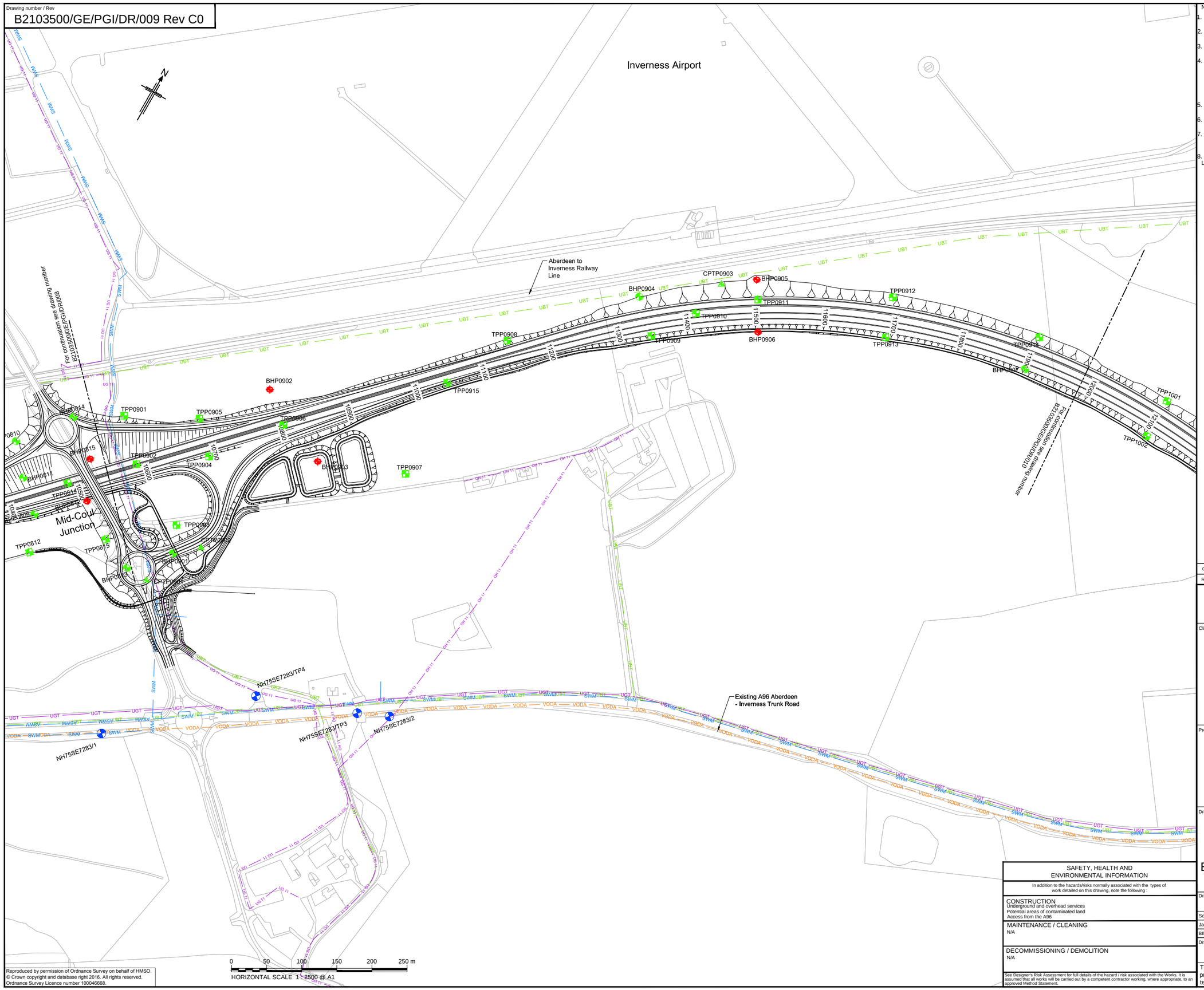
MAINTENANCE / CLEANING
N/A

DECOMMISSIONING / DEMOLITION
N/A

See Designer's Risk Assessment for full details of the hazard / risk associated with the Works. It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved Method Statement.

Drawing number / Rev

B2103500/GE/PGI/DR/009 Rev C0



Notes:

1. The exploratory hole locations are based on the developed preferred option (February 2016).
2. The OS Mastermap shown was obtained in November 2015 and is for illustrative purposes only.
3. All positions are to be agreed with the Engineer and the Contractor's Ecological Clerk of Works on site prior to commencement.
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8. Boundaries of areas of worked and made ground are conjectural.

Legend:

Priority 1 Exploratory Holes (Phase 1 of Site Operations)
- Proposed Borehole Location
- Proposed Hand Dug Trial Pit Location

Priority 2 Exploratory Holes
- Proposed Borehole Location
- Proposed Machine Excavated Trial Pit Location
- Proposed Static Cone Penetration Test Location

Existing Information
- Historical Exploratory Hole Location
- Area of Made Ground
- Area of Worked Ground

*Services Information

British Telecom
- OBT — Existing Overhead Cable
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Scottish and Southern Energy - Transmission
- OH 132 — Existing 132kV Overhead Cable

Scottish and Southern Energy - Telecom
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Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
C0	18/02/2016	For Construction	HR	IWM	SJD	EHB

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Client: TRANSPORT SCOTLAND / CÒMHDHAIL ALBA

Project: A96 DUALLING INVERNESS TO NAIRN (Incl. Nairn Bypass)

Drawing title

INVERNESS TO GOLLANFIELD PRELIMINARY GROUND INVESTIGATION PROPOSED EXPLORATORY HOLE LOCATIONS SHEET 8 OF 11

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION
Underground and overhead services
Potential areas of contaminated land
Access from the A96

MAINTENANCE / CLEANING
N/A

DECOMMISSIONING / DEMOLITION
N/A

See Designer's Risk Assessment for full details of the hazard / risk associated with the Works. It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved Method Statement.

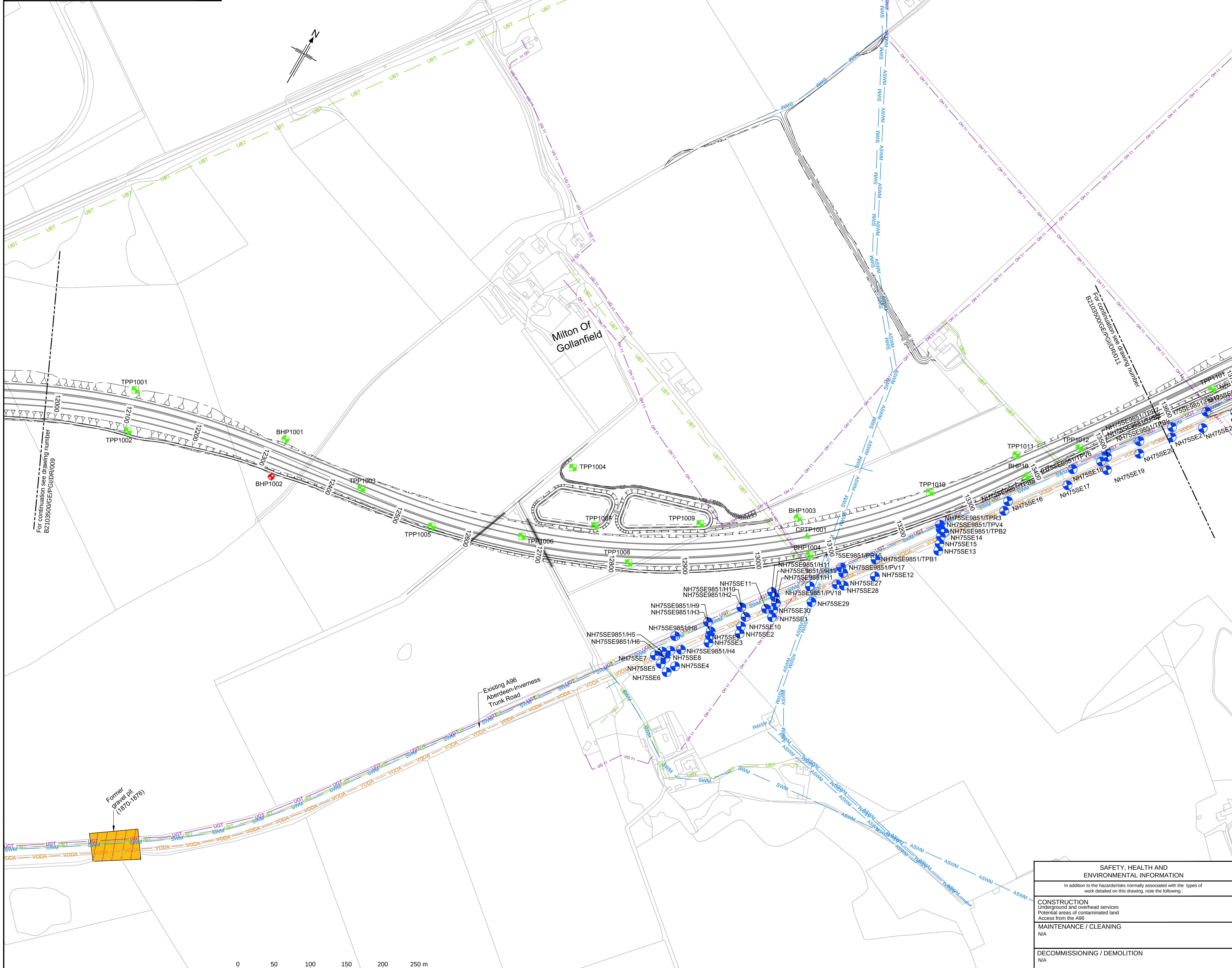
Drawing status: FOR CONSTRUCTION

Scale	1:2,500 @ A1	DO NOT SCALE
Jacobs No.	B2103500	
BIM no.		

Drawing number: B2103500/GE/PGI/DR/009 Rev C0

Drawing number / Rev

B2103500/GE/PGI/DR/010 Rev C1



Notes:

1. The exploratory hole locations are based on the developed preferred option (February 2016).
2. The OS Mastermap shown was obtained in November 2015 and is for illustrative purposes only.
3. All positions are to be agreed with the Engineer and the Contractor's Ecological Clerk of Works on site prior to commencement.
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Legend:

Priority 1 Exploratory Holes (Phase 1 of Site Operations)
- Proposed Borehole Location
- Proposed Hand Dug Trial Pit Location

Priority 2 Exploratory Holes
- Proposed Borehole Location
- Proposed Machine Excavated Trial Pit Location
- Proposed Static Cone Penetration Test Location

Existing Information
- Historical Exploratory Hole Location
- Area of Made Ground
- Area of Worked Ground

*Services Information

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Scottish and Southern Energy - Transmission
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Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
C1	06/04/16	For Construction	GMcA	IWM	SJD	EHG
C0	18/02/2016	For Construction	HR	IWM	SJD	EHB

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION
Underground and overhead services
Potential areas of contaminated land
Access from the A96

MAINTENANCE / CLEANING
N/A

DECOMMISSIONING / DEMOLITION
N/A

See Designer's Risk Assessment for full details of the hazard / risk associated with the Works. It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved Method Statement.

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Client

TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

Project

A96 DUALLING
INVERNESS TO NAIRN
(Incl. Nairn Bypass)

Drawing title

INVERNESS TO GOLLANFIELD PRELIMINARY GROUND INVESTIGATION PROPOSED EXPLORATORY HOLE LOCATIONS SHEET 9 OF 11

Drawing status

FOR CONSTRUCTION

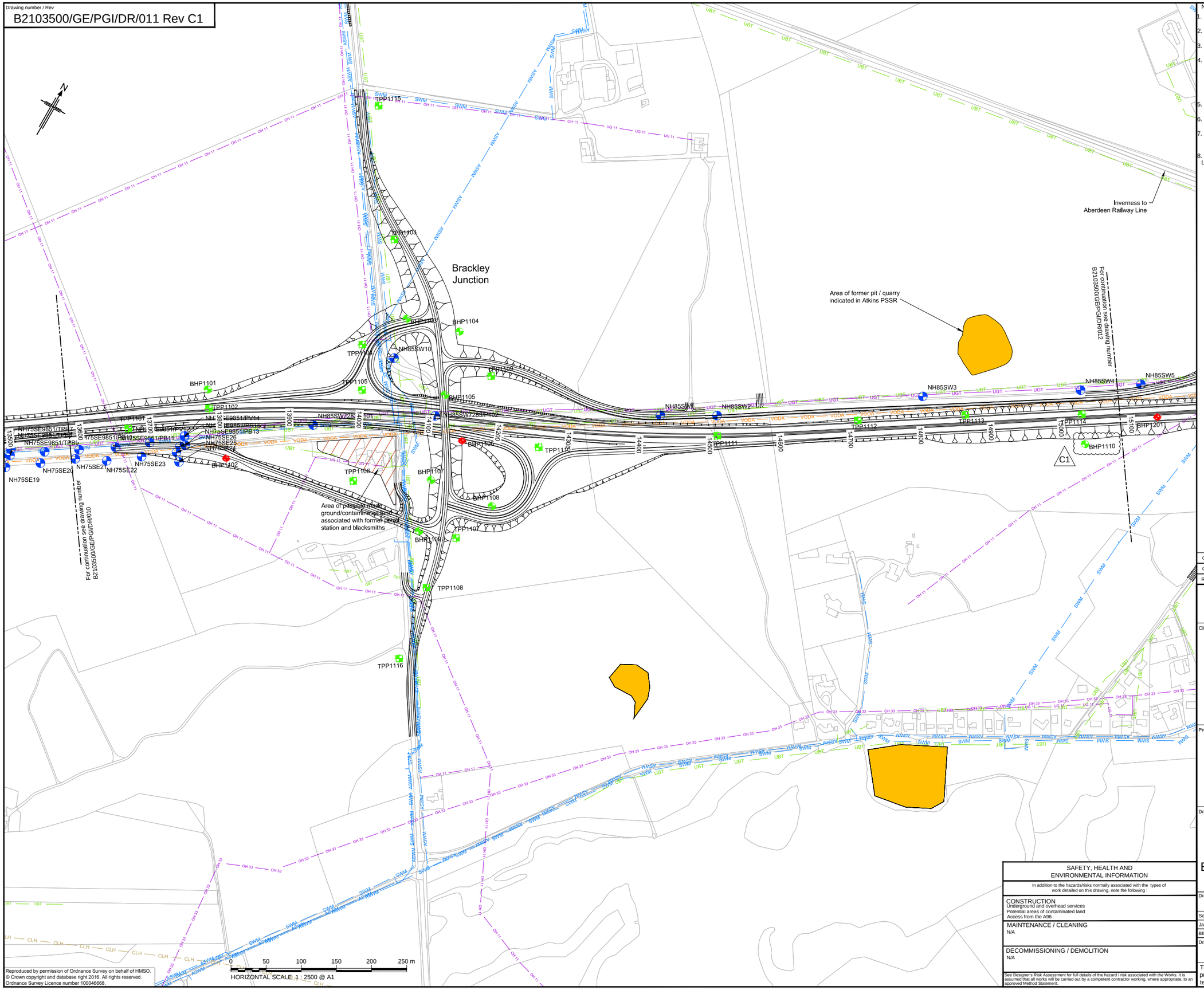
Scale	1:2,500 @ A1	DO NOT SCALE
Jacobs No.	B2103500	
BIM no.		

Drawing number: B2103500/GE/PGI/DR/010 — Rev: C1

This drawing is not to be used in whole or part other than for the intended purpose and project as defined on this drawing. Refer to the contract for full terms and conditions.

Drawing number / Rev

B2103500/GE/PGI/DR/011 Rev C1



Notes:

1. The exploratory hole locations are based on the developed preferred option (February 2016).
2. The OS Mastermap shown was obtained in November 2015 and is for illustrative purposes only.
3. All positions are to be agreed with the Engineer and the Contractor's Ecological Clerk of Works on site prior to commencement.
4. Drawings to be read in conjunction with A96 Dualling Inverness to Nairn (including Nairn Bypass) Preliminary Ground Investigation Contract Documents, Jacobs UK Ltd and the Transport Scotland Multi-Supplier Framework Agreement for Ground Investigation Work and the Ground Investigation Environmental Assessment, Environmental Report, Jacobs UK Ltd.
5. The Contractor shall not take access to exploratory holes until the relevant Schedule 6 Landowner Agreement has been signed by all parties.
6. Supply of the services information does not relieve the Contractor of the responsibility to undertake his own search with regard to services.
7. It is the responsibility of the Contractor to ensure that all services have been cleared and protected and are not damaged as a result of the site operations.
8. Boundaries of areas of worked and made ground are conjectural.

Legend:

Priority 1 Exploratory Holes (Phase 1 of Site Operations)
- Proposed Borehole Location
- Proposed Hand Dug Trial Pit Location

Priority 2 Exploratory Holes
- Proposed Borehole Location
- Proposed Machine Excavated Trial Pit Location
- Proposed Static Cone Penetration Test Location

Existing Information
- Historical Exploratory Hole Location
- Area of Made Ground
- Area of Worked Ground

*Services Information

British Telecom
- OBT — Existing Overhead Cable
- UBT — Existing Underground Cable

SGN
- IPG — Existing Intermediate Pressure Main
- LPG — Existing Low Pressure Main
- LHPG — Existing Local High Pressure Main
- MPG — Existing Medium Pressure Main

Vodafone
- VODA — Existing Vodafone Cable

Scottish Water - Sewer
- CSO — Existing Combined Sewer Outfall
- SWF — Existing Foul Water Sewer
- SWS — Existing Surface Water Sewer

Scottish Water - Supply
- ASWM — Abandoned Water Main
- SWM — Existing Water Main
- TSWM — Existing Trunk Water Main
- PRIV — Existing Private Water Main
- Possible Private Water Supply

CLH Pipeline System
- CLH — Existing CLH Pipeline**

Scottish and Southern Energy - Distribution
- OH 11 — Existing 11kV Overhead Cable
- UG 11 — Existing 11kV Underground Cable
- OH 33 — Existing 33kV Overhead Cable

Scottish and Southern Energy - Transmission
- OH 132 — Existing 132kV Overhead Cable

Scottish and Southern Energy - Telecom
- UGT — Existing Underground Cable

*Please note service information is provided for information only and no certainty is given to its accuracy. The Contractor shall undertake his own search in relation to utility information and satisfy himself on the location of all services.

**Any information regarding the location of the CLH pipeline shall not be shared with outside parties.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
C1	20/04/16	For Construction	HR	IWM	SJD	EHG
C0	18/02/2016	For Construction	HR	IWM	SJD	EHB

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION
Underground and overhead services
Potential areas of contaminated land
Access from the A96

MAINTENANCE / CLEANING
N/A

DECOMMISSIONING / DEMOLITION
N/A

See Designer's Risk Assessment for full details of the hazard / risk associated with the Works. It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved Method Statement.

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Client: TRANSPORT SCOTLAND / COMHDHAIL ALBA

Project: A96 DUALLING INVERNESS TO NAIRN (Incl. Nairn Bypass)

Drawing title

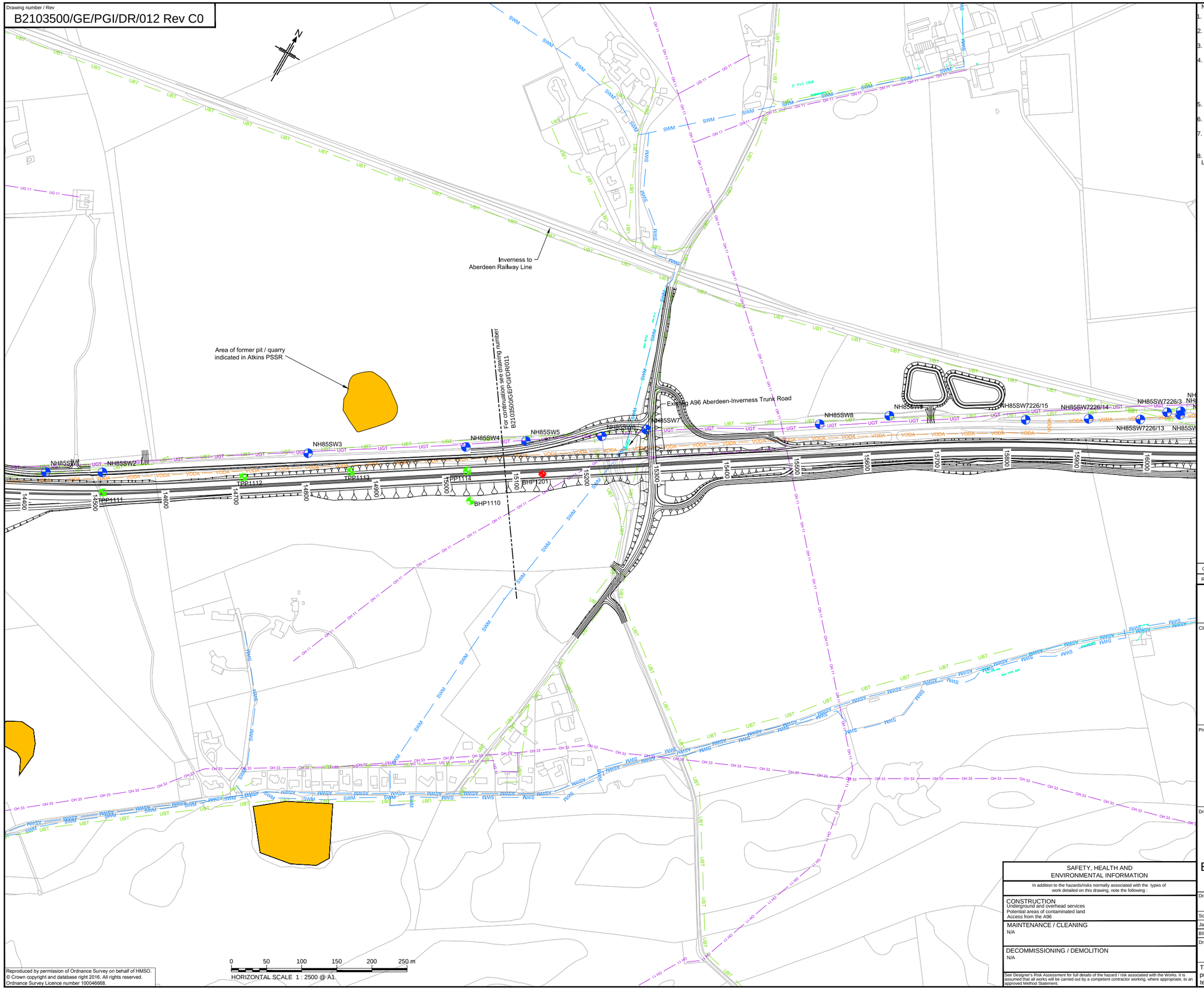
INVERNESS TO GOLLANFIELD PRELIMINARY GROUND INVESTIGATION PROPOSED EXPLORATORY HOLE LOCATIONS SHEET 10 OF 11

Drawing status: FOR CONSTRUCTION

Scale	1:2,500 @ A1	DO NOT SCALE
Jacobs No.	B2103500	
BIM no.		
Drawing number	B2103500/GE/PGI/DR/011	Rev C1

Drawing number / Rev

B2103500/GE/PGI/DR/012 Rev C0



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Scottish and Southern Energy - Transmission
- OH 132 — Existing 132kV Overhead Cable

Scottish and Southern Energy - Telecom
- UGT — Existing Underground Cable

*Please note service information is provided for information only and no certainty is given to its accuracy. The Contractor shall undertake his own search in relation to utility information and satisfy himself on the location of all services.

**Any information regarding the location of the CLH pipeline shall not be shared with outside parties.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
C0	18/02/2016	For Construction	HR	IWM	SJD	EHB

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Client: TRANSPORT SCOTLAND / CÒMHDHAIL ALBA

Project: A96 DUALLING INVERNESS TO NAIRN (incl. Nairn Bypass)

Drawing title

INVERNESS TO GOLLANFIELD PRELIMINARY GROUND INVESTIGATION PROPOSED EXPLORATORY HOLE LOCATIONS SHEET 11 OF 11

Drawing status: FOR CONSTRUCTION

Scale	1:2,500 @ A1	DO NOT SCALE
Jacobs No.	B2103500	
BIM no.		
Drawing number	B2103500/GE/PGI/DR/012	Rev C0

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION
Underground and overhead services
Potential areas of contaminated land
Access from the A96

MAINTENANCE / CLEANING
N/A

DECOMMISSIONING / DEMOLITION
N/A

See Designer's Risk Assessment for full details of the hazard / risk associated with the Works. It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved Method Statement.

Appendix B: Peat Probing Results

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Peat Probing (Area A) | **Undertaken 17/04/2016 at 1100** | **Weather - Overcast/Sunny**

Notes:
- Refer to Diagram 1 for Peat Probe layout
- GPS readings are accurate to 5m.

Area A Total (m)	**8.09**
No. of Probes	**41**
Max. depth (m)	**0.48**

Transect 1				Transect 2				Transect 3			
Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)
81571	53156	0	0.00	81586	53144	0	0.30	81616	53144	0	0.10
81555	53142	20	0.22	81575	53136	20	0.05	81578	53111	20	0.30
81539	53129	40	0.00	81556	53117	40	0.13	81557	53101	40	0.33
81522	53123	60	0.02	81529	53104	60	0.37	81539	53096	60	0.30
81511	53111	80	0.05	81513	53094	80	0.25	81520	53086	80	0.00
81491	53098	100	0.07	81498	53084	100	0.03	81504	53076	100	0.12
81476	53088	120	0.25	81481	53071	120	0.19	81490	53065	120	0.24
81423	53062	140	0.24	81465	53064	140	0.19	81475	53055	140	0.09
81446	53071	160	0.15	81450	53053	160	0.36	81457	53047	160	0.27
81431	53061	180	0.00	81438	53041	180	0.32	81443	53036	180	0.25
81416	53054	200	0.17	81425	53033	200	0.23	81429	53024	200	0.05
81402	53045	220	0.05	81411	53023	220	0.30	81422	53013	220	0.39
81389	53034	240	0.05	81380	53006	240	0.41	81404	53005	240	0.48
81373	53025	260	0.42					81390	52996	260	0.35
		Total (m)	1.69			Total (m)	3.13			Total (m)	3.27
		Max (m)	0.42			Max (m)	0.41			Max (m)	0.48
		Min (m)	0.00			Min (m)	0.03			Min (m)	0.00
		Average (m)	0.12			Average (m)	0.24			Average (m)	0.23
		Total Probes	14			Total Probes	13			Total Probes	14

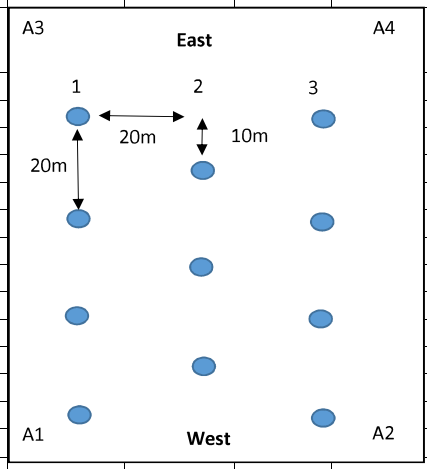

Diagram 1 - Peat Probe Layout. A1-A4 refer to corner co-ordinates of peat probing area.

Peat Probing (Area B) | **Undertaken 17/04/2016 at 1400** | **Weather - Overcast/Sunny**

Notes:
- Refer to Diagram 1 for layout of peat probes.
- GPS readings are accurate to 5m.

Transect 1				Transect 2				Transect 3			
Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)
81958	53385	0	0.45	81958	53369	0	0.35	81981	53355	0	0.31
81941	53379	20	0.10	81940	53354	20	0.41	81967	53343	20	0.26
81930	53369	40	0.04	81927	53341	40	0.21	81949	53338	40	0.10
81903	53361	60	0.05	81912	53336	60	0.23	81931	53326	60	0.30
81895	53354	80	0.05	81895	53329	80	0.24	81915	53317	80	0.26
81874	53344	100	0.05	81878	53317	100	0.23	81899	53309	100	0.27
81853	53330	120	0.08	81865	53307	120	0.20	81881	53298	120	0.28
81842	53320	140	0.02	81848	53296	140	0.22	81864	53288	140	0.27
81826	53312	160	0.08	81831	53285	160	0.25	81847	53281	160	0.37
81807	53305	180	0.15	81812	53285	180	0.12	81831	53269	180	0.29
81780	53285	200	0.21	81788	53271	200	0.05	81812	53258	200	0.32
81775	53277	220	0.00	81778	53260	220	0.10	81801	53242	220	0.28
81764	53270	240	0.15					81778	53233	240.00	0.09
		Total (m)	1.43			Total (m)	2.61			Total (m)	3.40
		Max (m)	0.45			Max (m)	0.41			Max (m)	0.37
		Min (m)	0.00			Min (m)	0.05			Min (m)	0.09
		Average (m)	0.11			Average (m)	0.22			Average (m)	0.26
		Total Probes	13			Total Probes	12			Total Probes	13

Area B Total (m)	**7.44**
No. of Probes	**38**
Max. depth (m)	**0.45**

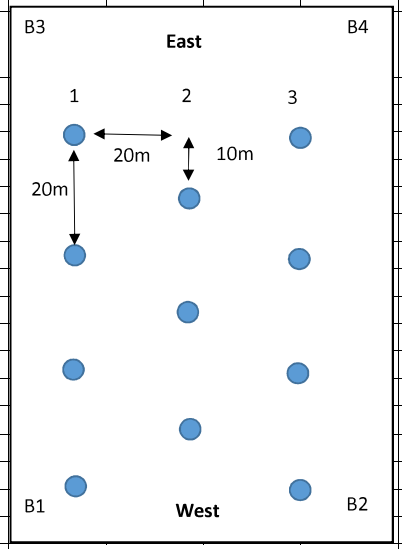

Diagram 1 - Peat Probe Layout. B1-B4 refer to corner co-ordinates of peat probing area.

Peat Probing (Area C) | **Undertaken 08/05/2016** | **Weather - Overcast/foggy, cloudy**

Notes:
- Refer to Diagram 1 for layout of peat probes.
- GPS readings are accurate to 5m.

Transect 1				Transect 2				Transect 3			
Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)
82095	53433	0	0.31	82120	53402	0	0.50	82111	53368	0	0.35
82114	53436	20	0.41	82137	53413	20	1.53	82132	53370	20	0.22
82134	53435	40	0.40	82159	53417	40	1.00	82152	53375	40	0.20
82134	53435	60	0.40	82177	53424	60	1.36	82174	53381	60	0.72
82152	53440	80	1.70	82195	53427	80	2.24	82196	53386	80	0.51
82174	53447	100	2.00	82214	53435	100	1.00	82216	53392	100	0.45
82191	53453	120	2.68	82233	53443	120	0.60	82239	53399	120	0.25
82211	53460	140	3.20	82250	53451	140	0.87	82259	53406	140	0.33
82228	53468	160	1.70					82284	53415	160	0.34
82251	53476	180	1.68								
		Total (m)	14.48			Total (m)	9.10			Total (m)	3.37
		Max (m)	3.20			Max (m)	2.24			Max (m)	0.72
		Min (m)	0.31			Min (m)	0.50			Min (m)	0.20
		Average (m)	1.45			Average (m)	1.14			Average (m)	0.37
		Total Probes	10			Total Probes	8			Total Probes	9

Area C Total (m)	**26.95**
No. of Probes	**27**
Max. depth (m)	**3.20**

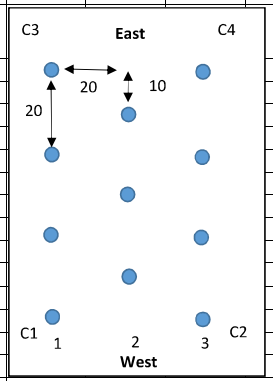

Diagram 1 - Peat Probe Layout. C1-C4 refer to corner co-ordinates of peat probing area.

Peat Probing (Area D) | **Undertaken 07/05/2016 and 08/05/2016** | **Weather - Overcast/Sunny and foggy, cloudy**

Transect 1				Transect 2				Transect 3			
Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)
82062	53462	0	1.20	82114	53471	0	1.19	82279	53546	0	0.31
82081	53469	20	0.21	82132	53483	20	1.23	82263	53533	20	1.28
82096	53485	40	2.15	82151	53493	40	1.70	82243	53521	40	2.94
82112	53495	60	0.24	82169	53506	60	3.33	82227	53511	60	0.51
82129	53507	80	2.90	82185	53516	80	3.65	82320	53573	80	0.10
82145	53513	100	0.30	82202	53526	100	1.12	82335	53583	100	0.01
82163	53527	120	3.00	82220	53538	120	1.83	82352	53591	120	0.05
82179	53539	140	0.29	82237	53549	140	2.14	82367	53601	140	0.28
82197	53550	160	0.62	82252	53562	160	1.49	82382	53612	160	0.05
82215	53563	180	2.85	82269	53573	180	0.39	82398	53623	180	0.05
82232	53573	200	2.84	82297	53590	200	0.45	82413	53636	200	0.13
82256	53589	220	2.80	82313	53601	220	1.36	82429	53647	220	0.12
82291	53618	240	0.34	82331	53615	240	1.00	82444	53660	240	0.15
82310	53633	260	0.40	82348	53628	260	1.00	82458	53673	260	0.14
82329	53646	280	0.28	82362	53636	280	1.60	82473	53686	280	0.20
82346	53659	300	0.37	82378	53646	300	0.93	82486	53695	300	0.15
82365	53671	320	3.00	82393	53653	320	0.36	82500	53709	320	0.35
82384	53686	340	1.27	82407	53667	340	0.50	82515	53719	340	0.18
82398	53701	360	3.43	82423	53679	360	0.25	82529	53731	360	0.14
82415	53715	380	3.67	82436	53693	380	0.05	82544	53741	380	0.15
82433	53730	400	3.90	82451	53703	400	0.05	82559	53752	400	0.12
82447	53743	420	3.67	82466	53715	420	0.05	82575	53764	420	0.20
82462	53753	440	3.23	82480	53726	440	0.20	82591	53773	440	0.18
82482	53767	460	0.38	82498	53735	460	0.09	82606	53784	460	0.30
82506	53781	480	0.05	82512	53746	480	0.10	82626	53794	480	0.27
82519	53794	500	0.05	82528	53760	500	0.32	82640	53804	500	0.26
82536	53806	520	0.20	82545	53767	520	0.17	82656	53815	520	0.20
82554	53819	540	0.65	82559	53777	540	0.28	82670	53826	540	1.00
82571	53831	560	0.84	82568	53782	560	0.17	82686	53837	560	3.52
82590	53844	580	0.38	82581	53791	580	0.06	82698	53850	580	4.43
82606	53856	600	0.50	82598	53805	600	0.10	82709	53862	600	3.69
82624	53868	620	1.16	82619	53824	620	0.60				
82640	53878	640	1.15	82638	53832	640	2.45				
82658	53890	660	0.45	82655	53844	660	3.65				
82680	53903	680	0.52	82671	53856	680	4.00				
				82687	53869	700	0.35				
		Total (m)	49.29			Total (m)	38.21			Total (m)	21.46
		Max (m)	3.90			Max (m)	4.00			Max (m)	4.43
		Min (m)	0.05			Min (m)	0.05			Min (m)	0.01
		Average (m)	1.41			Average (m)	1.06			Average (m)	0.69
		Total Probes	35			Total Probes	36			Total Probes	31

Notes:
- Refer to Diagram 1 for layout of peat probes.
- GPS readings are accurate to 5m.

Area D Total (m)	108.96
No. of Probes	102
Max. depth (m)	4.43

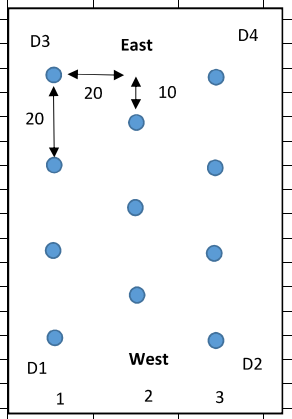

Diagram 1 - Peat Probe Layout. D1-D4 refer to corner co-ordinates of peat probing area

Peat Probing (Area E) | **Undertaken 08/05/2016** | **Weather - Overcast/foggy, cloudy**

Notes:
- Refer to Diagram 1 for layout of peat probes.
- GPS readings are accurate to 5m.

Transect 1				Transect 2				Transect 3			
Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)
83605	54132	0	0.42	83621	54119	0	0.23	83628	54082	0	0.33
83628	54158	20	0.37	83634	54129	20	0.55	83655	54102	20	0.24
83651	54176	40	0.33	83654	54138	40	0.37	83671	54115	40	0.23
83668	54190	60	0.55	83673	54147	60	0.83	83693	54121	60	0.15
83684	54201	80	0.25	83683	54155	80	1.12	83706	54131	80	0.37
83694	54209	100	0.17	83699	54167	100	0.83	83719	54135	100	0.40
83721	54215	120	0.12	83709	54175	120	0.87	83729	54143	120	0.50
				83719	54177	140	0.92	83748	54148	140	0.51
				83735	54180	160	0.90				
		Total (m)	2.21			Total (m)	6.62			Total (m)	2.73
		Max (m)	0.55			Max (m)	1.12			Max (m)	0.51
		Min (m)	0.12			Min (m)	0.23			Min (m)	0.15
		Average (m)	0.32			Average (m)	0.74			Average (m)	0.34
		Total Probes	7			Total Probes	9			Total Probes	8

Area E Total (m)	**11.56**
No. of Probes	**24**
Max. depth (m)	**1.12**

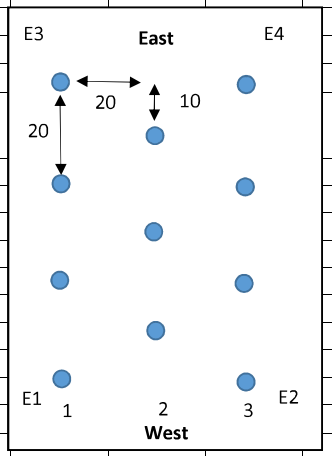

Diagram 1 - Peat Probe Layout. E1-E4 refer to corner co-ordinates of peat probing area

Peat Probing (Area F) — **Undertaken 14/06/2016**

Area F Total (m)	11.93
No. of Probes	123
Max. depth (m)	2.24
Average Probe Depth	0.09695122

Notes:
- Refer to Diagram 1 for layout of peat probes.
- GPS readings are accurate to 5m.

Excluding result of 2.24m	
Area F Total (m)	9.69
No. of Probes	122
Max. depth (m)	0.47
Average	0.079385246

Transect 1				Transect 2				Transect 3			
Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)
84129	54445		0.03	84130	54362		0.01	84240	54448		0.03
84134	54462		0.02	84151	54364		0.01	84242	54426		0.01
84129	54421		0.06	84131	54375		0.01	84242	54405		0.08
84138	54436		0.02	84131	54394		0.01	84245	54386		0.14
84140	54421		0.02	84148	54388		0.00	84254	54366		0.26
84158	54447		0.01	84150	54375		0.10	84262	54451		0.00
84155	54438		0.01	84149	54362		0.01	84264	54427		0.14
84152	54422		0.02	84170	54388		0.03	84265	54407		0.00
84176	54462		0.02	84173	54360		0.03	84269	54388		0.00
84177	54441		0.02	84187	54401		0.00	84274	54368		0.11
84185	54421		0.21	84187	54379		0.11	84277	54346		0.13
84203	54467		0.01	84186	54360		0.16	84281	54454		0.00
84220	54453		0.08	84206	54410		0.04	84284	54434		0.00
84207	54437		0.16	84207	54388		0.10	84287	54413		0.00
84221	54465		0.05	84210	54366		0.07	84293	54391		0.00
84220	54453		0.08	84220	54421		0.10	84294	54369		0.10
84238	54469		0.15	84224	54402		0.01	84297	54351		0.12
				84229	54385		0.10				
				84231	54360		0.12				
		Total (m)	0.97			Total (m)	1.01			Total (m)	1.12
		Max (m)	0.21			Max (m)	0.16			Max (m)	0.26
		Min (m)	0.01			Min (m)	0.00			Min (m)	0.00
		Average (m)	0.06			Average (m)	0.05			Average (m)	0.07
		Total probes	17			Total probes	19			Total probes	17

Transect 4				Transect 5				Transect 6				Transect 7			
Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)
84302	54448		0.00	84383	54461		0.00	84453	54363		0.16	84492	54377		0.01
84304	54425		0.00	84387	54438		0.00	84452	54383		0.20	84493	54397		0.02
84307	54406		0.00	84389	54416		0.17	84451	54408		0.31	84492	54417		0.02
84310	54385		0.00	84390	54396		0.35	84451	54430		0.16	84487	54436		0
84313	54363		0.16	84392	54373		0.32	84451	54451		0.20	84488	54455		0
84322	54460		0.00	84392	54357		0.01	84449	54471		0.02	84491	54478		0
84324	54439		0.00	84401	54463		0.00	84471	54476		0.28	84508	54471		0
84326	54417		0.00	84405	54443		0.03	84475	54455		0.02	84508	54451		0
84328	54401		0.00	84410	54424		0.36	84476	54436		0.01	84509	54431		0
84330	54376		0.12	84409	54402		0.20	84476	54415		0.01	84511	54410		0
84333	54353		0.00	84408	54380		0.24	84476	54397		0.02	84513	54389		0
84343	54450		0.00	84411	54363		0.41	84476	54372		0.03	84510	54342		0
84345	54429		0.01	84430	54455		0.05	84492	54377		0.01	84513	54361		0
84348	54409		0.12	84430	54437		0.33	84474	54345		2.24	84496	54363		0
84349	54387		0.39	84434	54416		0.36	84469	54354		0.00	84495	54346		0
84353	54363		0.14	84438	54400		0.47								
84362	54461		0.00	84437	54378		0.30								
84363	54441		0.01	84433	54359		0.27								
84366	54421		0.01												
84365	54400		0.00												
84369	54380		0.28												
84372	54360		0.01												
		Total (m)	1.25			Total (m)	3.87			Total (m)	3.66			Total (m)	0.05
		Max (m)	0.39			Max (m)	0.47			Max (m)	2.24			Max (m)	0.02
		Min (m)	0.00			Min (m)	0.00			Min (m)	0.00			Min (m)	0
		Average (m)	0.06			Average (m)	0.22			Average (m)	0.24			Average (m)	0.003
		Total probes	22			Total probes	18			Total probes	15			Total probes	15

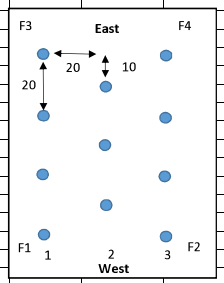

Diagram 1 - Peat Probe Layout. F1-F4 refer to corner co-ordinates of peat probing area

Peat Probing (Area G) | Undertaken 16/06/2016 | Weather - Overcast and raining

Transect 1				Transect 2				Transect 3			
Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)
85237	54311	0	0.14	85425	54440	0	0.03	85218	54344	0	0.06
85254	54322	20	0.11	85409	54428	20	0.36	85237	54352	20	0.05
85273	54332	40	0.15	85390	54418	40	0.04	85255	54359	40	0.03
85291	54345	60	0.15	85377	54408	60	0.05	85272	54369	60	0.05
85308	54352	80	0.14	85361	54396	80	0.07	85290	54379	80	0.06
85332	54362	100	0.16	85341	54387	100	0.03	85308	54387	100	0.06
85339	54374	120	0.18	85322	54376	120	0.04	85326	54396	120	0.06
85358	54382	140	0.05	85305	54364	140	0.07	85343	54407	140	0.07
85375	54392	160	0.08	85288	54354	160	0.08	85360	54417	160	0.05
85392	54404	180	0.09	85272	54343	180	0.10	85376	54426	180	0.04
85409	54412	200	0.00	85256	54333	200	0.04	85394	54438	200	0.01
85425	54422	220	0.90	85236	54324	220	0.07	85411	54449	220	0.03
85444	54432	240	0.00	85220	54315	240	0.07	85427	54460	240	0.03
		Total (m)	2.15			Total (m)	1.05			Total (m)	0.60
		Max (m)	0.90			Max (m)	0.36			Max (m)	0.07
		Min (m)	0.00			Min (m)	0.03			Min (m)	0.01
		Total probes	13			Total probes	13			Total probes	13

Transect 4				Transect 5				Transect 6			
Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)
85295	54201	0	0.00	85273	54210	0	0.00	85275	54235	0	0.00
85315	54211	20	0.00	85292	54221	20	0.00	85297	54246	20	0.00
85331	54222	40	0.00	85311	54233	40	0.00	85307	54258	40	0.00
85348	54233	60	0.00	85326	54242	60	0.00	85324	54269	60	0.00
85365	54245	80	0.00	85343	54254	80	0.00	85342	54282	80	0.00
85380	54259	100	0.00	85360	54267	100	0.00	85352	54289	100	0.00
85402	54269	120	0.00	85376	54276	120	0.00	85369	54300	120	0.00
85418	54278	140	0.00	85394	54286	140	0.00	85387	54307	140	0.00
85436	54285	160	0.00	85414	54293	160	0.00	85406	54317	160	0.00
85454	54294	180	0.00	85433	54303	180	0.00	85424	54325	180	0.00
85473	54302	200	0.00	85450	54312	200	0.00	85441	54333	200	0.00
85490	54310	220	0.00	85467	54321	220	0.00	85460	54343	220	0.00
85507	54321	240	0.00	85486	54330	240	0.00	85479	54350	240	0.00
				85503	54341	260	0.00	85497	54367	260	0.00
		Total (m)	0.00			Total (m)	0.00			Total (m)	0.00
		Max (m)	0.00			Max (m)	0.00			Max (m)	0.00
		Min (m)	0.00			Min (m)	0.00			Min (m)	0.00
		Total probes	13			Total probes	14			Total probes	14

Area G Total (m)	**4.04**
No. of Probes	**133**
Max. Depth	**0.90**

Discounting irrelevant probe of 0.9m

Area G Total (m)	3.14
No. of Probes	132
Max. Depth	0.36
Average for Area G	0.023787879

Notes:
- Refer to Diagram 1 for layout of peat probes.
- GPS readings are accurate to 5m.

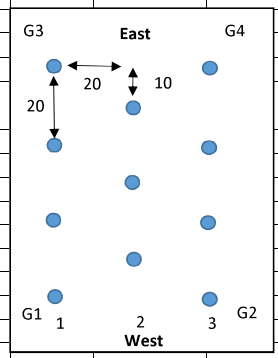

Diagram 1 - Peat Probe Layout. G1-G4 refer to corner co-ordinates of peat probing area

Transect 7				Transect 8				Transect 9			
Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)	Easting	Northing	Transect CH (m)	Probe Depth (m)
85329	54297	0	0.00	85258	54271	0	0.00	85241	54285	0	0.00
85312	54285	20	0.00	85278	54283	20	0.13	85256	54299	20	0.00
85296	54273	40	0.00	85292	54296	40	0.07	85273	54308	40	0.00
85281	54263	60	0.00	85308	54307	60	0.00	85293	54322	60	0.00
85267	54252	80	0.00	85324	54317	80	0.00	85310	54332	80	0.00
85339	54305	100	0.00	85342	54328	100	0.00	85319	54338	100	0.00
85348	54308	120	0.00	85358	54336	120	0.00	85336	54346	120	0.00
85364	54319	140	0.00	85376	54346	140	0.00	85354	54355	140	0.00
85383	54326	160	0.00	85395	54356	160	0.00	85373	54367	160	0.00
85402	54339	180	0.00	85413	54366	180	0.00	85391	54375	180	0.00
85420	54345	200	0.00	85431	54375	200	0.00	85407	54385	200	0.00
85438	54353	220	0.00	85450	54384	220	0.00	85427	54394	220	0.00
85457	54362	240	0.00	85468	54392	240	0.00	85448	54405	240	0.04
85475	54371	260	0.00	85484	54397	260	0.00	85464	54413	260	0.00
		Total (m)	0.00			Total (m)	0.20			Total (m)	0.04
		Max (m)	0.00			Max (m)	0.13			Max (m)	0.04
		Min (m)	0.00			Min (m)	0.00			Min (m)	0.00
		Total probes	14			Total probes	14			Total probes	14

Transect 10			
Easting	Northing	Transect CH (m)	Probe Depth (m)
85246	54300	0	0.00
85267	54314	20	0.00
85282	54324	40	0.00
85308	54336	60	0.00
85354	54365	80	0.00
85371	54376	100	0.00
85387	54387	120	0.00
85405	54399	140	0.00
85422	54408	160	0.00
85456	54430	180	0.00
85465	54414	200	0.00
		Total (m)	0.00
		Max (m)	0.00
		Min (m)	0.00
		Total probes	11

Appendix C: Peat thickness contouring methodology

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This document serves as guidance on how to create appropriate contours based on a raster dataset (including those interpolated from initial point data). The ArcGIS 'Spatial Analyst' extension is needed to complete this process.

1. Load the point elevation dataset into ArcMap and identify the field that contains the elevation values OR if the raster has already been created, skip to Step 4.

2. To create the elevation raster you will need to choose an appropriate interpolation method (ArcToolbox/Spatial Analyst Tools/Interpolation).

    a. There are various options which have benefits and drawbacks depending on the input data. For instance a low-density point dataset will produce a less accurate raster and so *Natural Neighbour* may be the best interpolation method to use as it will not create raster cell values beyond the range of those specified in the point data.

3. Run the interpolation with the elevation field selected in the '*Z value field*' menu and the '*Output cell size*' left as the default value unless there is a need to change this.

4. Once the raster has been created or loaded in, it is helpful to symbolise it according to the contours that you are wanting to create (i.e. 0.5m colour bands for 0.5m contour intervals).

5. To create the contour dataset select the '*Contour*' tool (ArcToolbox/Spatial Analyst Tools/Surface/Contour).

6. Select the relevant raster and specify the contour interval according to your needs. The visualisation of the data should be taken into account at this point because whilst the data may be detailed enough to produce dense contours this may produce a cluttered and unhelpful output. '*Base contour*' and '*Z factor*' options should be left as the default values unless otherwise specified. Run the contour tool.

7. The contour polyline dataset should have been created and should now match up with the raster as symbolised in Step 4.

*This methodology document details how various volume calculations were carried out for peat probing survey data for the A96 Dualling- Inverness to Nairn. It directly follows the document **'A96_Contour_Creation_Guidance.pdf**' which can be found at the directory- O:\GIS_Team\02 Guidance Notes\Methodologies\Geotechnical.*

Deliverables

Following the creation of a peat depth raster (and associated contours) as detailed in the document A96_Contour_Creation_Guidance.pdf the following volumetric calculations were asked for:

a. Total volume of peat for study areas A-E

b. Volume of peat up to a depth of 0.5m for study areas A-E (including 12m buffered CPO boundary)

c. Volume of peat below a depth of 0.5m for study areas A-E (including 12m buffered CPO boundary)

d. Volume of peat up to a depth of 0.5m for study areas A-E that is covered by the May 2016 design footprint

e. Volume of peat below a depth of 0.5m for study areas A-E that is covered by the May 2016 design footprint

Inputs and Procedures

The initial data used for both the raster/contour creation and volume calculations was an excel spreadsheet containing the locations of peat probing points and associated peat depths as well as boundary co-ordinates for the study areas A-G- *A96_Peat_Probing_20160531.xlsx* located at

N:\GIS_Projects\B2103500_A96_Dualling_INVNN_Stage3\ArcGIS\001_Surveys\004D_GeolHydrContam\006_Peat_Probing

Later the instances of peat found at GI locations (i.e. boreholes and trial pits) were provided as an Excel spreadsheet (*GI_locations_encountering_peat.xlsx* at same location as above) and merged with the initial peat probing data; as well as this the creation of two 'dummy points' with associated peat depths was requested. Both the GI locations encountering peat and the dummy points were included in the data at the request of Joanna Thomson.

The Excel spreadsheet data referenced above was converted into shapefile format using ArcGIS. These point shapefiles were then used to create elevation rasters for each of the study areas. The interpolation method chosen for this process was *Topo to Raster*. This method was chosen as the input point data was not sufficiently dense to allow for the use of a more advanced interpolation method such as IDW or Kriging. During processing of the rasters the output cell size values were left at the default values for the different study areas (shorter of the width or height of the extent of the input point features divided by 250). This was decided as being appropriate due to the limited nature of the input data.

Calculations

These are in reference to the deliverables stated above:

a. The total volume for each study area was calculated by multiplying the known area by the mean peat depth specified in the statistics for each raster.
b. This was calculated by taking away the values of c. from the total volumes (a.) for each study area.
c. The volumes of peat below at a depth of greater than 0.5m were calculated by first converting the rasters to point shapefiles using the tool *Raster to Point.* Then selecting the points with a depth greater than 0.5m, taking away 0.5m from these values (as this data would be applicable to deliverable b.) and multiplying the mean depth of these points by their area (known by multiplying the number of selected points by the cell size of the associated raster).
d. These values were calculated by using the same methods specified for deliverables c and d but selecting relevant raster points that intersected the May 2016 design footprint shapefile using the tool *Select by Location*.
e. See above.

Conclusions

It was made known to those asking for the calculations and contours that the limitations of the input data would result in low-accuracy outputs. Different volume values would have been calculated had a different interpolation method been used. The conversion of rasters to points could have been eliminated through the use of the *Raster Calculator* however, the rasters themselves were calculated using low-accuracy data and so it would be difficult to say which method would have been more accurate.