Appendix 2-2

Grid Connection Package

Contents

Document / Drawing Issue Sheet

Project Title	Carrownagowan WF - 110kV UGC

Project No.	05-641

Title	Drawing/ Doc Number	Size	Revision										
Overall Site Layout Plan	05641-200	A1	00	00	01	01							
Site Layout Plan (1 of 16)	05641-201	A1	00	00	01	01							
Site Layout Plan (2 of 16)	05641-202	A1	00	00	01	01							
Site Layout Plan (3 of 16)	05641-203	A1	00	00	01	01							
Site Layout Plan (4 of 16)	05641-204	A1	00	00	01	01							
Site Layout Plan (5 of 16)	05641-205	A1	00	00	01	01							
Site Layout Plan (6 of 16)	05641-206	A1	00	00	01	01							
Site Layout Plan (7 of 16)	05641-207	A1	00	00	01	01							
Site Layout Plan (8 of 16)	05641-208	A1	00	00	01	01							
Site Layout Plan (9 of 16)	05641-209	A1	00	00	01	01							
Site Layout Plan (10 of 16)	05641-210	A1	00	00	01	01							
Site Layout Plan (11 of 16)	05641-211	A1	00	00	01	01							
Site Layout Plan (12 of 16)	05641-212	A1	00	00	01	01							
Site Layout Plan (13 of 16)	05641-213	A1	00	00	01	01							
Site Layout Plan (14 of 16)	05641-214	A1	00	00	01	01							
Substation Connections (SLP)	05641-217	A1	00	00	01	01							

Issue Date	D	05	18	29	19							
	M	03	06	11	05							
	Y	19	19	19	20							

Distribution List	Number of copies										
MWP	1		1	1							
EirGrid		1									

Status	I	I	PL	PL							

Method	E	E	E	E							

Status:
P = Preliminary, A = Approval, T = Tender, C= Construction, R = Record, I = Information, PL = Plannning

Issue Method:
C = CD, E = Email, P = Paper

Designed by Shane Kiely

Approved by Ruairi Geary

Issued by Shane Kiely

For & on behalf of TLI Group

Document / Drawing Issue Sheet

Project Title	Carrownagowan WF - 110kV UGC

Project No.	05-641

Title	Drawing/ Doc Number	Size	Revision										
Typical Ducting Off Road (Trefoil)	05641-221	A3	00	00	01	02							
Typical Ducting Roadways (Trefoil)	05641-222	A1	00	00	01	02							
Typical 110kV Joint Bay	05641-223	A1	00	00	01	02							
Typical Service Crossing	05641-224	A1	00	00	01	02							
Typical Watermain Crossing	05641-225	A1	00	00	01	02							
Typical HDD Detail	05641-227	A3	00	00	01	01							
Typical Ducting Flat Formation	05641-229	A3	00	00	01	02							
Typical Ducting Forestry Roads	05641-228	A3	00	00	01	02							
Typical 110kV Comms Chamber	05641-230	A3	00	00	01	02							
Bridge Crossings 1	05641-231	A2	00	00	01	01							
Bridge Crossings 2	05641-232	A2	00	00	01	01							
Bridge Crossings 3	05641-233	A2	00	00	01	01							
Bridge Crossings 4	05641-234	A2	00	00	01	02							
Bridge Crossings 5	05641-235	A2	00	00	01	01							
Bridge Crossings 6	05641-236	A2	00	00	01	01							
Bridge Crossings 7	05641-237	A2	00	00	01	02							

Issue Date	D	05	18	29	19							
	M	03	06	11	05							
	Y	19	19	19	20							

Distribution List	Number of copies										
MWP	1		1	1							
EirGrid		1									

Status	I	I	PL	PL							

Method	E	E	E	E							

Status:
P = Preliminary, A = Approval, T = Tender, C= Construction, R = Record, I = Information, PL = Plannning

Issue Method:
C = CD, E = Email, P = Paper

Designed by Shane Kiely

Approved by Ruairi Geary

Issued by Shane Kiely

For & on behalf of TLI Group

Document / Drawing Issue Sheet

Project Title	Carrownagowan WF - 110kV UGC

Project No.	05-641

Title	Drawing/ Doc Number	Size	Revision										
Bridge Crossings 8	05641-238	A2	00	00	01	01							
Bridge Crossings 9	05641-239	A2	00	00	01	01							
Culvert Crossings 1 of 3	05641-240	A2	00	00	01	01							
Culvert Crossings 2 of 3	05641-241	A2	00	00	01	01							
Tech Note 2: Cable Rating Check	05641-TN02	A4	00		00	00							
Tech Note 3: Cable Pulling Check	05641-TN03	A4	00		01	01							
Construction Methodology	05641-R03	A4	00		01	01							
Joint Bay Summary Sheet	-	-	00		01	01							
Site Layout Plan (15 of 16)	05641-215	A1			00	00							
Site Layout Plan (16 of 16)	05641-216	A1			00	00							
Culvert Crossings 3 of 3	05641-242	A2			00	00							
Transition Chamber Detail	05641-243	A3				00							
Link Box Chamber Details	05641-244	A3				00							

Issue Date												
	D	05	18	29	19							
	M	03	06	11	05							
	Y	19	19	19	20							

Distribution List	Number of copies										
MWP	1		1	1							
EirGrid		1									

Status	I	I	PL	PL							

Method	E	E	E	E							

Status:
P = Preliminary, A = Approval, T = Tender, C= Construction, R = Record, I = Information, PL = Plannning

Issue Method:
C = CD, E = Email, P = Paper

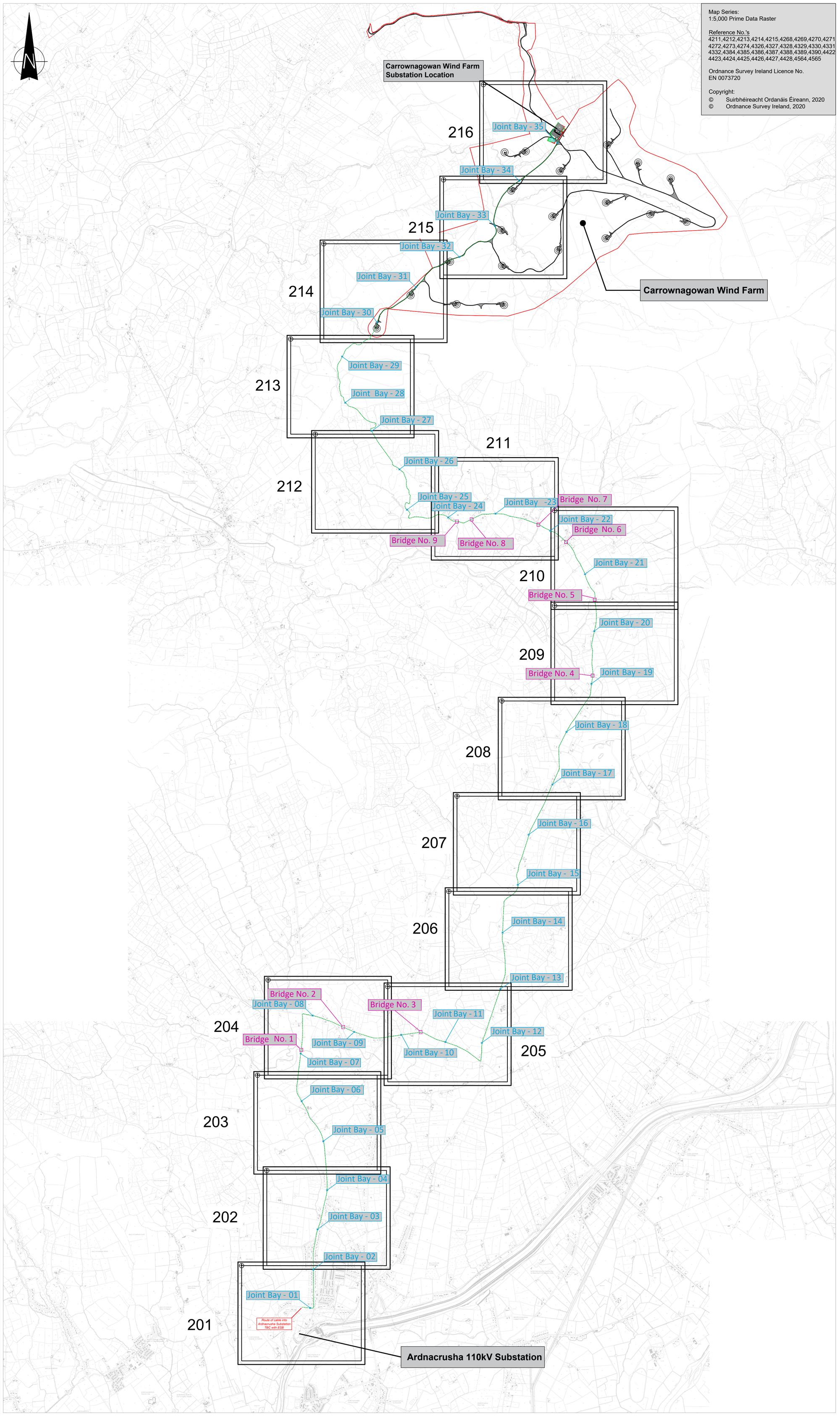
Designed by Shane Kiely

Approved by Ruairi Geary

Issued by Shane Kiely

For & on behalf of TLI Group

Project Management Initials: Designer: CH Checked: SK Approved: RG



Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

LEGEND: -

- Proposed UGC (25km)
- Joint Bay Locations shown thus
- Bridge Locations shown thus
- Planning Boundary shown thus

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

OVERALL SITE LAYOUT PLAN

Scale: 1:25,000

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Windfarm
110kV Grid Connection

CLIENT

COILLTE
GROW · TRANSFORM · SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

SHEET TITLE

Overall Site Layout Plan

SHEET NUMBER

05641-200

ISO A1 594mm x 841mm

ISO A1 594mm x 841mm

MATCHLINE REFER TO 05641-202

MATCHLINE REFER TO 05641-201

48.819

Joint Bay - 02
Comm. Chamber
Link Box

45.738

42.833

39.814

38.104

36.574

Joint Bay - 01
Comm. Chamber
Link Box

31.007

34.213

Route of cable into
Ardnacrusha Substation
TBC with ESB

Ardnacrusha

PARKROE

CASTLEBANK
Caisleán an Chalaidh

BALLYKEELAUN
Béal an Chaoláin

ROSMADDA WE

Pond

Lakyle Heights

Headrace Canal

Tailrace

Power Station

Electricity Station

Navigation Channel

Landing Slags

Castlebank House

Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

Copyright:
© Suirbhéireacht Ordanáis Éireann, 2020
© Ordnance Survey Ireland, 2020

SITE LAYOUT PLAN

Scale: 1:2500

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

Proposed UGC (25km)
Joint Bay Locations shown thus
Road Edge shown thus
Road Centre shown thus
Concrete Wall shown thus
Fence Line shown thus
Verge shown thus
Existing levels shown thus 79.617

ISSUE/REVISION

02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

SHEET TITLE

Site Layout Plan
Sheet 1 of 16

SHEET NUMBER

05641-201

ISO A1 594mm x 841mm

MATCHLINE REFER TO 05641-203
MATCHLINE REFER TO 05641-202

GLENLON NORTH

ROO WEST

GLENLON SOUTH

LAKYLE

BLACKWATER

71.828
72.145
71.875
69.228
68.060
66.256
62.865
61.329
61.856
59.640
57.699
56.402
53.211
48.819

Joint Bay - 04 Comm. Chamber Link Box

Joint Bay - 03 Comm. Chamber Link Box

Joint Bay - 02 Comm. Chamber

Culvert 1. 350ø Concrete

Spring

Reservoir

BM 36.60

MATCHLINE REFER TO 05641-202
MATCHLINE REFER TO 05641-201

SITE LAYOUT PLAN

Scale: 1:2500

Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271,4272,4273,4274,4326,4327,4328,4329,4330,4331,4332,4384,4385,4386,4387,4388,4389,4390,4422,4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

- Proposed UGC (25km)
- Joint Bay Locations shown thus
- Culvert Locations shown thus
- Road Edge shown thus
- Road Centre shown thus
- Concrete Wall shown thus
- Fence Line shown thus
- Verge shown thus
- Existing levels shown thus 79.617

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

SHEET TITLE

Site Layout Plan
Sheet 2 of 16

SHEET NUMBER

05641-202

Project Management Initials: Designer: CH Checked: SK Approved: RG

ISO A1 594mm x 841mm

SITE LAYOUT PLAN
Scale: 1:2500

Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271,4272,4273,4274,4326,4327,4328,4329,4330,4331,4332,4384,4385,4386,4387,4388,4389,4390,4422,4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

Copyright:
© Suirbhéireacht Ordanáis Éireann, 2020
© Ordnance Survey Ireland, 2020

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

- Proposed UGC (25km)
- Joint Bay Locations shown thus
- Road Edge shown thus
- Road Centre shown thus
- Concrete Wall shown thus
- Fence Line shown thus
- Verge shown thus
- Existing levels shown thus 79.617

ISSUE/REVISION

02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

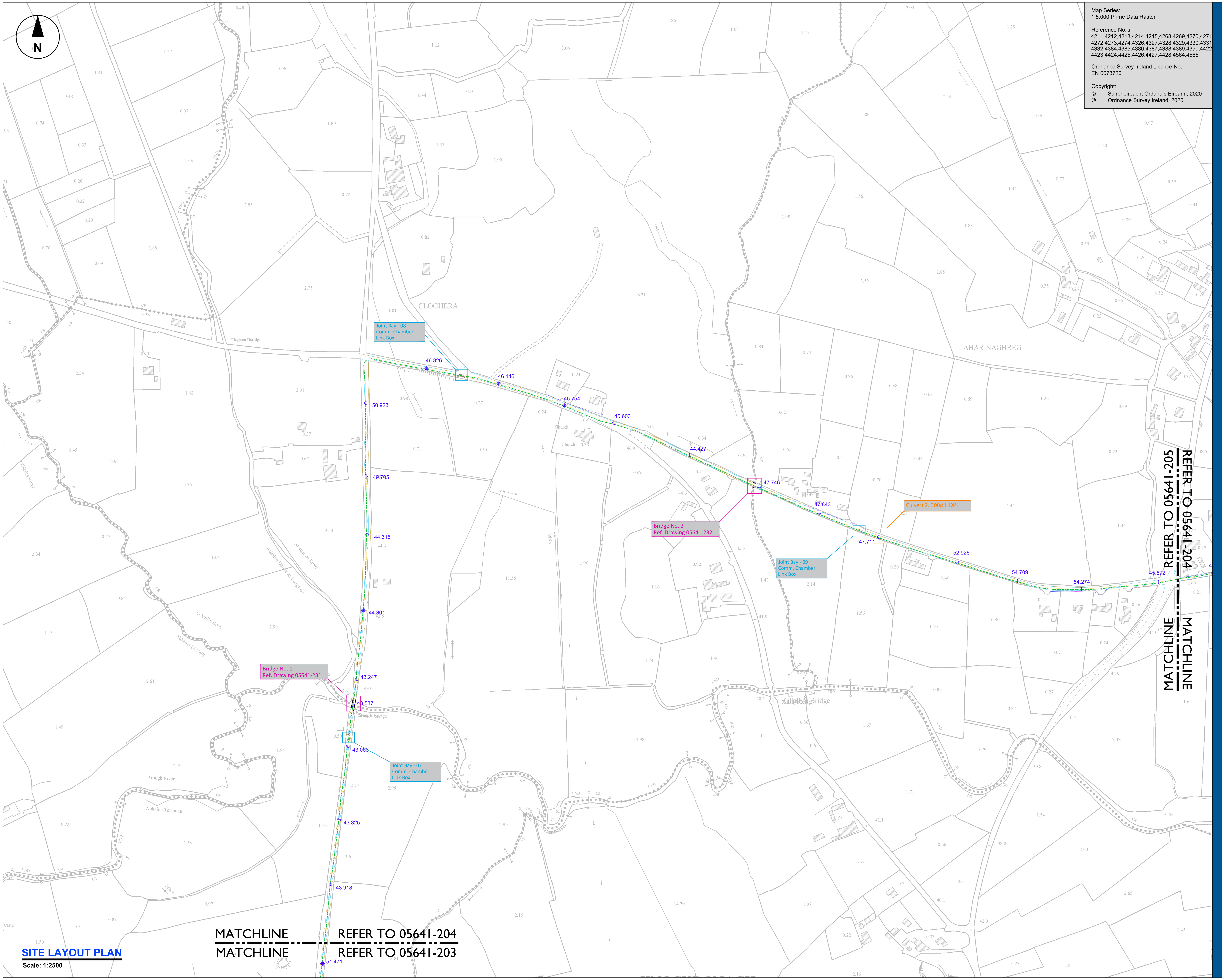
SHEET TITLE

Site Layout Plan
Sheet 3 of 16

SHEET NUMBER

05641-203

Project Management Initials: Designer: CH Checked: SK Approved: RG



Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

SITE LAYOUT PLAN

Scale: 1:2500

ISO A1 594mm x 841mm

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm 110kV Grid Connection

CLIENT

COILLTE
GROW · TRANSFORM · SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

- Proposed UGC (25km)
- Joint Bay Locations shown thus
- Bridge Locations shown thus
- Culvert Locations shown thus
- Road Edge shown thus
- Road Centre shown thus
- Concrete Wall shown thus
- Fence Line shown thus
- Verge shown thus
- Existing levels shown thus 79.617

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

SHEET TITLE

Site Layout Plan
Sheet 4 of 16

SHEET NUMBER

05641-204

ISO A1 594mm x 841mm

MATCHLINE REFER TO 05641-205

MATCHLINE REFER TO 05641-204

MATCHLINE REFER TO 05

MATCHLINE REFER TO 05

Bridge No. 3
Ref. Drawing 05641-233

Culvert 3. 2x600ø Concrete

Joint Bay - 10
Comm. Chamber
Link Box

Joint Bay - 11
Comm. Chamber
Link Box

Joint Bay - 12
Comm. Chamber
Link Box

Joint Bay - 13
Comm. Chamber
Link Box

Culvert 5. 600ø HDPE

Culvert 4. 600(W)x800(H) Stone

AHARINAGHMORE

TOOREEN

Ballyveurober

Birds Cross Roads

Ringfort

45.672
42.668
40.004
39.825
41.054
41.823
44.423
46.230
51.395
54.371
60.521
65.820
68.443
72.018
72.814
72.768
73.317
72.971
70.782
67.290
65.963
65.875
66.340
67.726
69.512
69.518

SITE LAYOUT PLAN

Scale: 1:2500

Project Management Initials: Designer: CH Checked: SK Approved: RG

Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

Proposed UGC (25km)
Joint Bay Locations shown thus
Bridge Locations shown thus
Culvert Locations shown thus
Road Edge shown thus
Road Centre shown thus
Concrete Wall shown thus
Fence Line shown thus
Verge shown thus
Existing levels shown thus 79.617

ISSUE/REVISION

02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

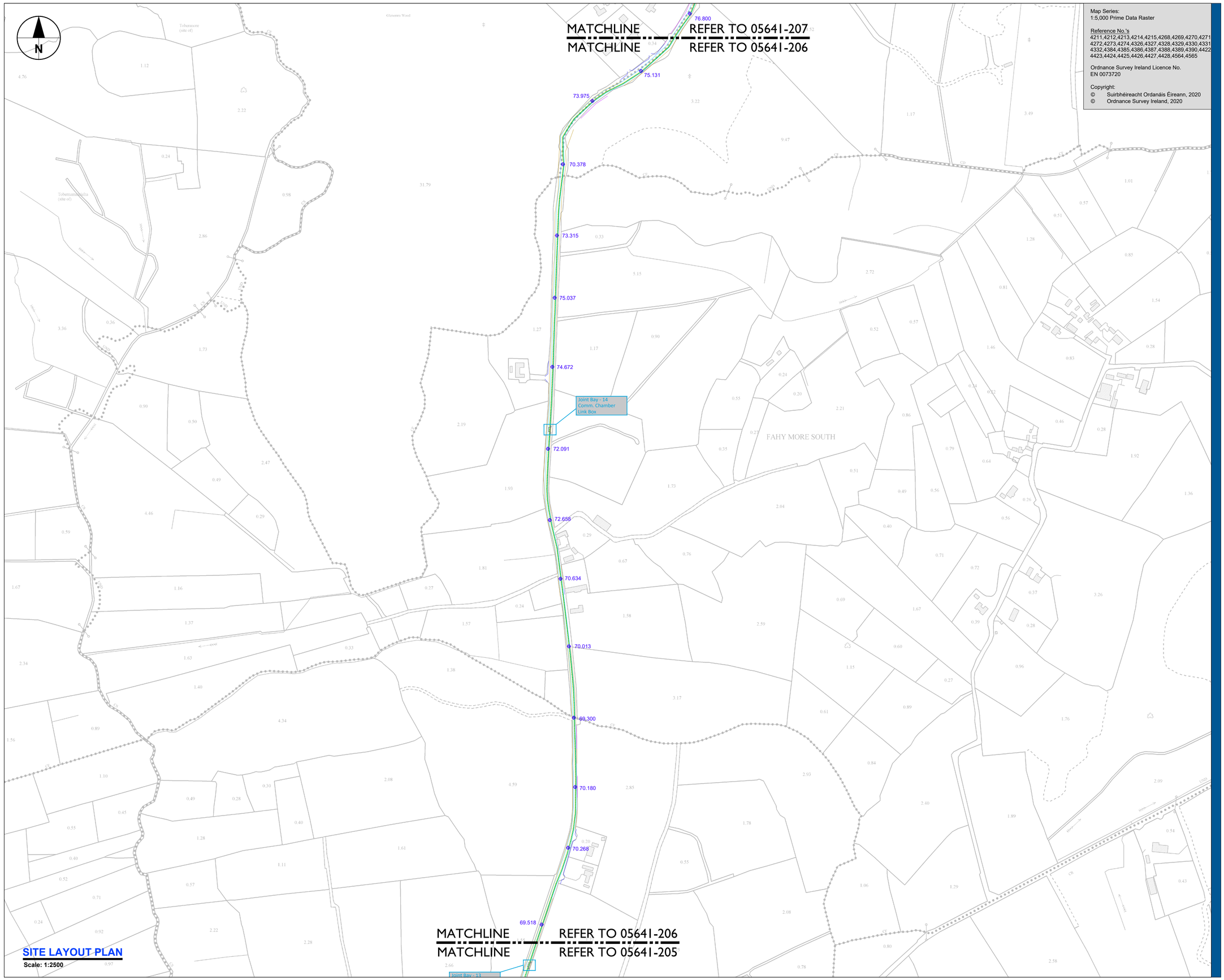
SHEET TITLE

Site Layout Plan
Sheet 5 of 16

SHEET NUMBER

05641-205

ISO A1 594mm x 841mm



Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

Copyright:
© Suirbhéireacht Ordanáis Éireann, 2020
© Ordnance Survey Ireland, 2020

SITE LAYOUT PLAN
Scale: 1:2500

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

- Proposed UGC (25km)
- Joint Bay Locations shown thus
- Road Edge shown thus
- Road Centre shown thus
- Concrete Wall shown thus
- Fence Line shown thus
- Verge shown thus
- Existing levels shown thus ⊕ 79.617

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

SHEET TITLE

Site Layout Plan
Sheet 6 of 16

SHEET NUMBER

05641-206

ISO A1 594mm x 841mm

SITE LAYOUT PLAN

Scale: 1:2500

Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

- Proposed UGC (25km)
- Joint Bay Locations shown thus
- Culvert Locations shown thus
- Road Edge shown thus
- Road Centre shown thus
- Concrete Wall shown thus
- Fence Line shown thus
- Verge shown thus
- Existing levels shown thus ⊕ 79.617

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

SHEET TITLE

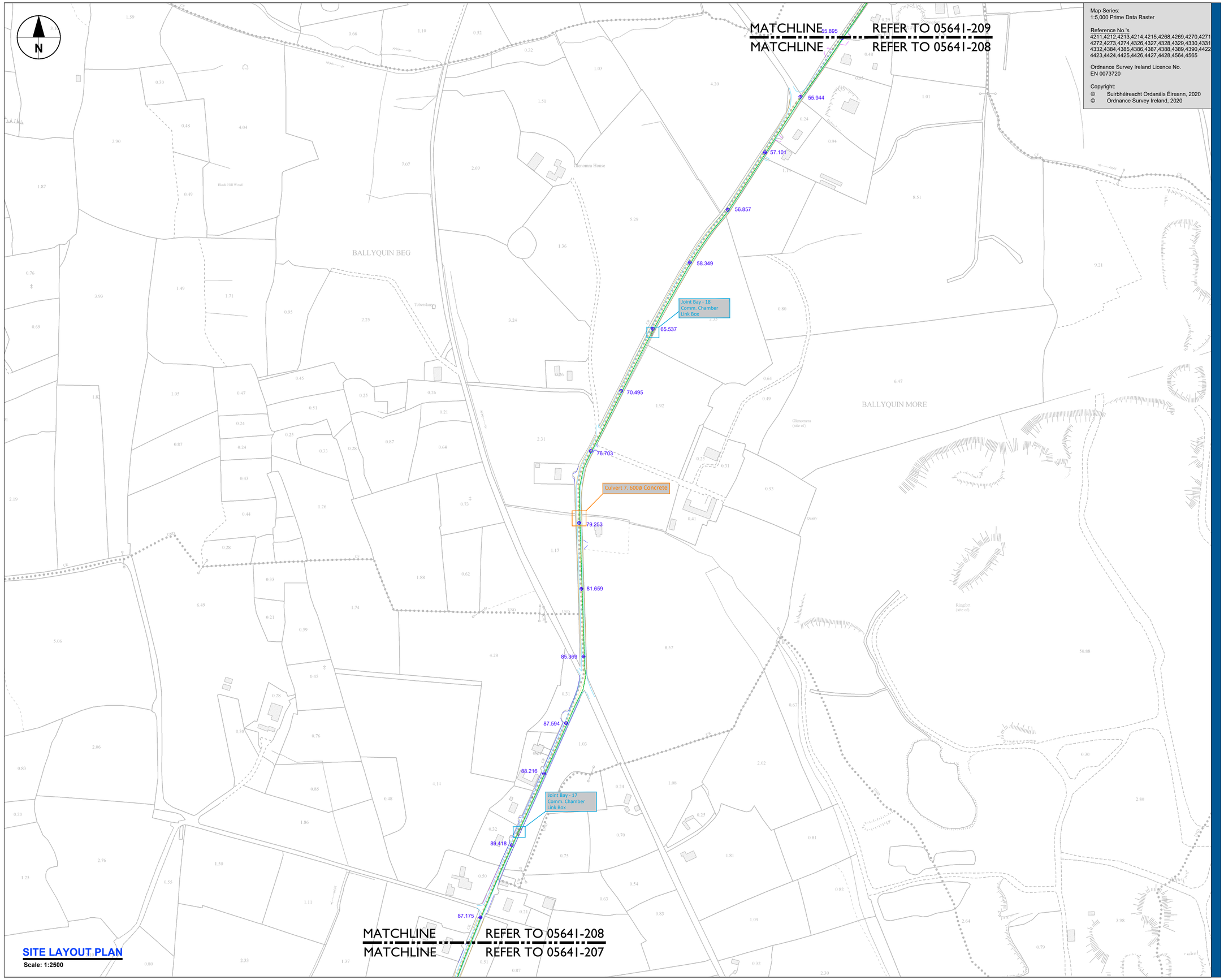
Site Layout Plan
Sheet 7 of 16

SHEET NUMBER

05641-207

Project Management Initials: Designer: CH Checked: SK Approved: RG

ISO A1 594mm x 841mm



SITE LAYOUT PLAN

Scale: 1:2500

Project Management Initials: Designer: CH Checked: SK Approved: RG

Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

Proposed UGC (25km)
Joint Bay Locations shown thus
Culvert Locations shown thus
Road Edge shown thus
Road Centre shown thus
Concrete Wall shown thus
Fence Line shown thus
Verge shown thus
Existing levels shown thus 79.617

ISSUE/REVISION

02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

SHEET TITLE

Site Layout Plan
Sheet 8 of 16

SHEET NUMBER

05641-208

ISO A1 594mm x 841mm

MATCHLINE REFER TO 05641-210

MATCHLINE REFER TO 05641-209

68.835

66.115

Culvert 8. 400(W)x500(H) Stone

66.468

Joint Bay - 20
Comm. Chamber
Link Box

65.350

63.718

64.260

63.981

63.473

58.174

Bridge No. 4
Ref. Drawing 05641-234

54.368

Joint Bay - 19
Comm. Chamber
Link Box

52.367

58.066

57.908

55.895

MATCHLINE REFER TO 05641-209

MATCHLINE REFER TO 05641-208

BALLYMOLONEY

Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

SITE LAYOUT PLAN

Scale: 1:2500

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

- Proposed UGC (25km)
- Joint Bay Locations shown thus
- Bridge Locations shown thus
- Culvert Locations shown thus
- Road Edge shown thus
- Road Centre shown thus
- Concrete Wall shown thus
- Fence Line shown thus
- Verge shown thus
- Existing levels shown thus 79.617

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

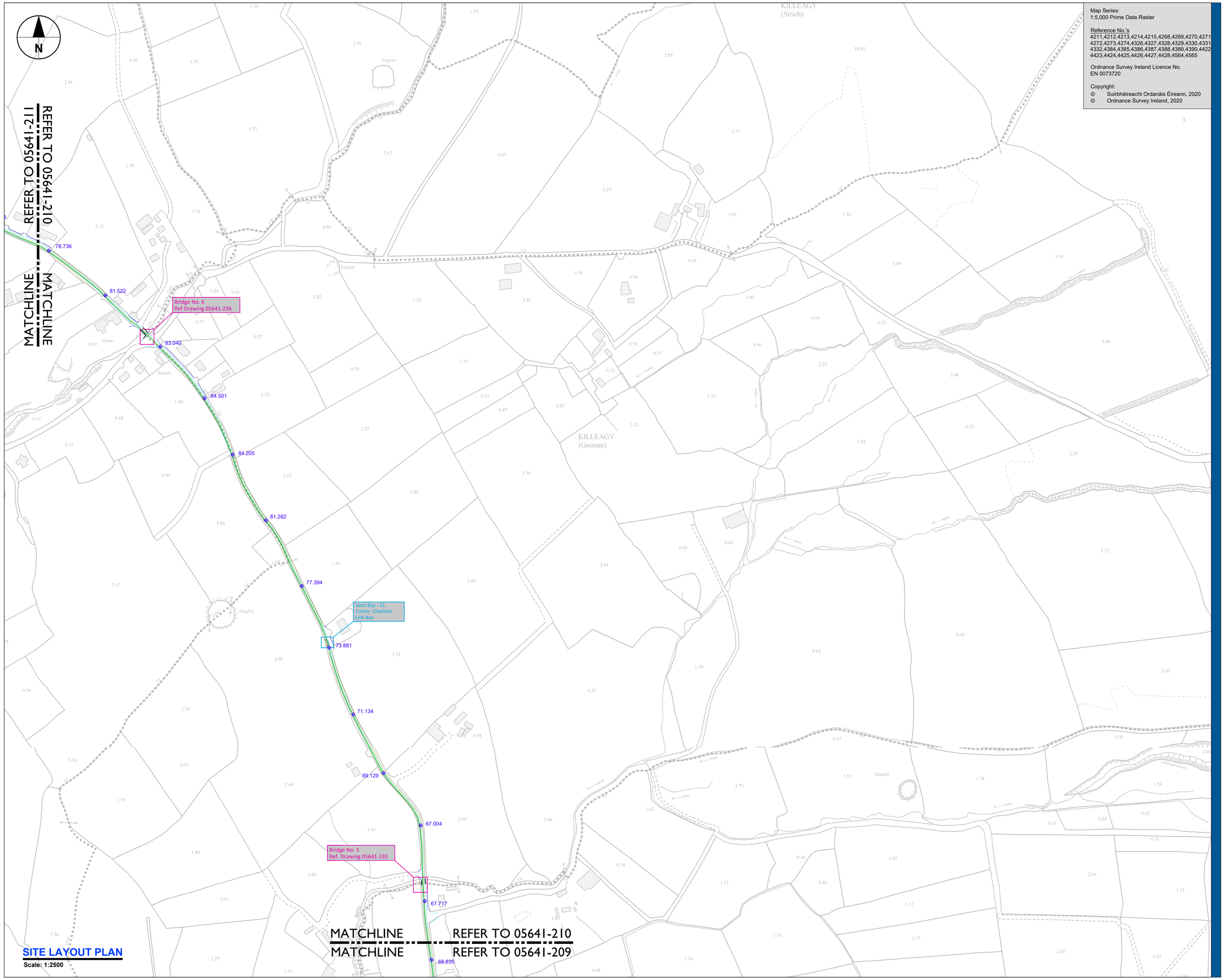
SHEET TITLE

Site Layout Plan
Sheet 9 of 16

SHEET NUMBER

05641-209

ISO A1 594mm x 841mm



SITE LAYOUT PLAN

Scale: 1:2500

Project Management Initials: Designer: CH Checked: SK Approved: RG

Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

Proposed UGC (25km)
Joint Bay Locations shown thus
Bridge Locations shown thus
Road Edge shown thus
Road Centre shown thus
Concrete Wall shown thus
Fence Line shown thus
Verge shown thus
Existing levels shown thus 79.617

ISSUE/REVISION

02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

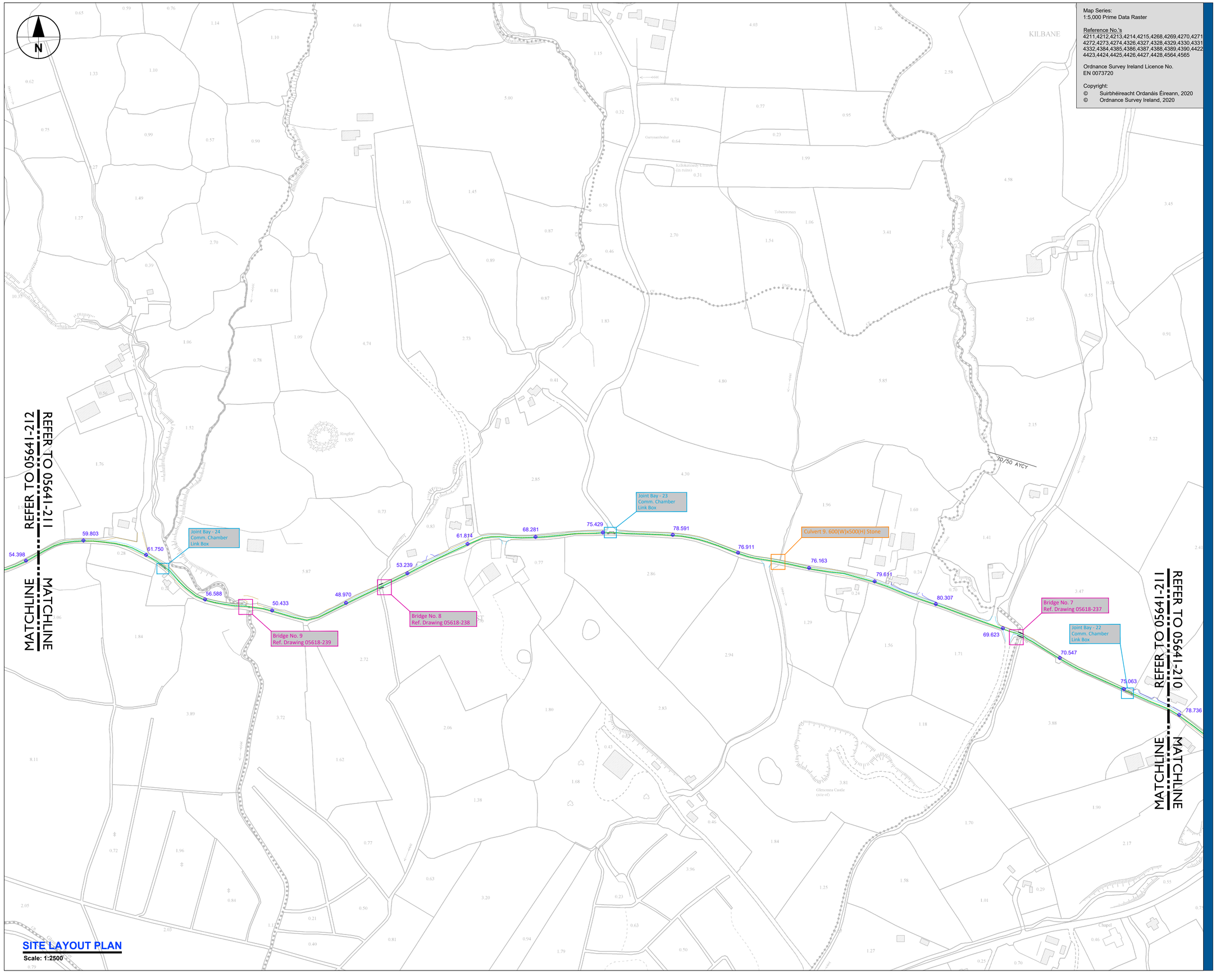
SHEET TITLE

Site Layout Plan
Sheet 10 of 16

SHEET NUMBER

05641-210

ISO A1 594mm x 841mm



SITE LAYOUT PLAN

Scale: 1:2500

Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271,4272,4273,4274,4326,4327,4328,4329,4330,4331,4332,4384,4385,4386,4387,4388,4389,4390,4422,4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

- Proposed UGC (25km)
- Joint Bay Locations shown thus
- Bridge Locations shown thus
- Culvert Locations shown thus
- Road Edge shown thus
- Road Centre shown thus
- Concrete Wall shown thus
- Fence Line shown thus
- Verge shown thus
- Existing levels shown thus 79.617

ISSUE/REVISION

02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

SHEET TITLE

Site Layout Plan
Sheet 11 of 16

SHEET NUMBER

05641-211

Project Management Initials: Designer: CH Checked: SK Approved: RG

ISO A1 594mm x 841mm

MATCHLINE REFER TO 05641-213

MATCHLINE REFER TO 05641-212

MATCHLINE REFER TO 05641-211

211.882
194.79
178.573
168.76
158.472
145.777
130.216
124.962
123.285
112.247
103.071
87.096
74.045
70.650
53.390
49.577
52.746
54.398

Joint Bay - 26 Comm. Chamber Link Box

Joint Bay - 25 Comm. Chamber Link Box

CLOONGAHEEN WEST

BARBANE

Barbane House

Ringfort

Giant's Grave

Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

Copyright:
© Suirbhéireacht Ordanáis Éireann, 2020
© Ordnance Survey Ireland, 2020

SITE LAYOUT PLAN

Scale: 1:2500

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

- Proposed UGC (25km)
- Joint Bay Locations shown thus
- Road Edge shown thus
- Road Centre shown thus
- Concrete Wall shown thus
- Fence Line shown thus
- Verge shown thus
- Existing levels shown thus ⊕ 79.617

ISSUE/REVISION

02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

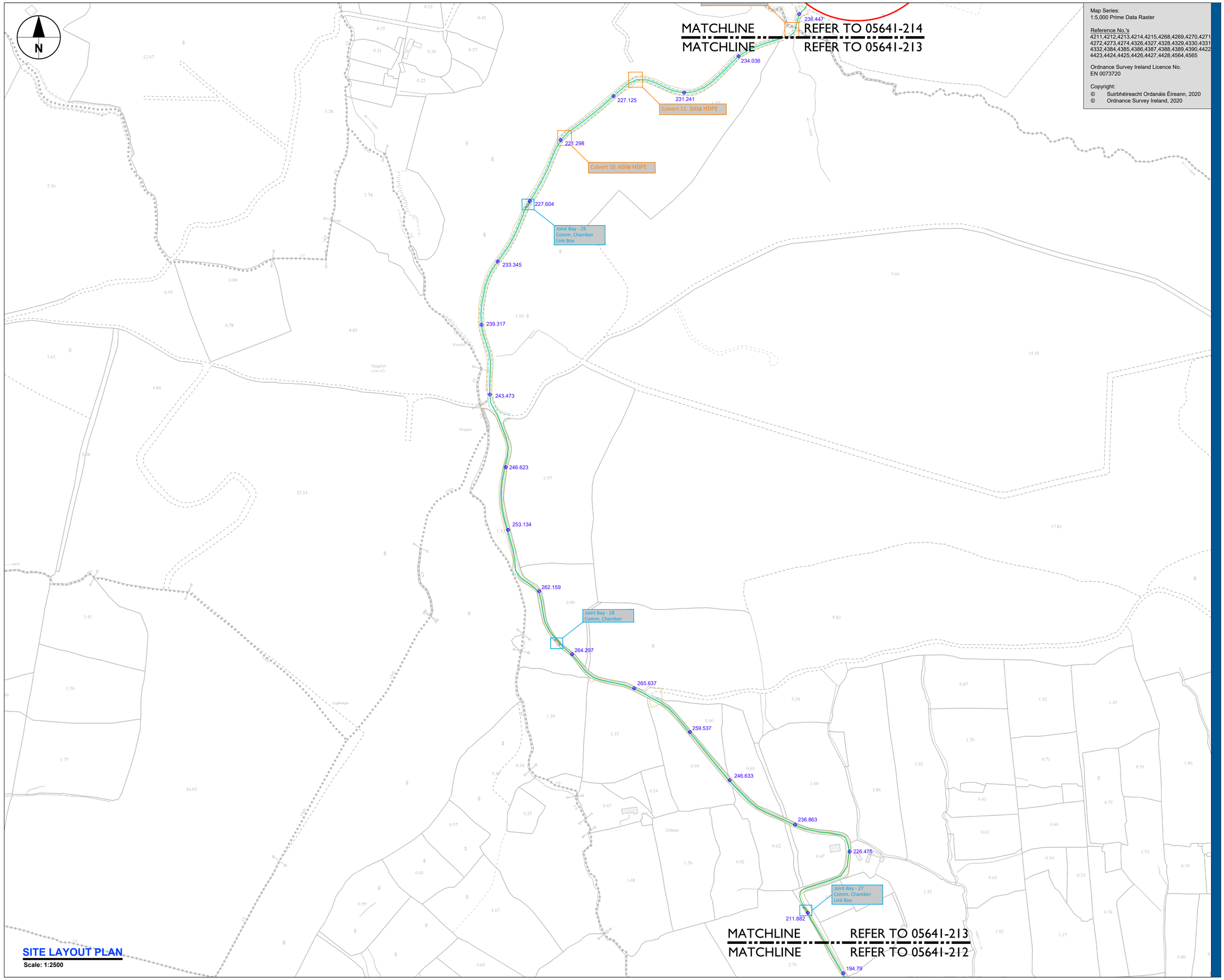
SHEET TITLE

Site Layout Plan
Sheet 12 of 16

SHEET NUMBER

05641-212

ISO A1 594mm x 841mm



SITE LAYOUT PLAN

Scale: 1:2500

Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

- Proposed UGC (25km)
- Joint Bay Locations shown thus
- Culvert Locations shown thus
- Road Edge shown thus
- Road Centre shown thus
- Concrete Wall shown thus
- Fence Line shown thus
- Verge shown thus
- Existing levels shown thus ⊕ 79.617

ISSUE/REVISION

02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

SHEET TITLE

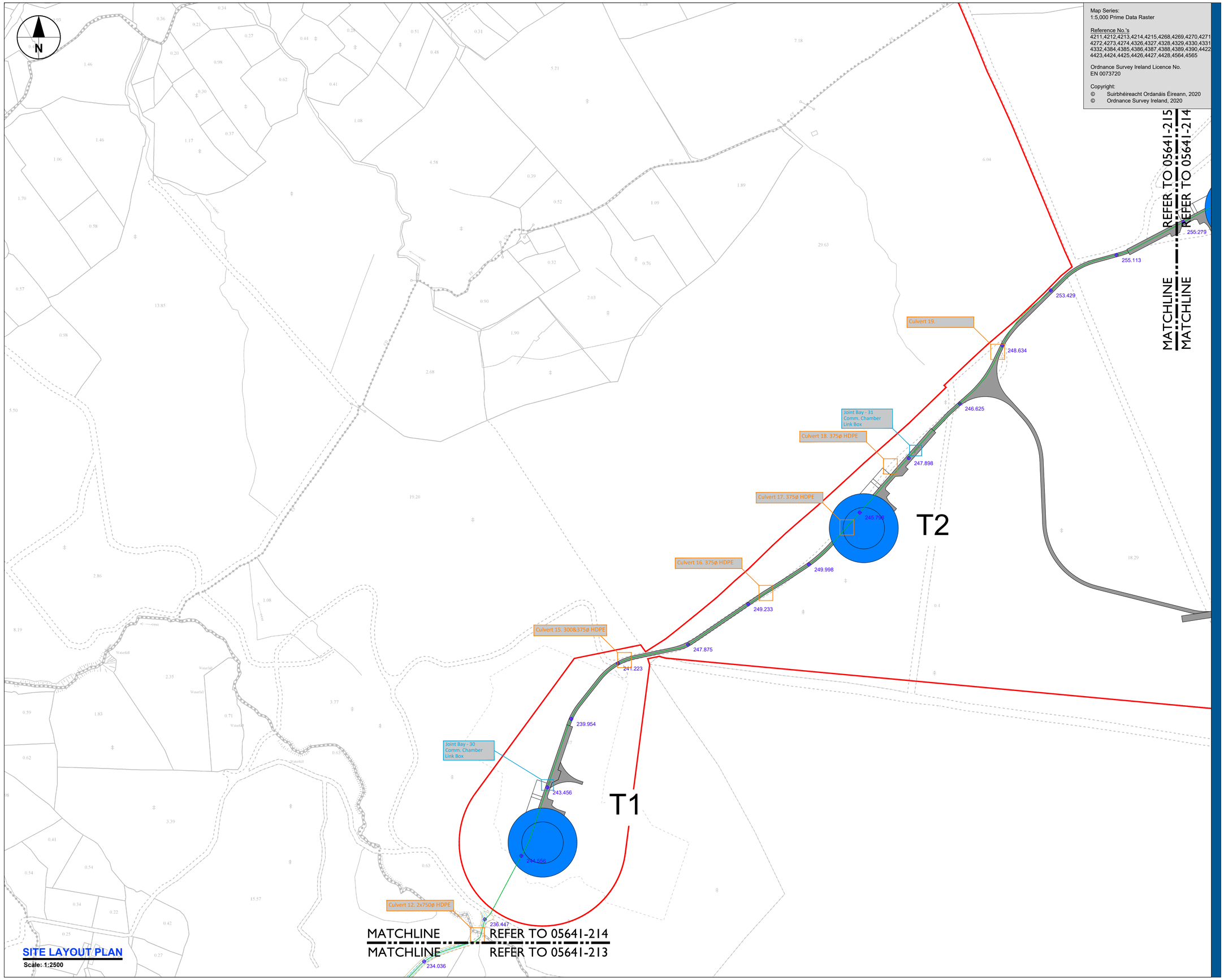
Site Layout Plan
Sheet 13 of 16

SHEET NUMBER

05641-213

Project Management Initials: Designer: CH Checked: SK Approved: RG

ISO A1 594mm x 841mm



SITE LAYOUT PLAN

Scale: 1:2500

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

- Proposed UGC (25km)
- Joint Bay Locations shown thus
- Culvert Locations shown thus
- Road Edge shown thus
- Road Centre shown thus
- Concrete Wall shown thus
- Fence Line shown thus
- Verge shown thus
- Existing levels shown thus — 79.617
- Wind Farm roads/hardstandings shown thus
- Turbine locations shown thus — T12
- Wind Farm Planning boundary shown thus

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

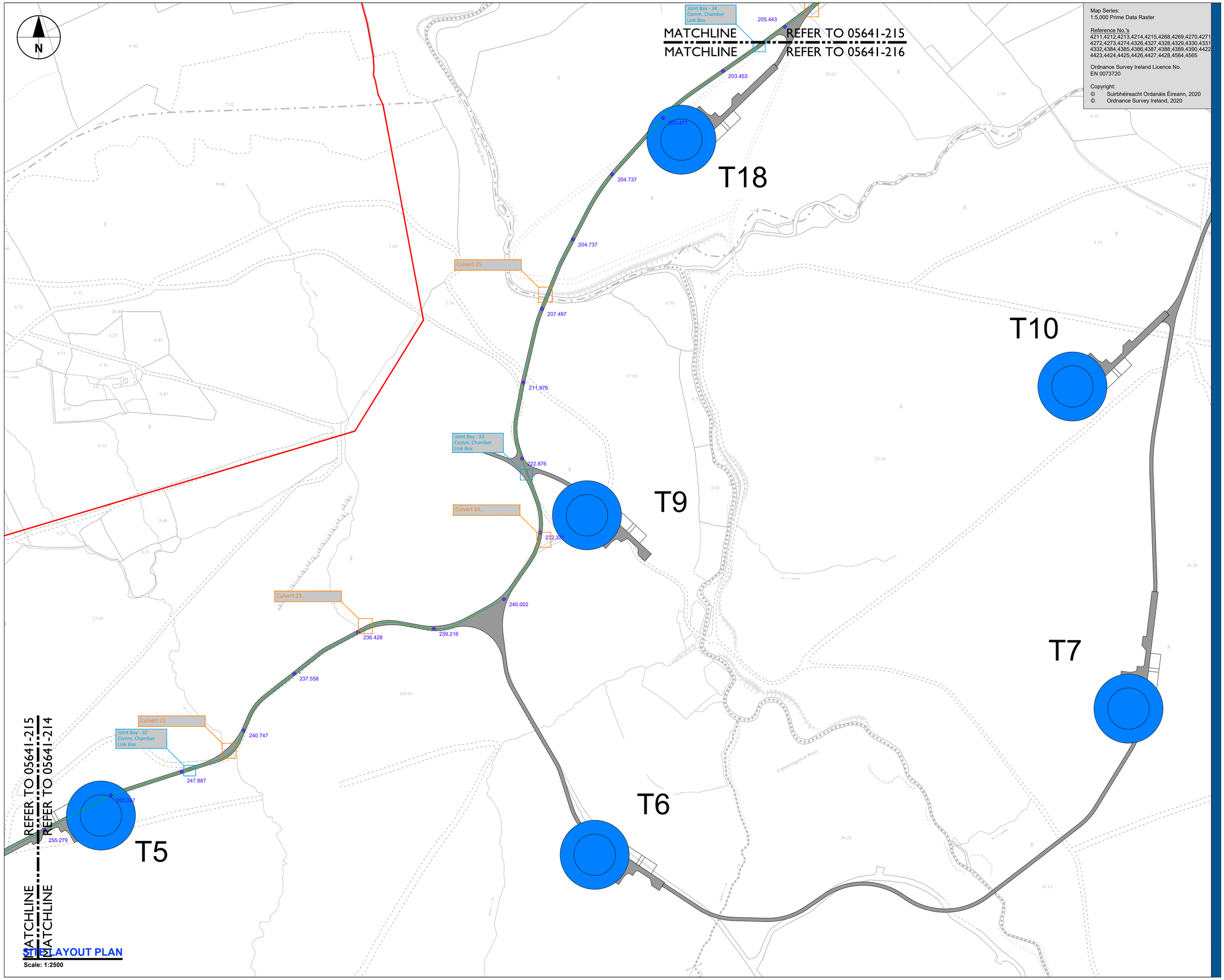
SHEET TITLE

Site Layout Plan
Sheet 14 of 16

SHEET NUMBER

05641-214

ISO A1 594mm x 841mm



SITE LAYOUT PLAN
Scale: 1:2500

Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm

110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

- Proposed UGC (25km)
- Joint Bay Locations shown thus
- Culvert Locations shown thus
- Road Edge shown thus
- Road Centre shown thus
- Concrete Wall shown thus
- Fence Line shown thus
- Verge shown thus
- Existing levels shown thus 79.617
- Wind Farm roads/hardstandings shown thus
- Turbine locations shown thus T12
- Wind Farm Planning boundary shown thus

ISSUE/REVISION

01	27.03.20	Issued for Planning
00	29.11.19	Issued for Planning
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

SHEET TITLE

Site Layout Plan
Sheet 15 of 16

SHEET NUMBER

05641-215

Project Management Initials: Designer: CH Checked: SK Approved: RG

ISO A1 594mm x 841mm

Project Management Initials: Designer: CH Checked: SK Approved: RG

Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720

Carrownagowan Wind Farm
Substation Location

PMM

T19

T17

Culvert 28.

Culvert 27.

Culvert 26.

Joint Bay - 35
Comm. Chamber
Link Box

Joint Bay - 34
Comm. Chamber
Link Box

207.493

208.593

208.473

207.263

206.683

206.873

205.443

MATCHLINE REFER TO 05641-215

MATCHLINE REFER TO 05641-216

SITE LAYOUT PLAN

Scale: 1:2500

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm

110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

LEGEND: -

- Proposed UGC (25km)
- Joint Bay Locations shown thus
- Culvert Locations shown thus
- Road Edge shown thus
- Road Centre shown thus
- Concrete Wall shown thus
- Fence Line shown thus
- Verge shown thus
- Existing levels shown thus 79.617
- Wind Farm roads/hardstandings shown thus
- Turbine locations shown thus T12
- Wind Farm Planning boundary shown thus

ISSUE/REVISION

I/R	DATE	DESCRIPTION
01	27.03.20	Issued for Planning
00	29.11.19	Issued for Planning

PROJECT NUMBER

05-641

SHEET TITLE

Site Layout Plan
Sheet 16 of 16

SHEET NUMBER

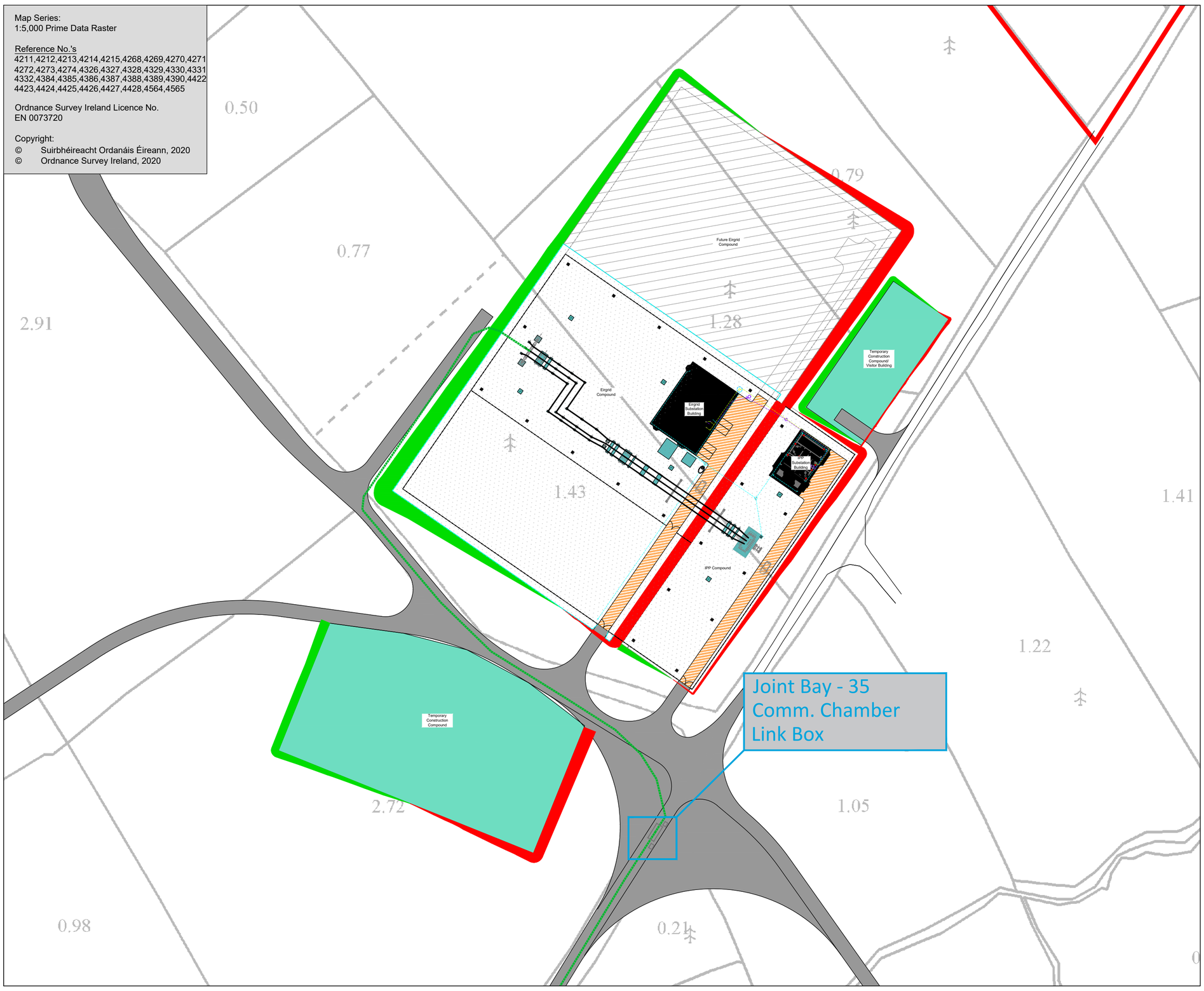
05641-216

Project Management Initials: Designer: CH Checked: SK Approved: RG

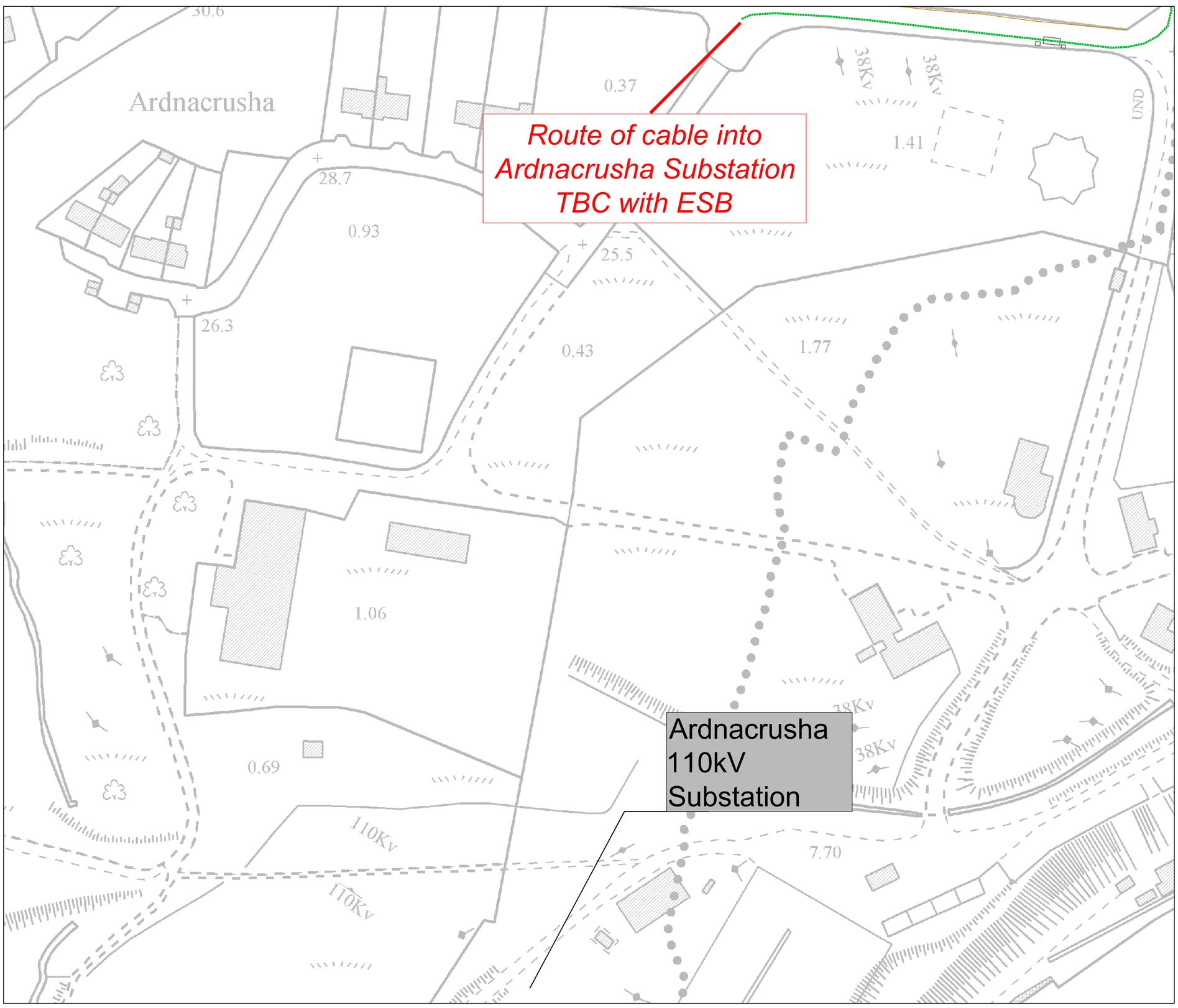
Map Series:
1:5,000 Prime Data Raster

Reference No.'s
4211,4212,4213,4214,4215,4268,4269,4270,4271
4272,4273,4274,4326,4327,4328,4329,4330,4331
4332,4384,4385,4386,4387,4388,4389,4390,4422
4423,4424,4425,4426,4427,4428,4564,4565

Ordnance Survey Ireland Licence No.
EN 0073720



110kV Grid Design - Connection to Carrowanagowan WF 110kV Substation
Scale: 1:1000



110kV Grid Design - Connection to Ardnacrusha 110kV ESB Substation
Scale: 1:1000

LEGEND: -

Proposed UGC (25km)
Joint Bay Locations shown thus
Wind Farm Planning boundary shown thus

NOTES: -

Path of cable route and location of associated Joint Bays, Link Boxes and Comms Chambers may vary depending on site conditions.

Other services may be encountered along the route.

Route of UGC in ESB compound to be determined by ESBN based on connection point.

This drawing is to be used only for the purpose of the planning application and is subject to detailed design.

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan WindFarm
110kV Grid Connection

CLIENT

COILLTE
GROW · TRANSFORM · SUSTAIN

CONSULTANTS

ISSUE/REVISION

02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

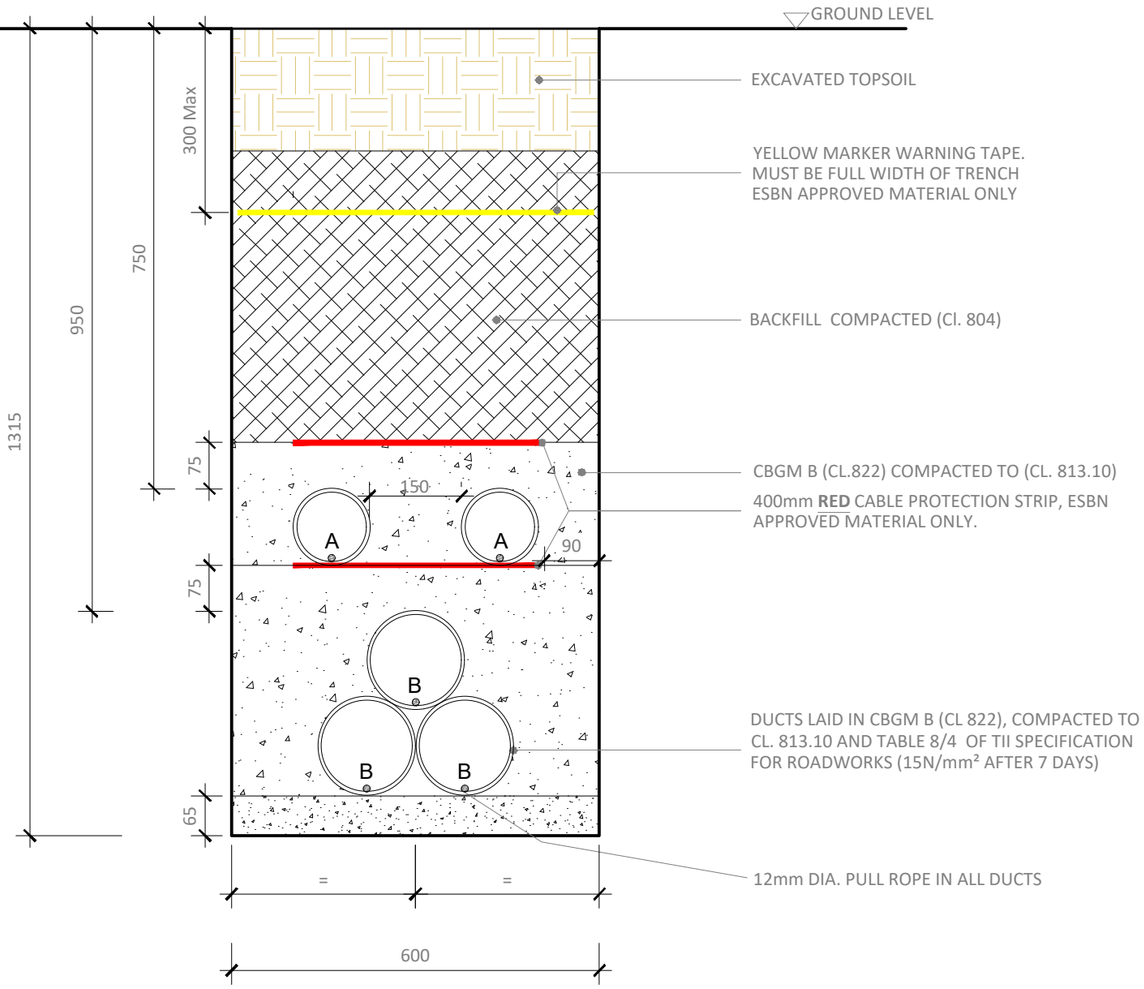
SHEET TITLE

Substation Connections

SHEET NUMBER

05641-217

ISO A1 594mm x 841mm



A = 125mm: Outer Diameter HDPE ESB Approved Duct, SDR=17.6

B= 160mm : Outer Diameter HDPE ESB Approved Duct, SDR=21.0

Typical Section Through Private Lands

SCALE 1:10

Note:
- This drawing is to be read in conjunction with relevant drawings, specifications and reports
- Dimensions are in millimeters, unless noted otherwise
- Drawings are not to be scaled use figured dimensions only

ALL REINSTATEMENT WORKS ARE TO BE IN ACCORDANCE WITH LANDOWNER REQUIREMENTS

Reinstatement details based on Guidelines for Managing Openings in Public Roads - SD14

tli GROUP
Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

CLIENT: COILLTE

PROJECT: Carrownagowan Wind Farm
110kV Grid Connection

PROJECT NUMBER: 05-641

SHEET NUMBER: 05641-221

SHEET TITLE: Typical Ducting through Off Road Sections - Section

DRAWING STATUS: For Planning

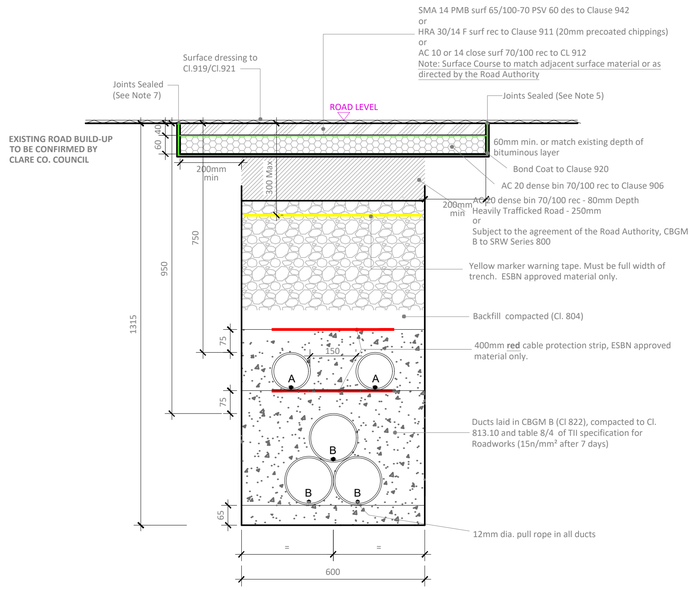
ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	18.05.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

ISO A1 594mm x 841mm

Permanent Reinstatement

Reinstatement details based on Guidelines for Managing Openings in Public Roads - SD4



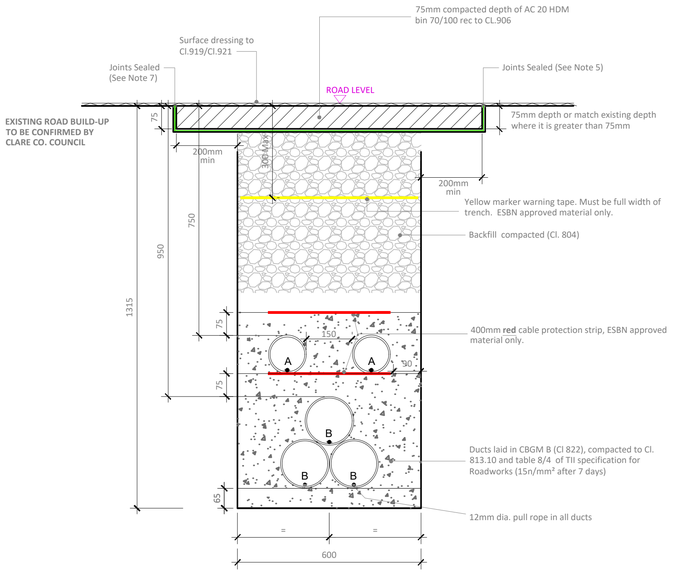
A = 125mm: Outer Diameter HDPE ESB Approved Duct, SDR=17.6

B= 160mm : Outer Diameter HDPE ESB Approved Duct, SDR= 21

Typical Section Through Permanent Reinstatement of Longitudinal Opening in Roadway

SCALE 1:10

Reinstatement details based on Guidelines for Managing Openings in Public Roads - SD5



A = 125mm: Outer Diameter HDPE ESB Approved Duct, SDR=17.6

B= 160mm : Outer Diameter HDPE ESB Approved Duct, SDR= 21

Typical Section Through Permanent Reinstatement of Longitudinal Opening in Dressed Rural Unbound Roadway

SCALE 1:10

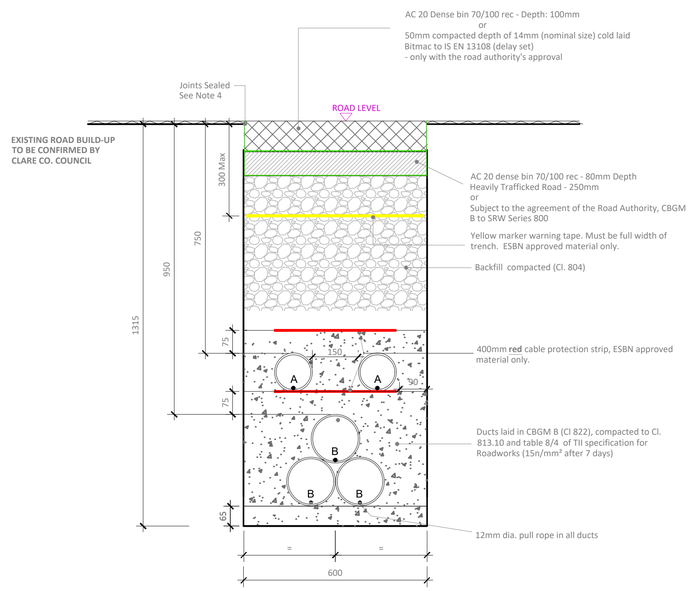
ALL REINSTATEMENT WORKS ARE TO BE IN ACCORDANCE WITH LOCAL AREA ENGINEERS REQUIREMENTS AND GUIDELINES FOR MANAGING OPENINGS IN PUBLIC ROADS

Note:

1. Refer to Guidelines for managing Openings in Public Roads (Purple Book - April 2017), Chapter 6 'Specifications' for guidance on Duct type / colour and Marker Tape type / colour.
2. All bound edges shall be saw cut to expose the full vertical thickness of each layer prior to excavation. All edges shall be essentially straight, smooth and vertical.
3. Where a temporary surface has been used, material shall be planed out to the depth specified in this drawing. The new permanent surface shall be machined laid and mechanically compacted with a vibrating roller.
4. Where the trimmed edge of excavation is within 400mm* of a joint / edge, ironwork or other reinstatement, this trimmed edge shall be extended to include same and the area of reinstatement shall be extended accordingly (* increase to 800mm where this is pre-existing practice).
5. Any damaged area adjacent to the opening and resulting from the excavation operation shall be included within the area to be reinstated.
6. Clause 808 or Cement Bound Granular Material surface to be sprayed per clause 920 prior to application of Asphalt Concrete Layer.
7. Joint sealer shall be a hot 50 pen bitumen binder or cold thixtropic bitumen 50 -70 pen to be applied to all vertical cuts in accordance with B.S.594987 prior to application of bituminous materials.
8. For roads without asphalt concrete surface (e.g. may be Cl.804 with double surface dressing), the road authority may as its discretion permit the temporary reinstatement surface of asphalt concrete to be regulated in lieu of excavation and reinstatement; and subsequently surface dressed.
9. On highly trafficked roads services must have a minimum cover of 750mm.
10. Where required by the Road authority the trench may be reinstated with a Cement Bound Granular Material.

Temporary Reinstatement

Reinstatement details based on Guidelines for Managing Openings in Public Roads - SD1



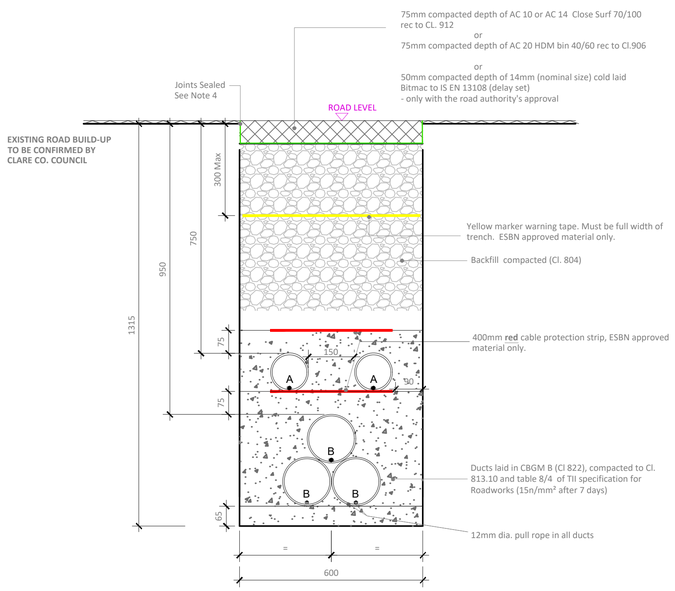
A = 125mm: Outer Diameter HDPE ESB Approved Duct, SDR=17.6

B= 160mm : Outer Diameter HDPE ESB Approved Duct, SDR= 21

Typical Section Through Temporary Reinstatement of Longitudinal Opening in Roadway

SCALE 1:10

Reinstatement details based on Guidelines for Managing Openings in Public Roads - SD2



A = 125mm: Outer Diameter HDPE ESB Approved Duct, SDR=17.6

B= 160mm : Outer Diameter HDPE ESB Approved Duct, SDR= 21

Typical Section Through Temporary Reinstatement of Longitudinal Opening in Dressed Rural Unbound Roadway

SCALE 1:10

ALL REINSTATEMENT WORKS ARE TO BE IN ACCORDANCE WITH LOCAL AREA ENGINEERS REQUIREMENTS AND GUIDELINES FOR MANAGING OPENINGS IN PUBLIC ROADS

Note:

1. Refer to 'Guidelines for managing Openings in Public Roads (Purple Book - April 2017)', Chapter 6 'Specifications' for guidance on Duct type / colour and Marker Tape type / colour.
2. All bound edges shall be saw cut to expose the full vertical thickness of each layer prior to excavation. All edges shall be essentially straight, smooth and vertical.
3. Clause 808 surface to be sprayed per clause 920 prior to application of Asphalt Concrete Layer.
4. Joint sealer shall be a hot 50 pen bitumen binder or cold thixotropic bitumen 50-70 pen to be applied to all vertical cuts in accordance with B.S. 594987 prior to application of bituminous materials.
5. Licence holder must maintain temporary reinstatement to a safe and acceptable standard.
6. Any damaged area adjacent to the opening and resulting from the excavation operation shall be included within the area to be reinstated.
7. Temporary Road Surface warning signs must be used in accordance with the Traffic Signs Manual (Chaper 8 - Temporary Traffic Measures and Signs for Roadworks).
8. Refer to detail Permanent Reinstatement of Road for advice on permanent reinstatement - all permanent reinstatement shall be carried out when adequate settlement has occurred as determined by the Road Authority.

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan
Windfarm
110kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

- This drawing is to be read in conjunction with relevant drawings, specifications and reports
- Dimensions are in millimeters, unless noted otherwise
- Drawings are not to be scaled use figured dimensions only
- Geogrid may be implemented along the cable trench route where deemed necessary by the contractor or as required by Clare County Council

LEGEND: -

ISSUE/REVISION

02	18.05.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

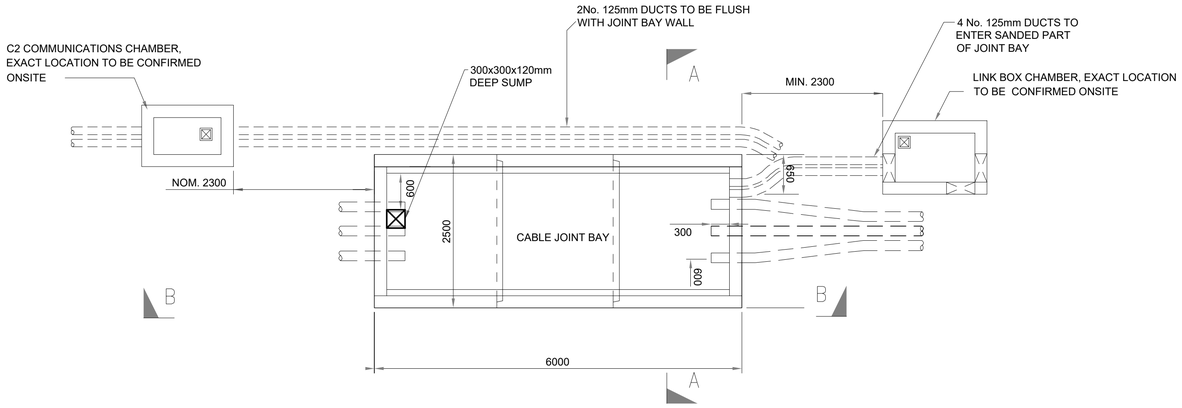
SHEET TITLE

Typical Ducting Through
Regional / Local Roadways

SHEET NUMBER

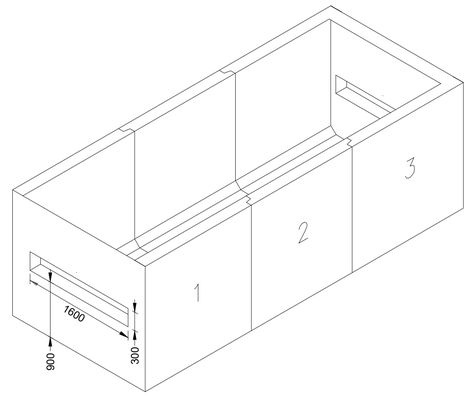
05641-222

ISO A1 594mm x 841mm



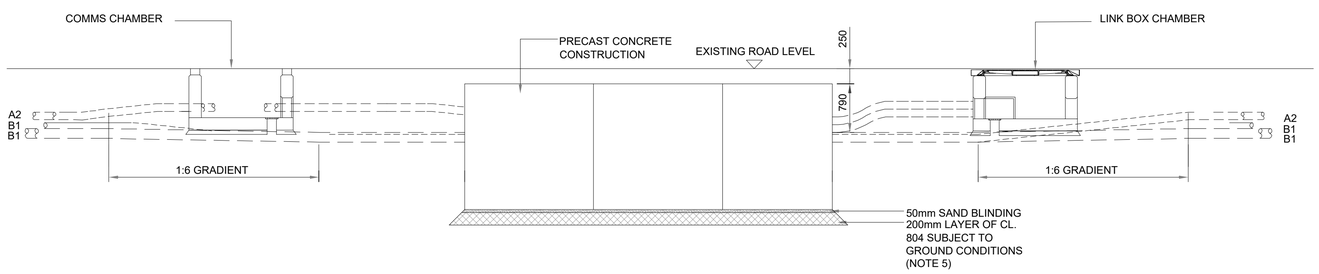
PLAN VIEW

SCALE 1:50



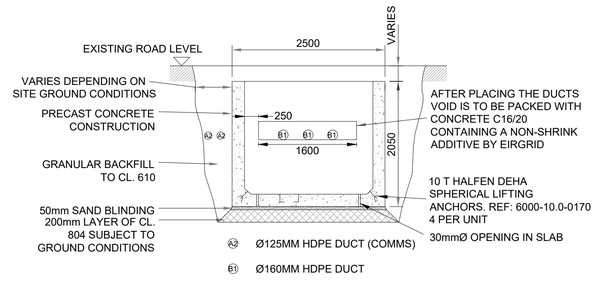
ISOMETRIC VIEW PRECAST CHAMBER

SCALE 1:50



SECTION B-B

SCALE 1:50



SECTION A-A

SCALE 1:50

GENERAL NOTES:

1. THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE AND IS SUBJECT TO AMENDMENT.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT INFORMATION
3. DO NOT SCALE FROM THIS DRAWING, USE ONLY PRINTED DIMENSIONS.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS DEFINED OTHERWISE.
5. STANDARD FOUNDATIONS ARE BASED ON THE FORMATION AT THE BASE OF THE EXCAVATION SHOWN BEING SUITABLE FOR A MINIMUM BEARING PRESSURE OF 100kN/m2. SUITABILITY OF STANDARD JOINT BAY FOUNDATIONS CAN ONLY BE CONFIRMED FOLLOWING GROUND INVESTIGATION. HAND VANE TESTS SHALL BE REQUIRED AS PER GI SPECIFICATION. WHERE SPECIFIED MINIMUM BEARING PRESSURE IS NOT ACHIEVABLE, AND WHERE PEAT IS ENCOUNTERED, THE CONTRACTOR SHALL REFER TO THE ENGINEER FOR GUIDANCE.
6. THE LENGTH OF BONDING LEAD LENGTH SHALL IN NO CASE EXCEED 10M. NO JOINTS IN BONDING CABLE ARE PERMITTED.
7. ALL EARTHING SHALL BE IN ACCORDANCE WITH ENA ER C55 AND EIRGRID/ESBN FUNCTIONAL SPECIFICATION
8. THE DEPTH FROM GROUND/ROAD LEVELTO THE TOP OF THE CONCRETE WALL SHALL BE
   A. 500MM - IN CULTIVATED FIELDS & GRASS LAND
   B. 300MM - IN PAVED ROADS AND GRASS VERGES
   C. 350MM - IN PAVED CITY ROADS AND GRASS VERGES
9. LINK BOX CHAMBERS TO BE POSITIONED AT THE EDGE OR OFF ROAD
10. LINK BOX CHAMBERS AND C2 COMM CHAMBERS FINAL POSITIONING TO BE AGREED WITH EIRGRID PRIOR TO INSTALLATION

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm

110kV Grid Connection

CLIENT

COILLTE
GROW. TRANSFORM. SUSTAIN.

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

See General Notes

LEGEND: -

ISSUE/REVISION

02	18.05.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

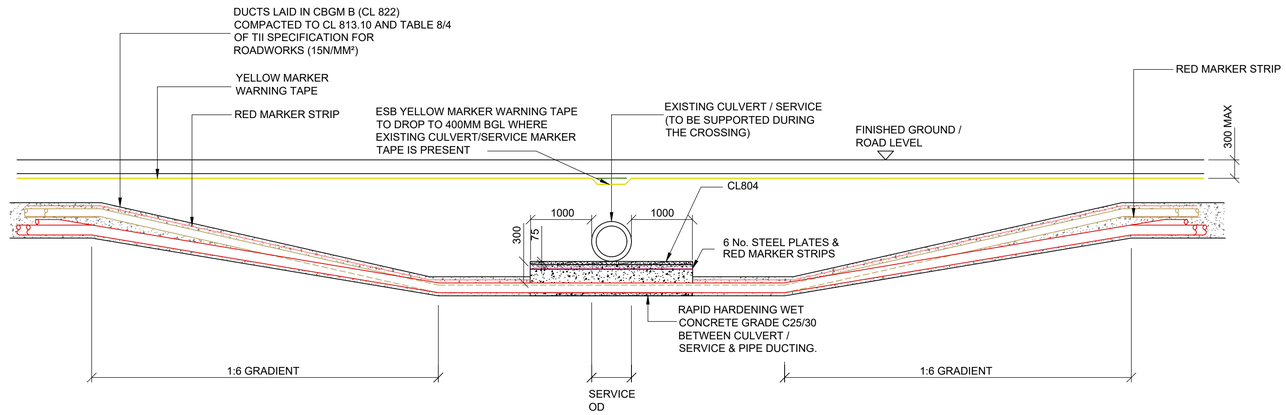
SHEET TITLE

110kV Joint Bay General Arrangement and Details

SHEET NUMBER

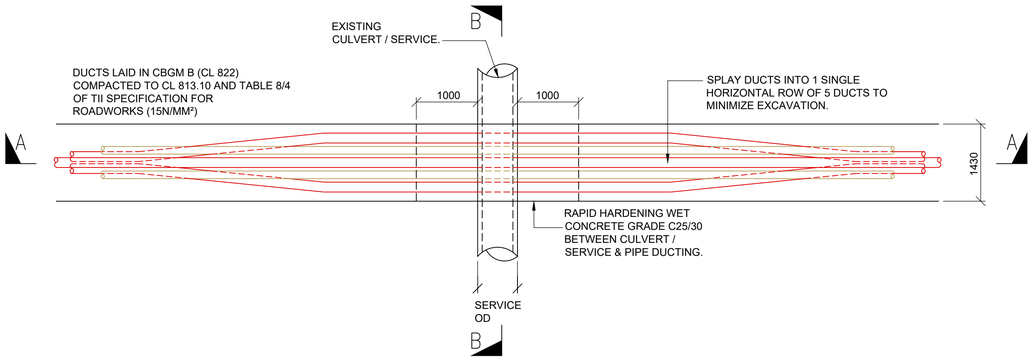
05641-223

ISO A1 594mm x 841mm



SECTION A-A

SCALE 1:50

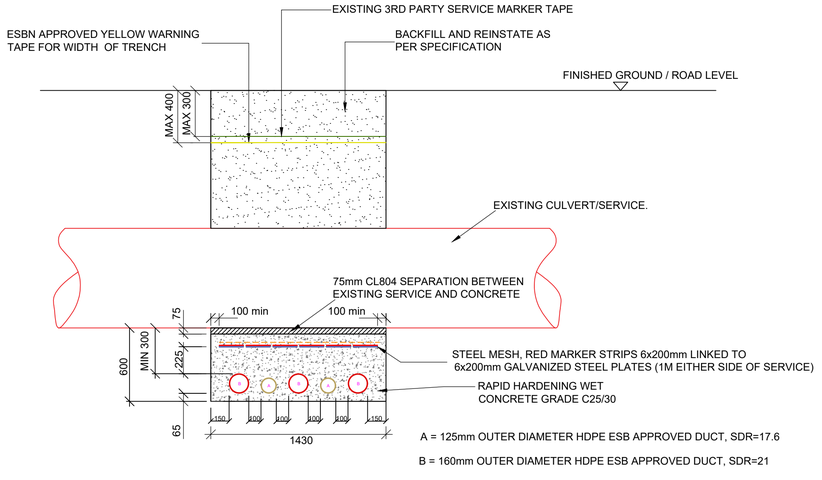


PLAN VIEW

SCALE 1:50

GENERAL NOTES

1. This drawing is to be read in conjunction with all other relevant documentation.
2. Do not scale from this drawing use only printed dimensions.
3. All dimensions are in millimetres, all chainages, levels and co-ordinates are in metres unless defined otherwise.
4. This drawing is to be read in conjunction with the project Health & Safety file for any identified potential risks.
5. No excavation shall commence until the contractor has consulted up to date services drawings and carried out an Electromagnetic Locator (EML) Scan.
6. Hand dig only within 500mm of existing services.
7. If compacting CBGM B could cause damage to the culvert / service below, use rapid hardening cement grade C25/30 following engineers prior approval.
8. For standard trench cross section drawings and minimum horizontal separation to existing services, see 05641-222 (TREFOIL) and 05641-229 (FLAT).
9. Where depths exceed 3000mm to the top of duct the contractor shall consult the cable system design engineer for phase spacing requirements.
10. For Watermain crossings, see 05641-225
11. All Products and materials to be utilised during construction to comply with Eirgrid functional specification for road works and all relevant Irish (European) and British standards
12. 300mm minimum vertical and horizontal clearances to be observed between cable ducts and third party services (e.g. gas pipes, water mains, culverts etc.) In the case of high risk 3rd party services, greater clearances mat be required. Designer to consult Eirgrid and 3rd party service owners for guidance
13. Steel plates must cover ducts. No overlap is required however standard dimensions may result in an overlap. Spacing of 10mm to be maintained between steel plates to prevent the transfer of stray current.
14. Templates are to be used at 5m intervals during duct installation in CBGM. Pre-made 75mm wide concrete spacers to be used during duct installation in wet concrete
15. If existing service marker tape is not present, the ESBN yellow marker tape should be installed at maximum 300mm below finished surface level



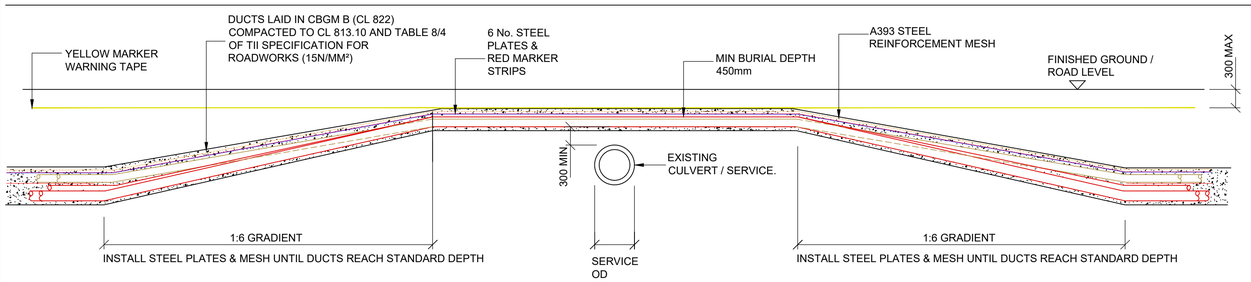
A = 125mm OUTER DIAMETER HDPE ESB APPROVED DUCT, SDR=17.6

B = 160mm OUTER DIAMETER HDPE ESB APPROVED DUCT, SDR=21

SECTION B-B

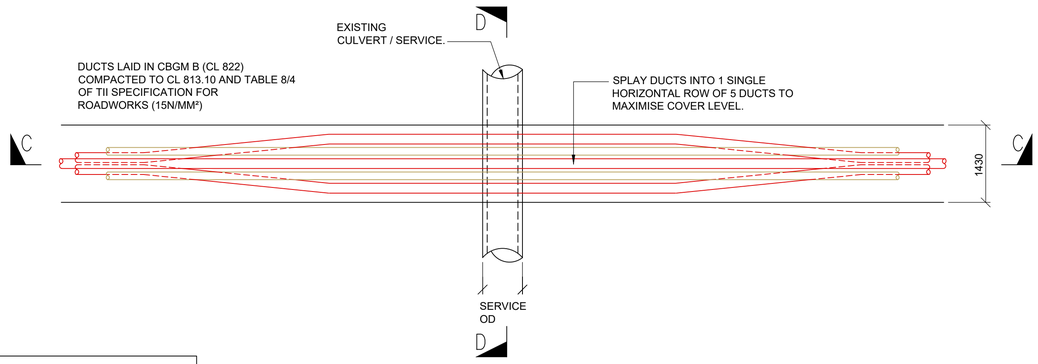
SCALE: NTS

SERVICE UNDERCROSSING



SECTION C-C

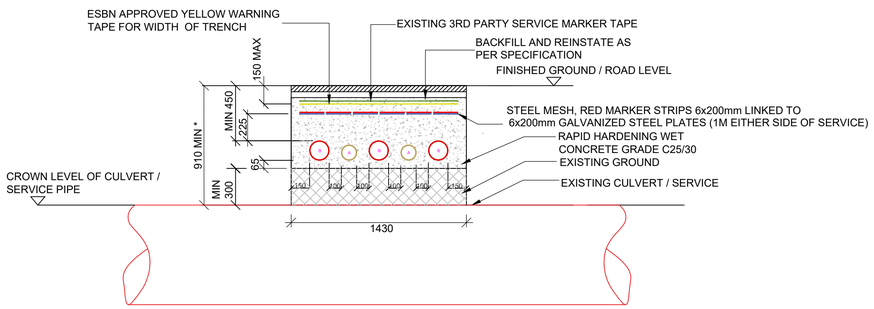
SCALE 1:50



PLAN VIEW

SCALE 1:50

SERVICE OVERCROSSING



* ALL EXISTING SERVICES WITH COVER LESS THAN MIN. DIMENSIONS ABOVE SHALL BE CROSSED BY UNDERCROSSING METHOD

A = 125mm OUTER DIAMETER HDPE ESB APPROVED DUCT, SDR=17.6

B = 160mm OUTER DIAMETER HDPE ESB APPROVED DUCT, SDR=21

SECTION D-D

SCALE: NTS

LEGEND

- 160mm Ø HDPE POWER DUCT WITH 12mm DIAMTER PULL ROPE
- 125mm Ø HDPE COMMUNICATION DUCT WITH 12mm DIAMTER PULL ROPE
- RED MARKER STRIP OR STEEL PLATES
- YELLOW MARKER WARNING TAPE
- A393 STEEL REINFORCEMNET MESH
- 6mm GALVANISED STEEL PLATE
- EXISTING 3RD PARTY MARKER TAPE

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

See General Notes

LEGEND: -

ISSUE/REVISION

02	18.05.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

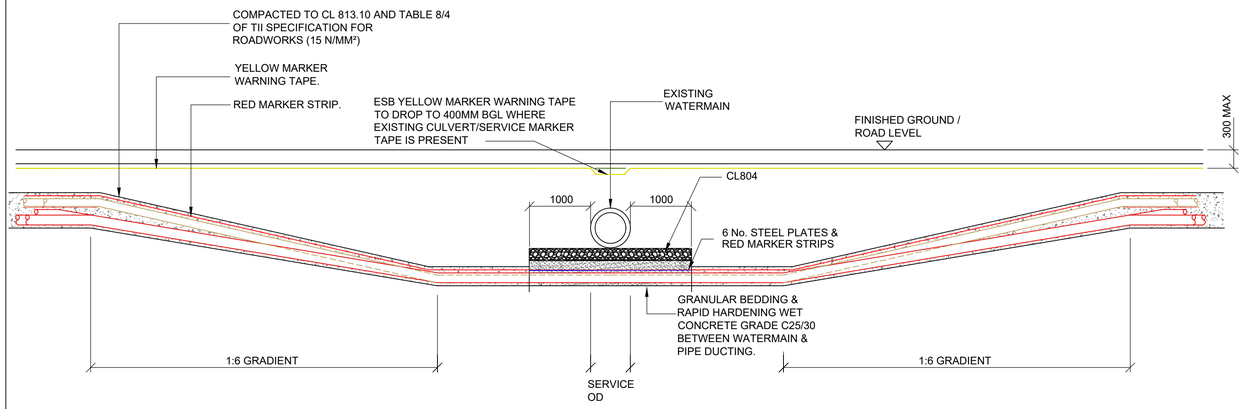
SHEET TITLE

Typical Trench Sections for Crossing Existing Culverts/Services

SHEET NUMBER

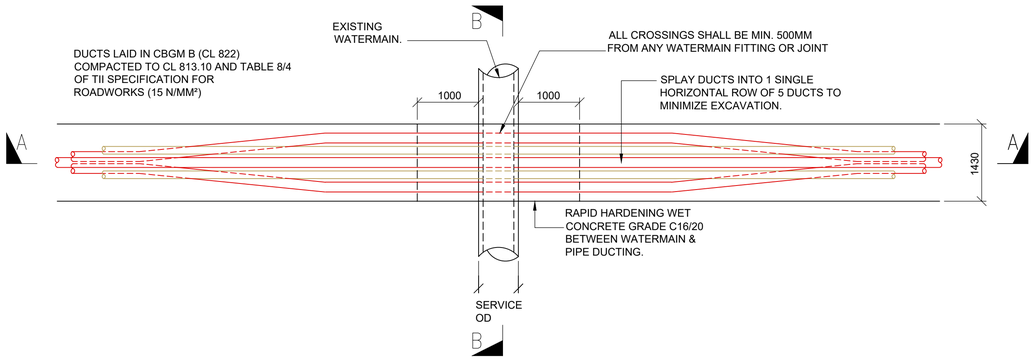
05641-224

ISO A1 594mm x 841mm



SECTION A-A

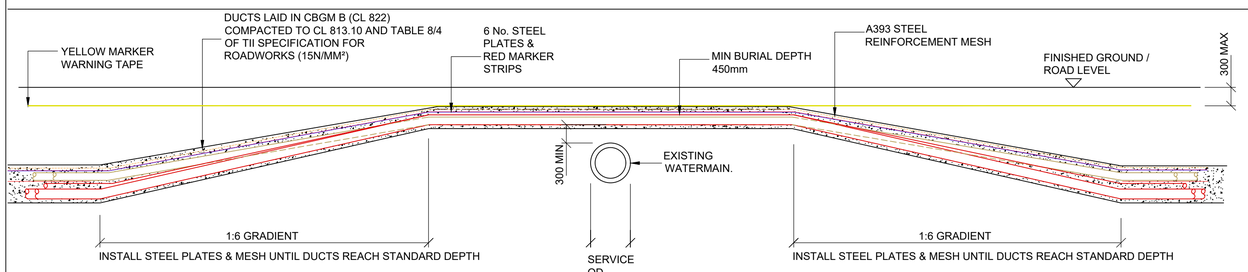
SCALE 1:50



PLAN VIEW

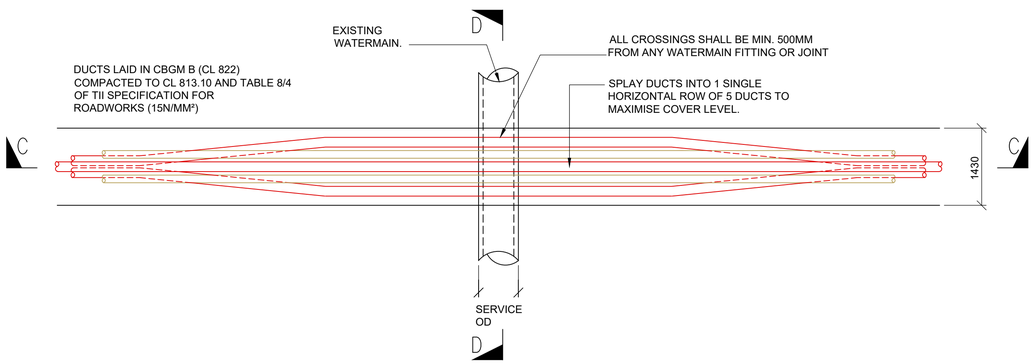
SCALE 1:50

WATERMAIN UNDERCROSSING



SECTION C-C

SCALE 1:50



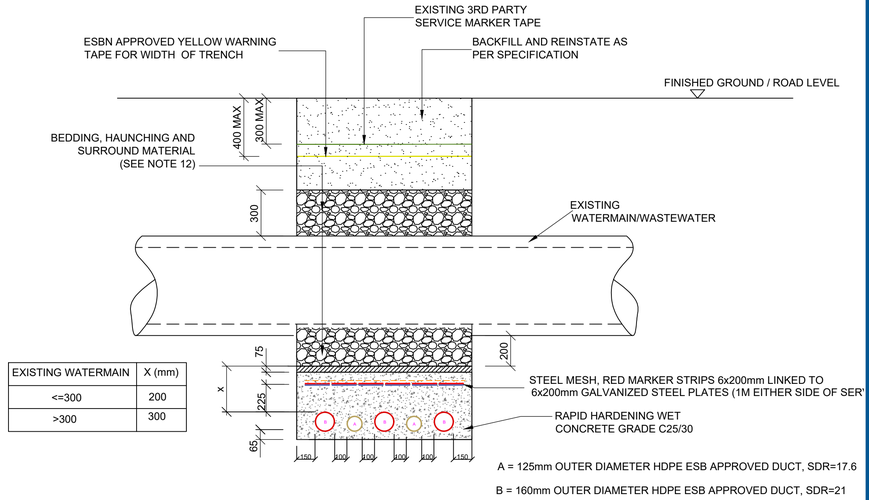
PLAN VIEW

SCALE 1:50

WATERMAIN OVERCROSSING

GENERAL NOTES

1. This drawing is to be read in conjunction with all other relevant documentation.
2. Do not scale from this drawing use only printed dimensions.
3. All dimensions are in millimetres, all chainages, levels and co-ordinates are in metres unless defined otherwise.
4. This drawing is to be read in conjunction with the project Health & Safety file for any identified potential risks.
5. No excavation shall commence until the contractor has consulted up to date services drawings and carried out an Electromagnetic Locator (EML) Scan.
6. Hand dig only within 500mm of existing services.
7. If compacting CBGM B could cause damage to the culvert / service below, use rapid hardening cement grade C25/30 following engineers prior approval.
8. For standard trench cross section drawings and minimum horizontal separation to existing services, see 05641-222 (TREFOIL) and 05641-229 (FLAT).
9. Where depths exceed 3000mm to the top of duct the contractor shall consult the cable system design engineer for phase spacing requirements.
10. All works shall be in accordance with Irish Water code of practice for infrastructure.
11. Backfill as per guidelines for the opening, backfilling and reinstatement of openings in public roads (2015)
12. As per WIS 4-08-02 & IGN 4-08-01 granular material shall be 14mm to 5mm graded aggregate or 10mm single sized aggregate
13. All Products and materials to be utilised during construction to comply with Eirgrid functional specification for road works and all relevant Irish (European) and British standards
14. 300mm minimum vertical and horizontal clearances to be observed between cable ducts and third party services (e.g. gas pipes, water mains, culverts etc.) In the case of high risk 3rd party services, greater clearances mat be required. Designer to consult Eirgrid and 3rd party service owners for guidance
15. Steel plates must cover ducts. No overlap is required however standard dimensions may result in an overlap. Spacing of 10mm to be maintained between steel plates to prevent the transfer of stray current.
16. Templates are to be used at 5m intervals during duct installation in CBGM. Pre-made 75mm wide concrete spacers to be used during duct installation in wet concrete
17. If existing service marker tape is not present, the ESBN yellow marker tape should be installed at maximum 300mm below finished surface level



EXISTING WATERMAIN	X (mm)
<=300	200
>300	300

A = 125mm OUTER DIAMETER HDPE ESB APPROVED DUCT, SDR=17.6

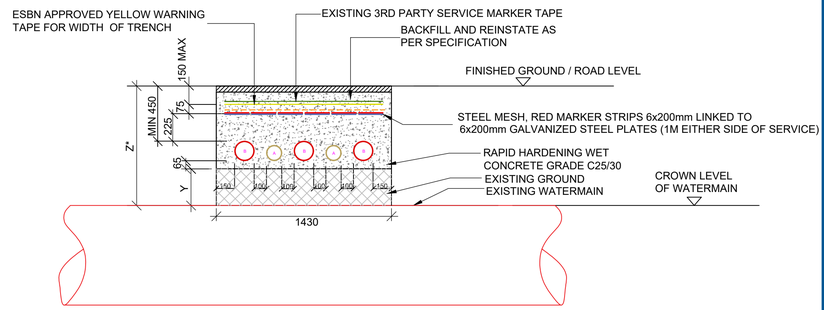
B = 160mm OUTER DIAMETER HDPE ESB APPROVED DUCT, SDR=21

SECTION B-B

SCALE: NTS

LEGEND

- 160mm Ø HDPE POWER DUCT WITH 12mm DIAMTER PULL ROPE
- 125mm Ø HDPE COMMUNICATION DUCT WITH 12mm DIAMTER PULL ROPE
- RED MARKER STRIP OR STEEL PLATES
- YELLOW MARKER WARNING TAPE
- A393 STEEL REINFORCEMNET MESH
- 6mm GALVANISED STEEL PLATE
- EXISTING 3RD PARTY MARKER TAPE



SECTION D-D

SCALE: NTS

EXISTING WATERMAIN	Y (mm)	Z* (mm)
<=300	235	885 MIN
>300	435	1085 MIN

* ALL EXISTING SERVICES WITH COVER LESS THAN MIN. DIMENSIONS ABOVE SHALL BE CROSSED BY UNDERCROSSING METHOD

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Carrownagowan Wind Farm
110kV Grid Connection

CLIENT

COILLTE
GROW·TRANSFORM·SUSTAIN

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

See General Notes

LEGEND: -

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	18.05.20	Issued for Planning
01	05.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

SHEET TITLE

Typical Trench Sections for Crossing Watermain/Wastewater

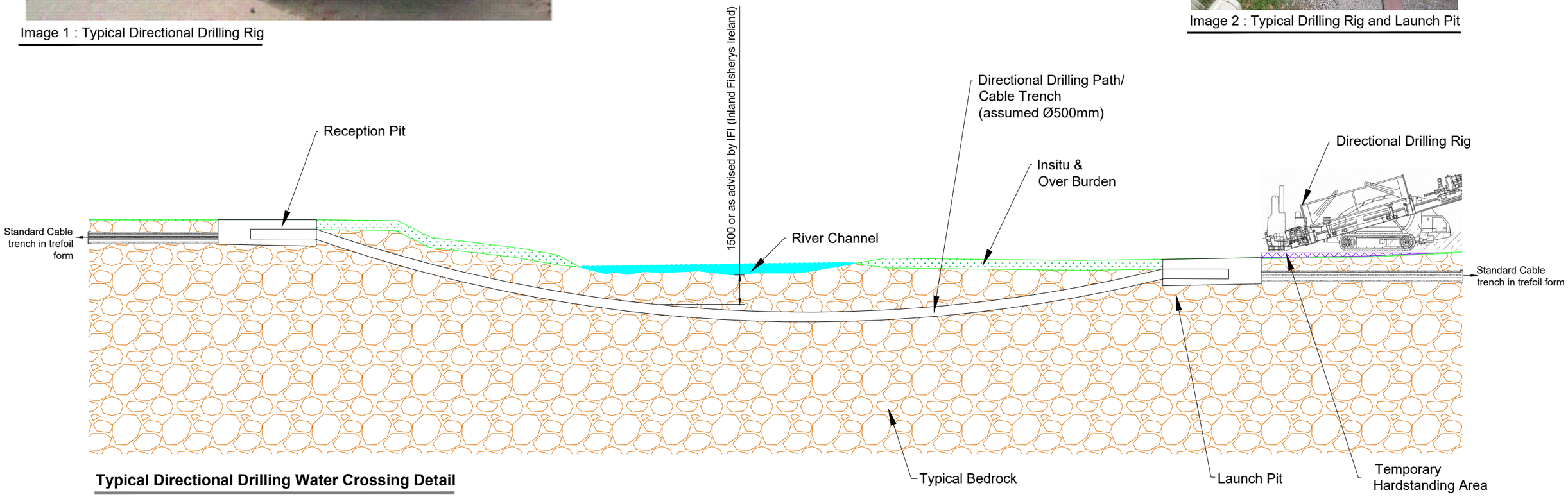
SHEET NUMBER

05641-225

Project Management Initials: Designer: CH Checked: SK Approved: RG

Image 1 : Typical Directional Drilling Rig

Image 2 : Typical Drilling Rig and Launch Pit



Typical Directional Drilling Water Crossing Detail

SCALE - 1:200

tli GROUP
Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

CLIENT

COILLTE

PROJECT
Carrownagowan Wind Farm
110kV Grid Connection

PROJECT NUMBER
05-641

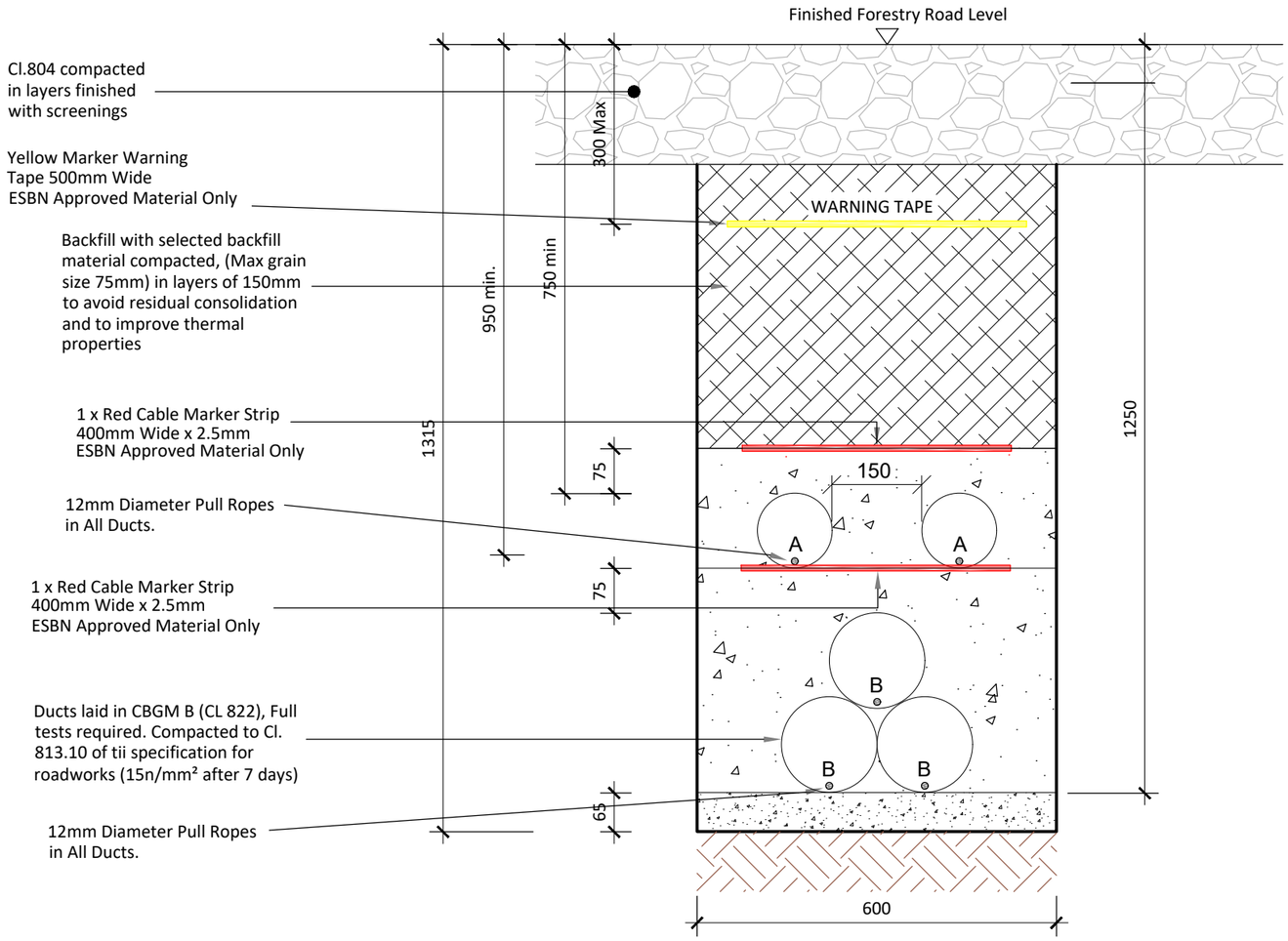
SHEET NUMBER
05641-227

SHEET TITLE
Typical Directional Drilling Water Crossing Detail

DRAWING STATUS
For Planning

ISSUE/REVISION

I/R	DATE	DESCRIPTION
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information



A = 125mm: Outer Diameter HDPE ESB Approved Duct, SDR=17.6

B= 160mm : Outer Diameter HDPE ESB Approved Duct, SDR=21

Typical Section Through Forestry Road

SCALE 1:10

Note:
- This drawing is to be read in conjunction with relevant drawings, specifications and reports
- Dimensions are in millimeters, unless noted otherwise
- Drawings are not to be scaled use figured dimensions only

ALL REINSTATEMENT WORKS ARE TO BE IN ACCORDANCE WITH LANDOWNERS REQUIREMENTS

tli GROUP
Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

CLIENT
COILLTE

PROJECT
Carrownagowan Wind Farm
110 kV Grid Connection

PROJECT NUMBER
05-641

SHEET NUMBER
05641-228

SHEET TITLE
Typical Ducting through Forestry Road - Section and Elevation

DRAWING STATUS
For Planning

ISSUE/REVISION

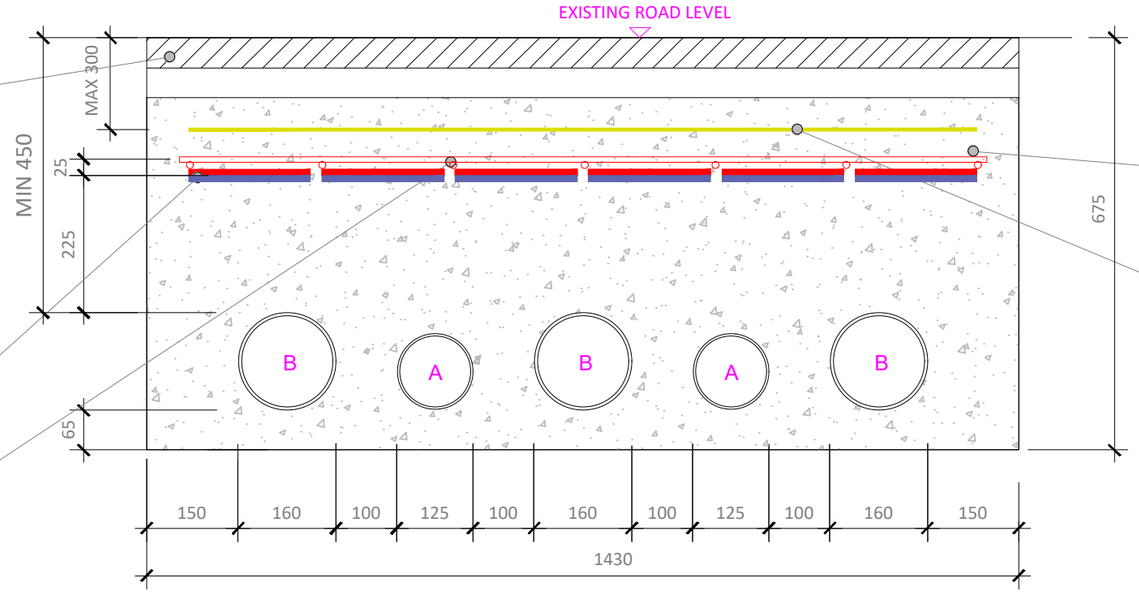
I/R	DATE	DESCRIPTION
02	18.05.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

Road reinstatement to be in accordance with *Guidelines for Managing Openings in Public Roads* (Purple Book - April 2017).

450mm is the minimum acceptable clearance dimension from the road surface to the top of the highest cable duct where the cable trench is in the carriageway

Heavy duty 6x200mm wide galvanized steel plates with red marker strips fixed to the top surface and to be installed until standard cover is achieved over hv ducts and communication ducts

A393 mesh to be installed until standard cover is achieved over hv ducts and communication ducts



C25/30 concrete to be in accordance with specification for road works 1000. 20mm max size of aggregate, with minimum duct spacing of 75mm. Min. cover to steel - 50mm.

4 X 400mm ESBN yellow warning tape across full width of trench

A = 125mm: Outer Diameter HDPE ESB Approved Duct, SDR=17.6

B= 160mm : Outer Diameter HDPE ESB Approved Duct, SDR=21

Typical Section Through Ducting in Flat Formation

SCALE 1:10

Note:
- This drawing is to be read in conjunction with relevant drawings, specifications and reports
- Dimensions are in millimeters, unless noted otherwise
- Drawings are not to be scaled use figured dimensions only

ALL REINSTATEMENT WORKS ARE TO BE IN ACCORDANCE WITH LOCAL AREA ENGINEERS LANDOWNERS REQUIREMENTS AND GUIDELINES FOR MANAGING OPENINGS IN PUBLIC ROADS

tli GROUP
Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

CLIENT: COILLTE

PROJECT: Carrownagowan Wind Farm
110 kV Grid Connection

PROJECT NUMBER: 05-641

SHEET NUMBER: 05641-229

SHEET TITLE: Typical Section Through Ducting in Flat Formation

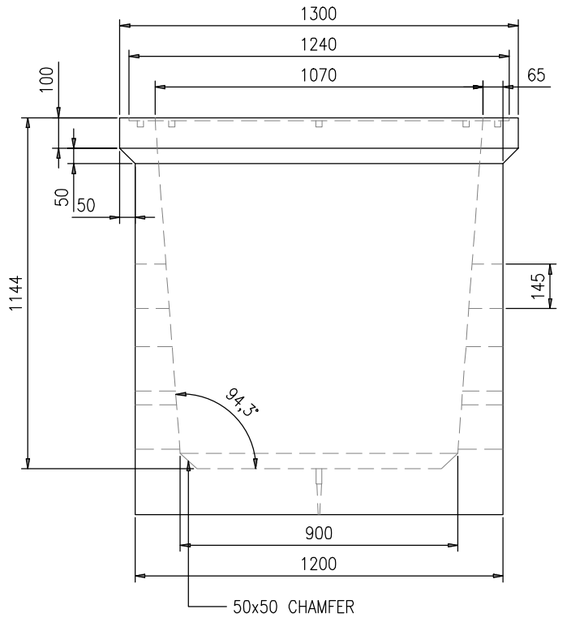
DRAWING STATUS: For Planning

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	18.05.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

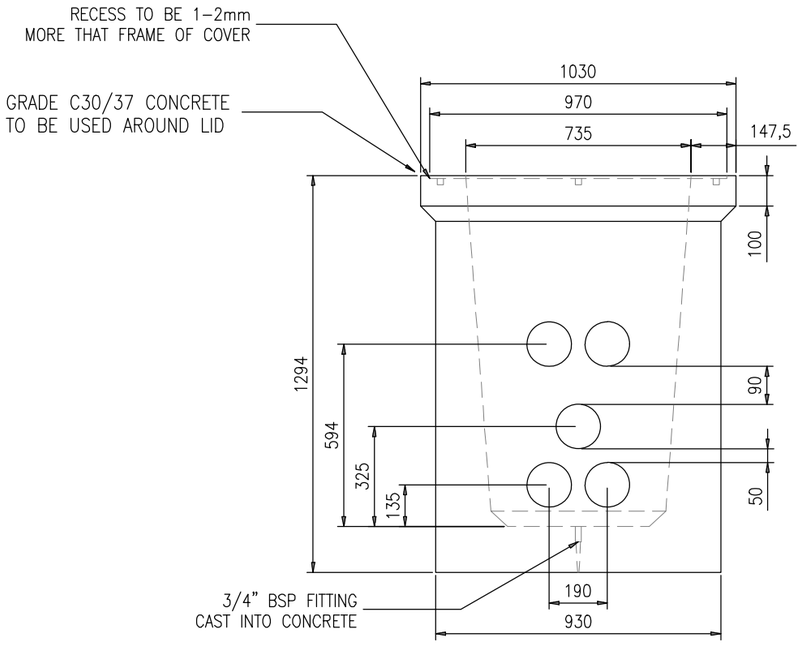
NOTES:

1. This drawing is to be read in conjunction with relevant drawings, specifications and reports.
2. Dimensions are in millimetres, unless noted otherwise.
3. Drawings are not to be scaled use figured dimensions only.
4. Reinstatement to comply with requirements of the relevant local Authority/Asset owner
5. Entrance & Exit ducts to be in line
6. All material and workmanship to be in accordance with the NRA./TII specification for Roadworks, May 2005 and subsequent revisions
7. Reinforced concrete to be a minimum grade C32/40, Sulphate resisting cement to be used where aggressive soil conditions apply, refer to table 6.1 of B.S. 8110.
8. Carraigeway covers and frames to be to B.S. 124.
9. All covers to have ESB logo incorporated in them to the approval of Eirgrid
10. Step irons to be hot dipped glvanised to B.S. 729 and positioned as shown on any chamber deeper than 700mm on the end remote from any side entry duct.
11. Concrete precast chamber and cover should be tested through a 5 point 40 tonnes vertical static loading test by an independent test company, if required, further details will be provided by Eirgrid.
12. Final position of C2 chambers shall be agreed with Eirgrid.
13. In a forest environment backfill with lean mix outside the cover frame.



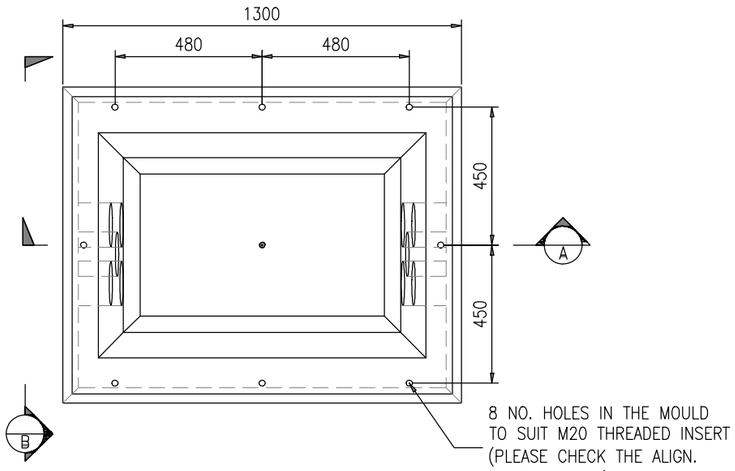
C2 Chamber Detail - Section A

SCALE 1:20



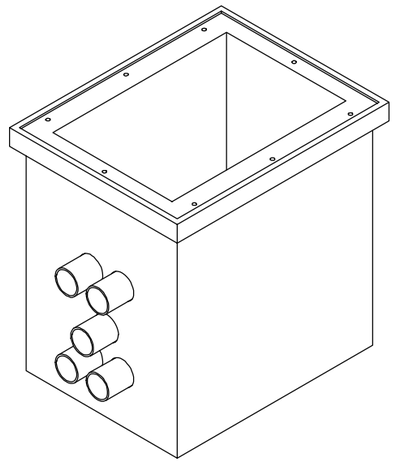
C2 Chamber Detail - Section B

SCALE 1:20



Typical Plan of Joint Bay

SCALE 1:20



Isometric : C2 Chamber Arrangement

SCALE 1:20

tli GROUP
Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

CLIENT
COILLTE

PROJECT
Carrownagowan Wind Farm
110kV Grid Connection

PROJECT NUMBER
05-641

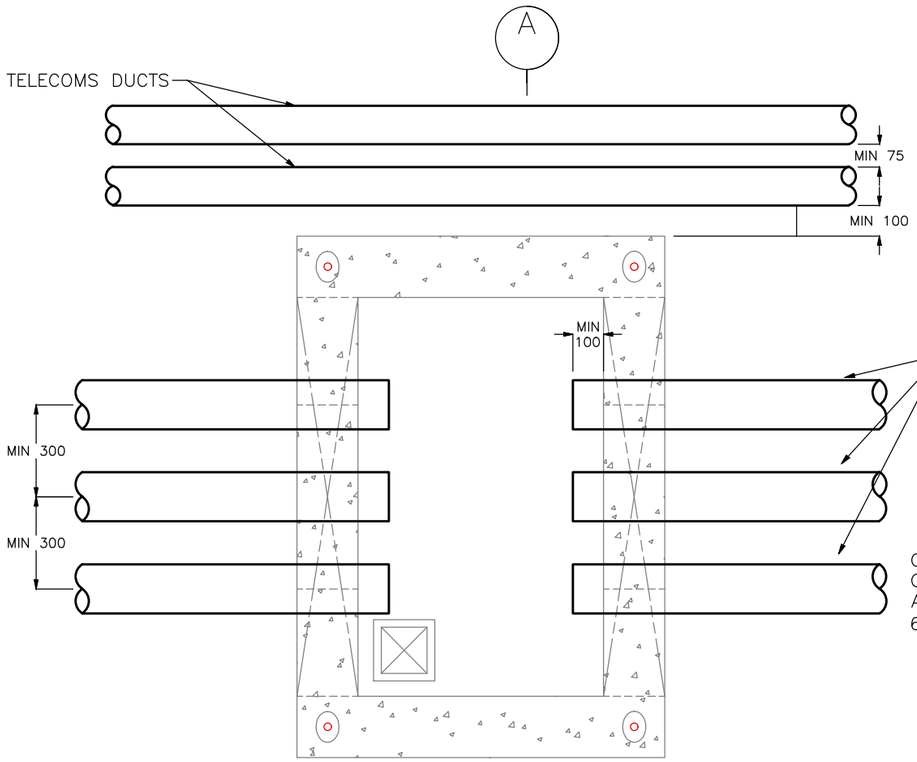
SHEET NUMBER
05641-230

SHEET TITLE
Typical Communications Chamber Details

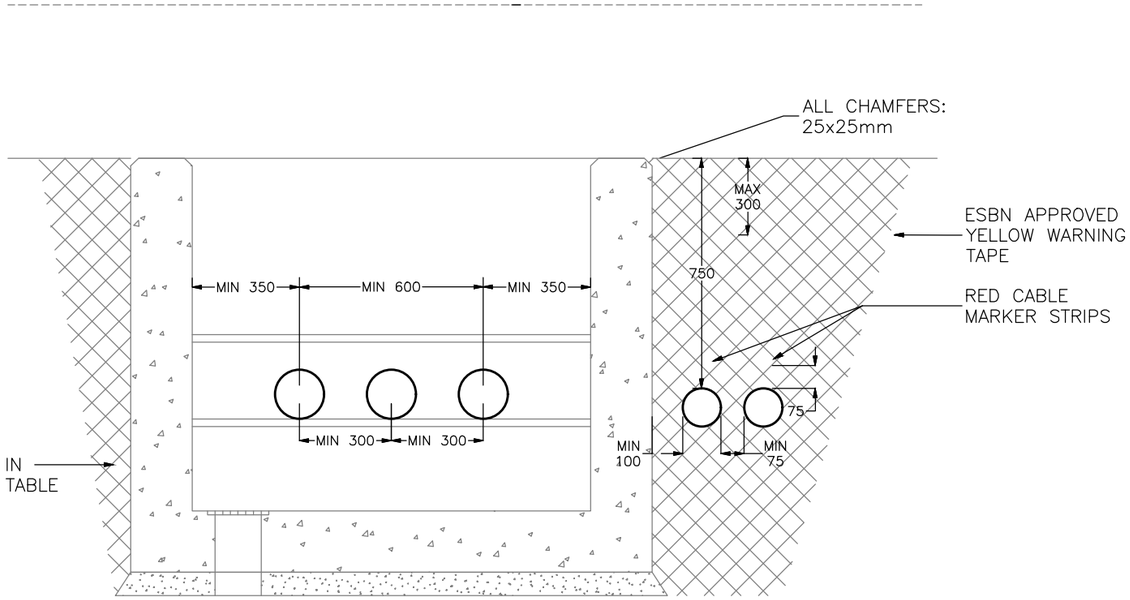
DRAWING STATUS
For Planning

ISSUE/REVISION

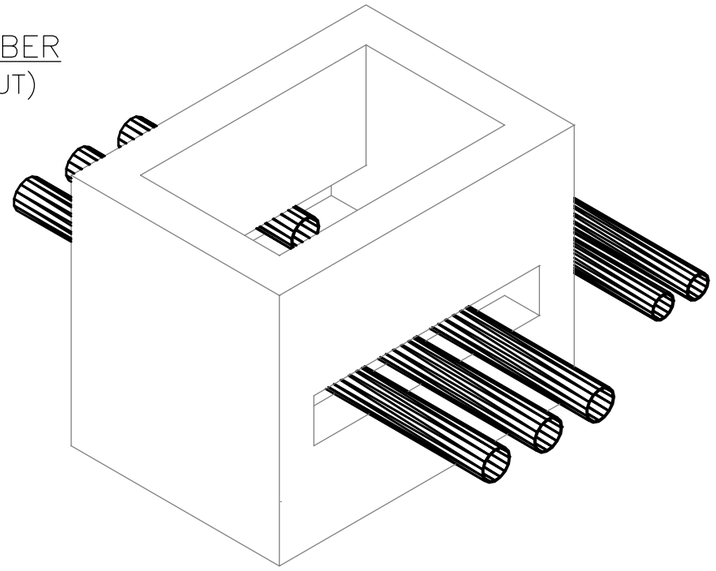
I/R	DATE	DESCRIPTION
02	18.05.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information



PLAN – TRANSITION CHAMBER
SCALE 1:20 (DUCT SETTING OUT)



SECTION A
SCALE 1:20



NOTES:

1. This drawing is to be read in conjunction with relevant drawings, specifications and reports.
2. Dimensions are in millimetres, unless noted otherwise.
3. Drawings are not to be scaled use figured dimensions only.
4. Telecomunication ducts not to be routed through Transition chamber
5. If Trnasition chamber is used to interface with a HDD section, Then the telecoms duct SDR 17.6 should be chamfered when coupled with SDR 11 ducts

tli GROUP
Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

CLIENT
COILLTE

PROJECT
Carrownagowan Wind Farm
110kV Grid Connection

PROJECT NUMBER
05-641

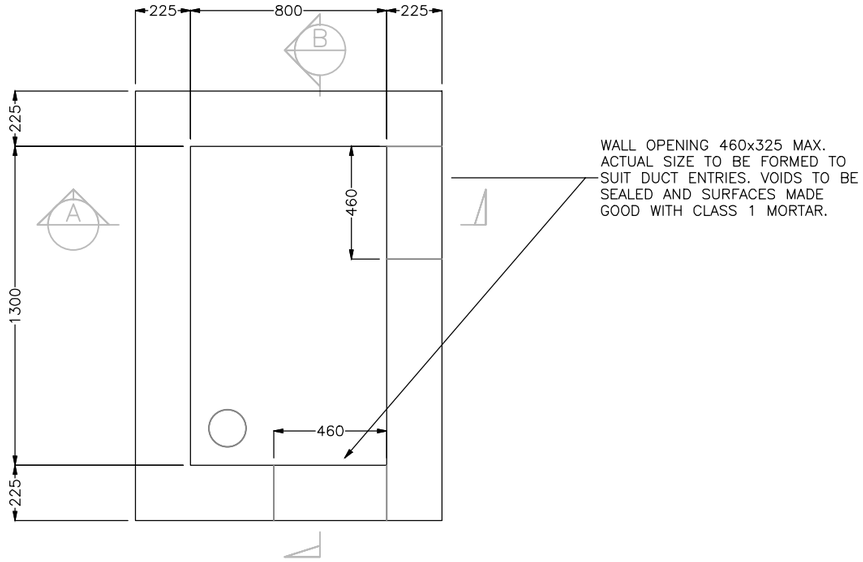
SHEET NUMBER
05641-243

SHEET TITLE
Typical Transition Chamber Details

DRAWING STATUS
For Planning

ISSUE/REVISION

I/R	DATE	DESCRIPTION
00	18.05.20	Issued for Planning

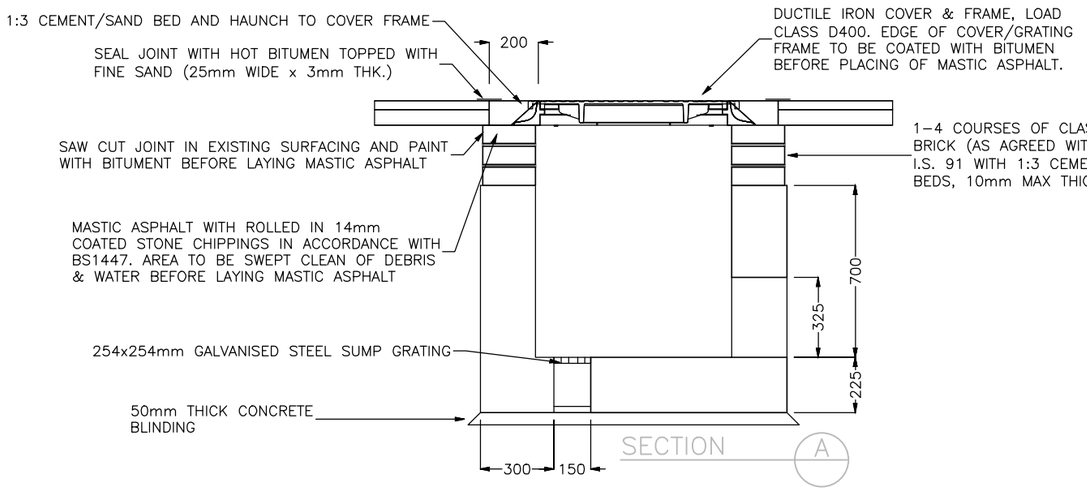


Link Box Chamber Detail - Plan

SCALE 1:20

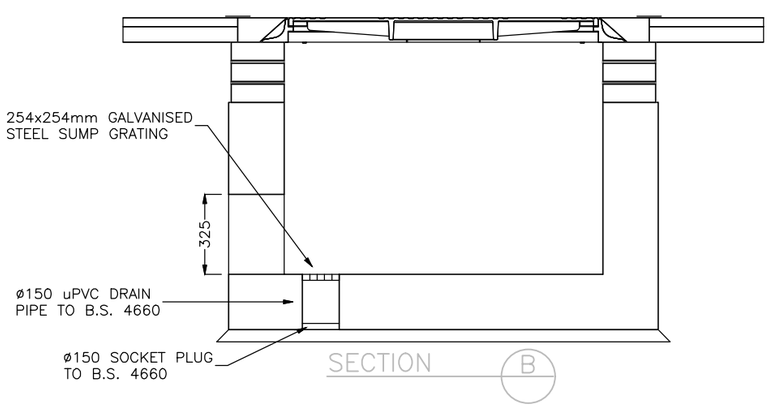
NOTES:

1. This drawing is to be read in conjunction with relevant drawings, specifications and reports.
2. Dimensions are in millimeters, unless noted otherwise.
3. Drawings are not to be scaled use figured dimensions only.
4. All material and workmanship to be in accordance with the NRA./TII specification for Roadworks, May 2005 and subsequent revisions
5. Reinforced concrete to be a minimum grade C32/40, Sulphate resisting cement to be used where aggressive soil conditions apply.
6. Carriageway covers and frames to be to B.S. 124.
7. All covers to have ESB logo incorporated in them to the approval of Eirgrid
8. Brickwork to be class B Engineering, beds and Joints to be class 1 mortar
9. Final position of Link Box to be agreed with Eirgrid prior to installation



Link Box Chamber Detail - Section A-A

SCALE 1:20



Link Box Chamber Detail - Section B-B

SCALE 1:20

tli GROUP
Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

CLIENT

COILLTE

PROJECT
Carrownagowan Wind Farm
110kV Grid Connection

PROJECT NUMBER
05-641

SHEET NUMBER
05641-244

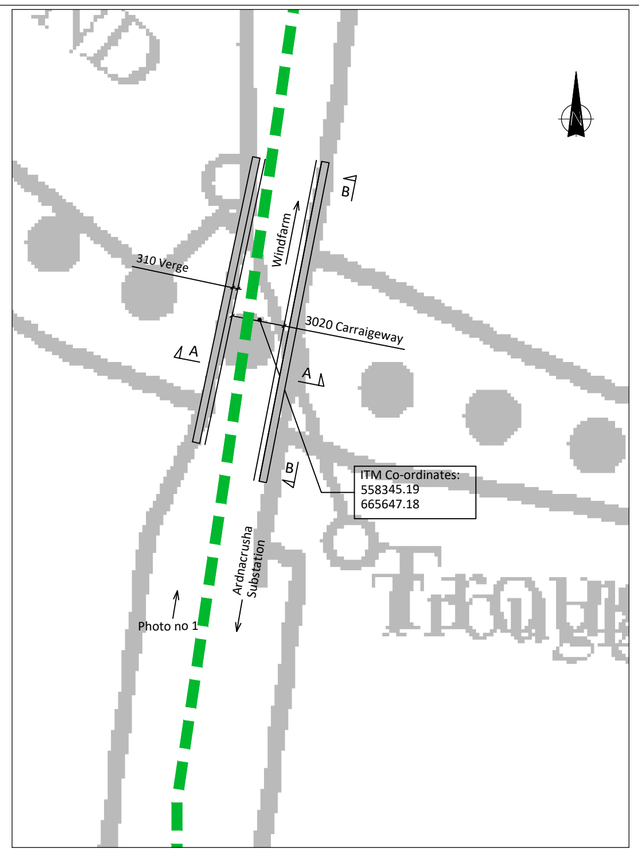
SHEET TITLE
Typical Link Box Chamber Details

DRAWING STATUS
For Planning

ISSUE/REVISION

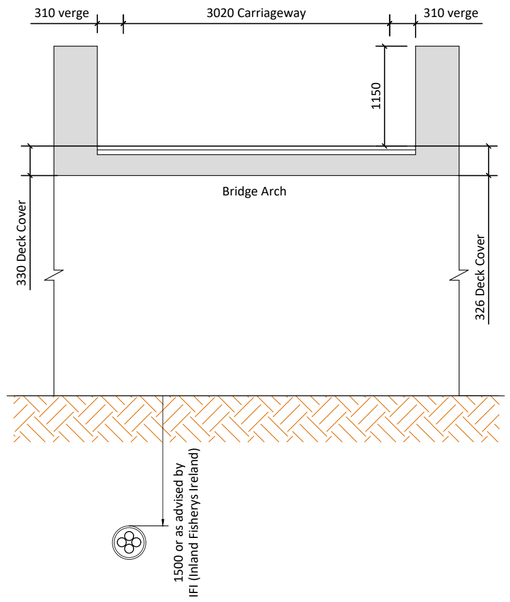
I/R	DATE	DESCRIPTION
00	18.05.20	Issued for Planning

ISO A2 420mm x 594mm



Plan View Bridge No 1

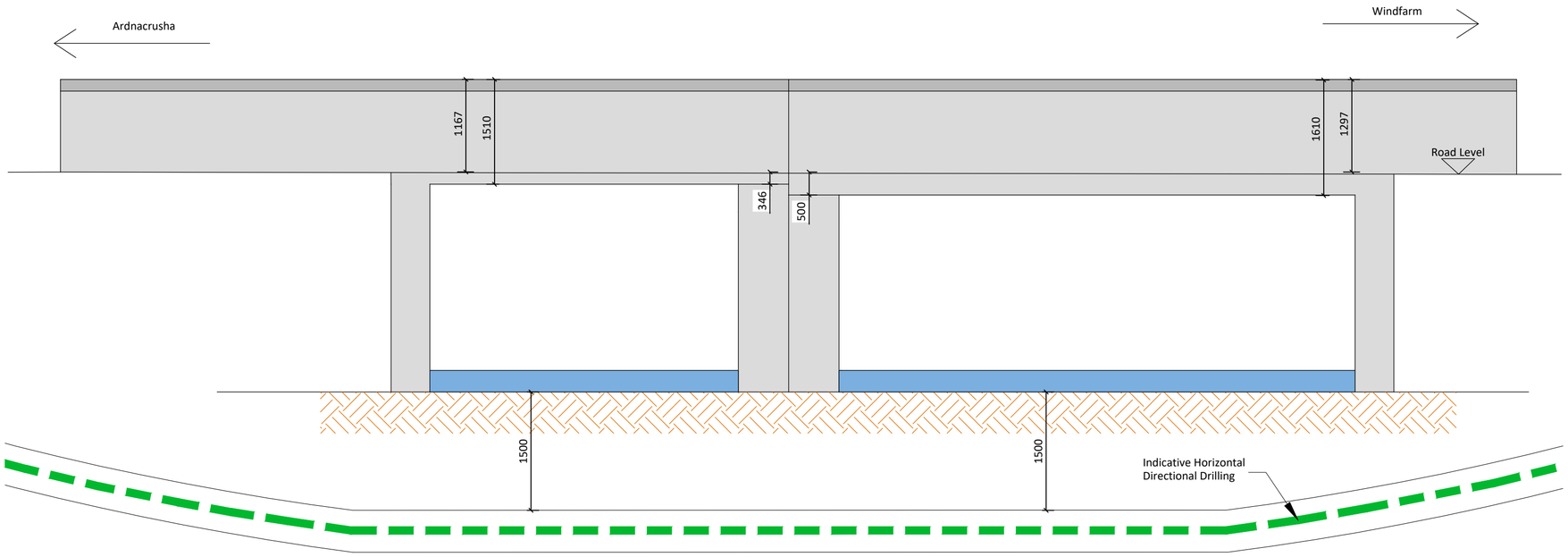
Scale : 1:250



Section A-A

Scale : 1:50

Photo No 1



Section B-B

Scale : NTS

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh, Abbeydorney,
Tralee, Co. Kerry, Ireland
Tel: 00353 66 7135710

PROJECT

Carrowanagowan Windfarm
110kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

- No structural bridge surveys have been carried out and the proposal s are subject to detailed design.
- Bridge crossing designs will be submitted to Clare Co. Council for review.
- Drawings are in compliance with ESBN specification requirements for shallow formation, bridge crossings, etc.
- HDD launch and reception pits locations to be determined following site investigations.

LEGEND: -

Proposed 110kV UGC Design Route

ISSUE/REVISION

01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

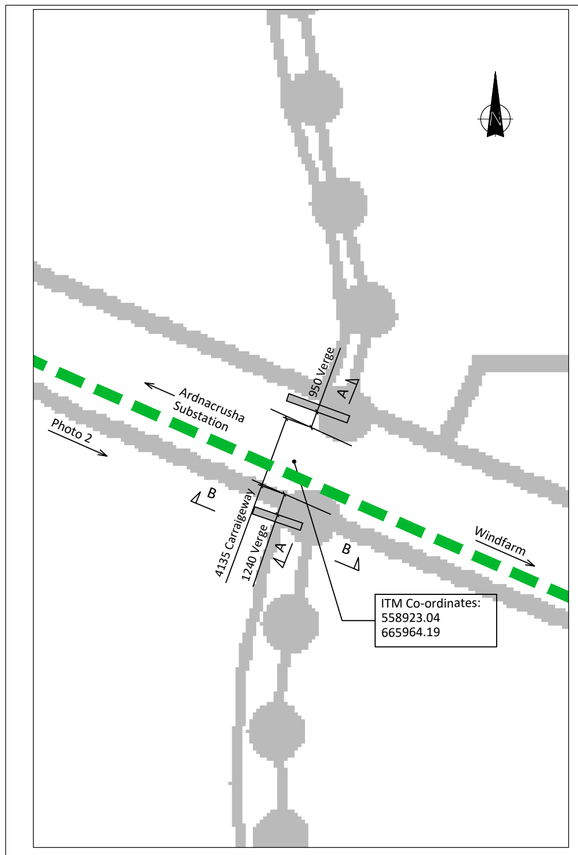
SHEET TITLE

Bridge 1 - Proposed Crossing Details

SHEET NUMBER

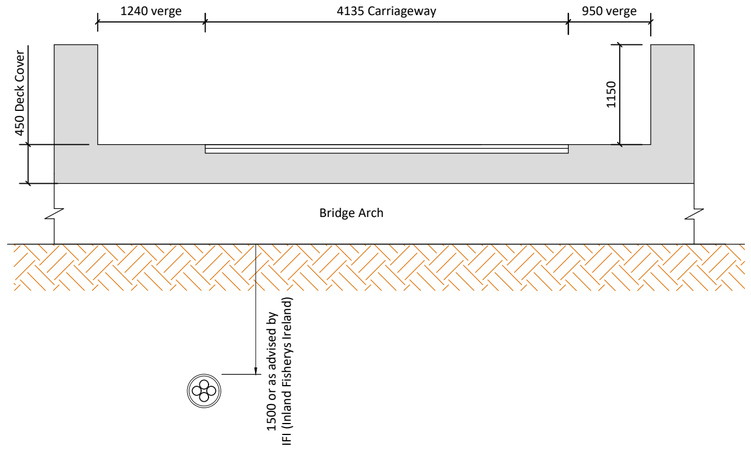
05641-231

ISO A2 420mm x 594mm



Plan View Bridge No 2

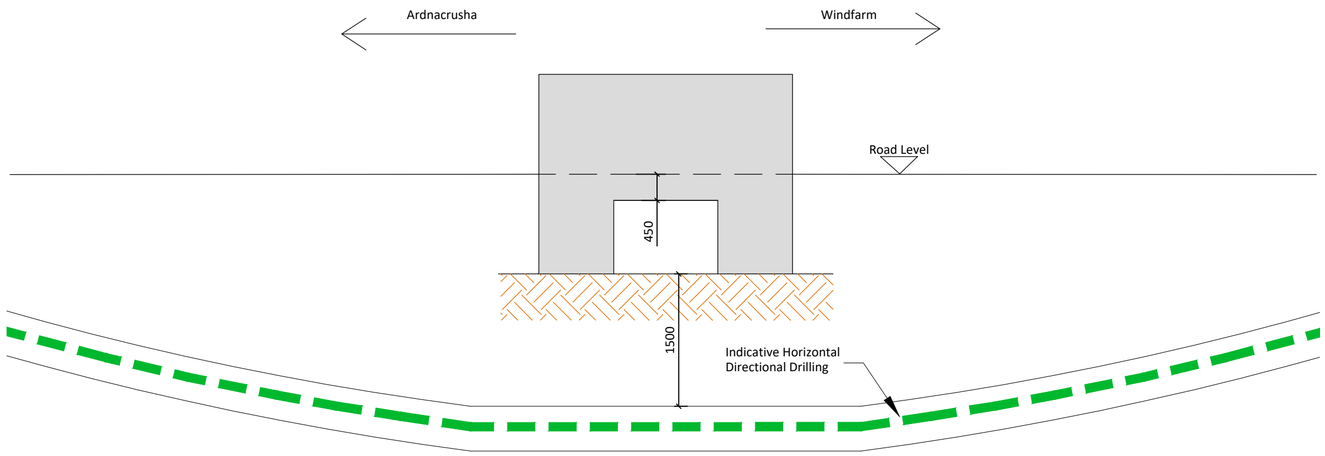
Scale : 1:250



Section A-A

Scale : 1:50

Photo No 2



Section B-B

Scale : NTS

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh, Abbeydorney,
Tralee, Co. Kerry, Ireland
Tel: 00353 66 7135710

PROJECT

Carrowanagowan Windfarm
110kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

- No structural bridge surveys have been carried out and the proposal s are subject to detailed design.
- Bridge crossing designs will be submitted to Clare Co. Council for review.
- Drawings are in compliance with ESBN specification requirements for shallow formation, bridge crossings, etc.
- HDD launch and reception pits locations to be determined following site investigations.

LEGEND: -

Proposed 110kV UGC Design Route

ISSUE/REVISION

I/R	DATE	DESCRIPTION
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

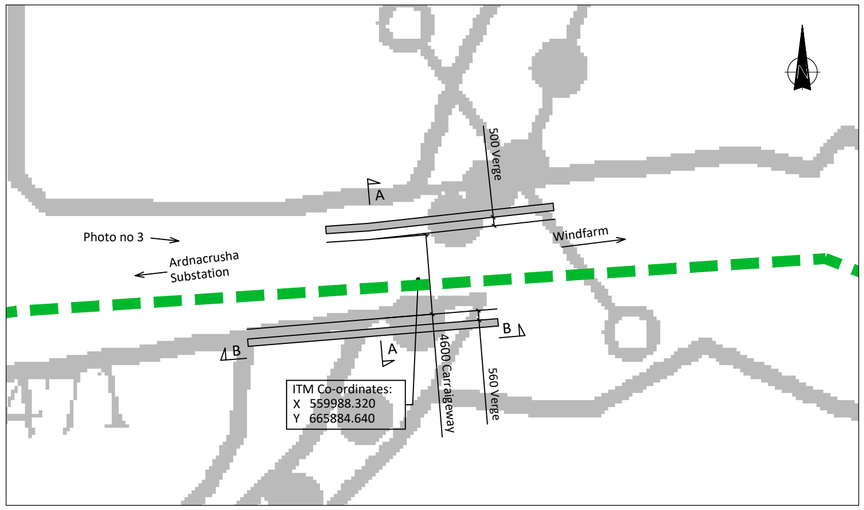
SHEET TITLE

Bridge 2 - Proposed Crossing Details

SHEET NUMBER

05641-232

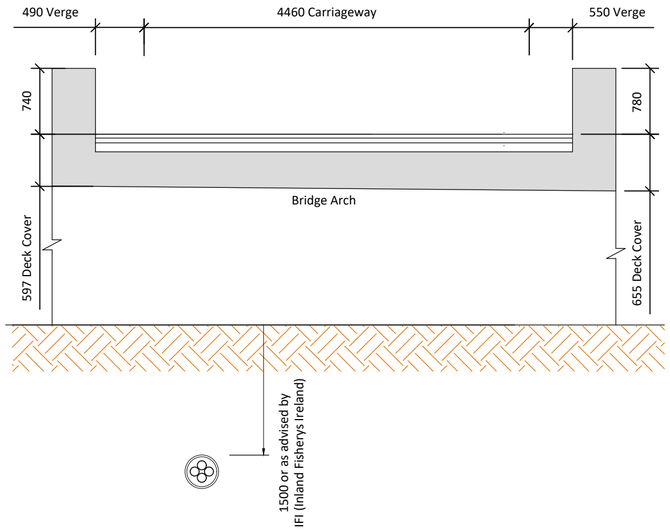
ISO A2 420mm x 594mm



Plan View Bridge No 3

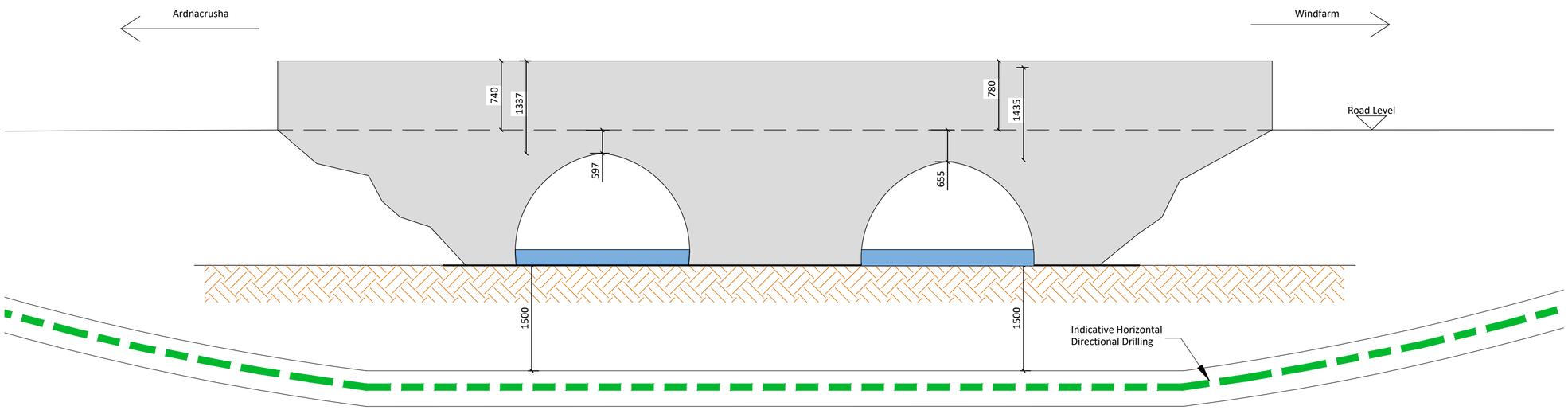
Scale : 1:250

Photo No 3



Section A-A

Scale : 1:50



Section B-B

Scale: NTS

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh, Abbeydorney,
Tralee, Co. Kerry, Ireland
Tel: 00353 66 7135710

PROJECT

Carrowanagowan Windfarm
110kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

- No structural bridge surveys have been carried out and the proposal s are subject to detailed design.
- Bridge crossing designs will be submitted to Clare Co. Council for review.
- Drawings are in compliance with ESBN specification requirements for shallow formation, bridge crossings, etc.
- HDD launch and reception pits locations to be determined following site investigations.

LEGEND: -

Proposed 110kV UGC Design Route

ISSUE/REVISION

I/R	DATE	DESCRIPTION
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

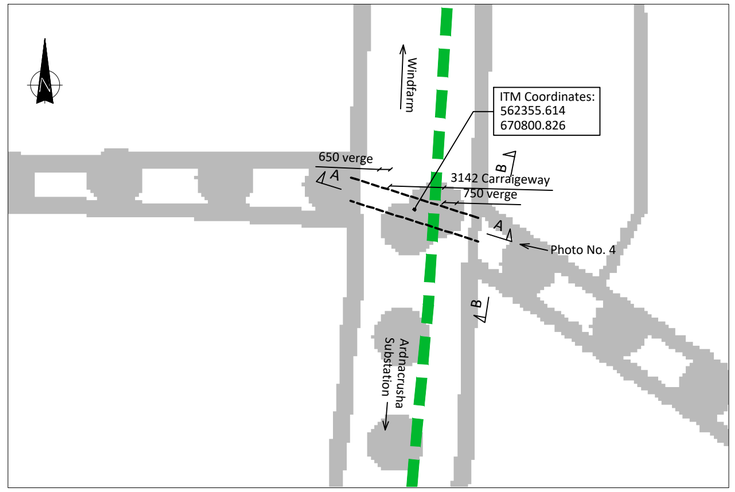
05-641

SHEET TITLE

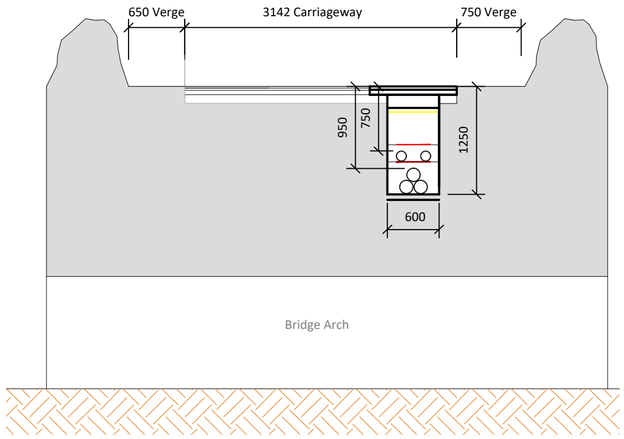
Bridge 3 - Proposed Crossing Details

SHEET NUMBER

05641-233

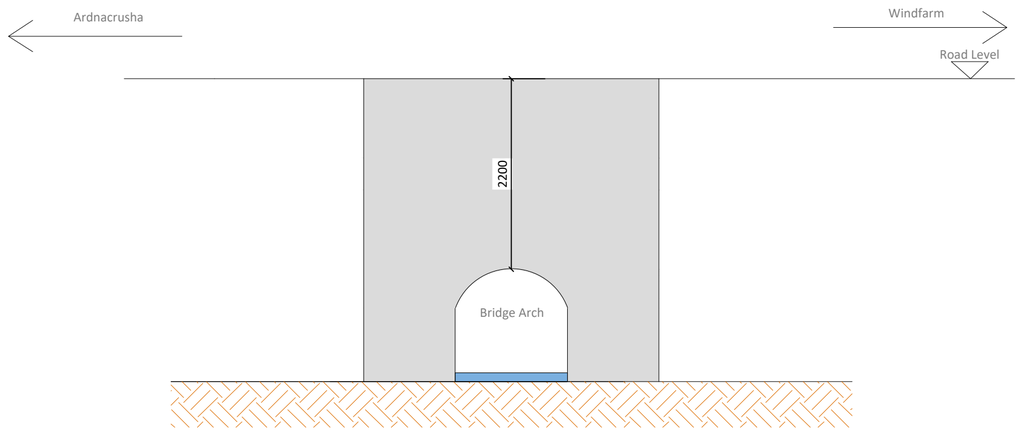


Plan View Bridge No 4
Scale : 1:250



Section A-A
Scale : 1:50

Photo No. 4



Section B-B
Scale : 1:50

tli GROUP
Head Office
Beenreigh, Abbeydorney,
Tralee, Co. Kerry, Ireland
Tel: 00353 66 7135710

PROJECT

Carrowanagowan Windfarm
110kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

- No structural bridge surveys have been carried out and the proposal s are subject to detailed design.
- Bridge crossing designs will be submitted to Clare Co. Council for review.
- Drawings are in compliance with ESBN specification requirements for shallow formation, bridge crossings, etc.

LEGEND: -

Proposed 110kV UGC Design Route

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	18.05.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

SHEET TITLE

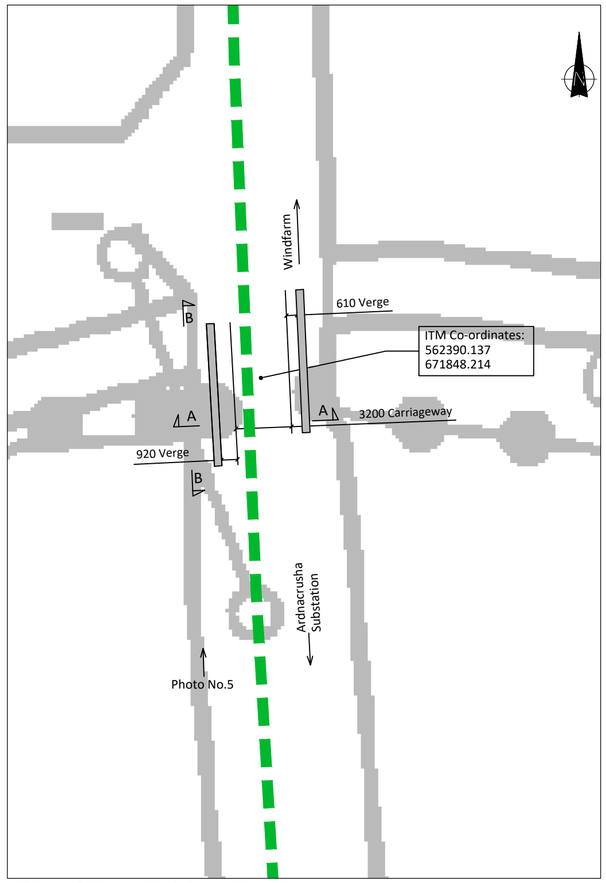
Bridge 4 - Proposed Crossing Details

SHEET NUMBER

05641-234

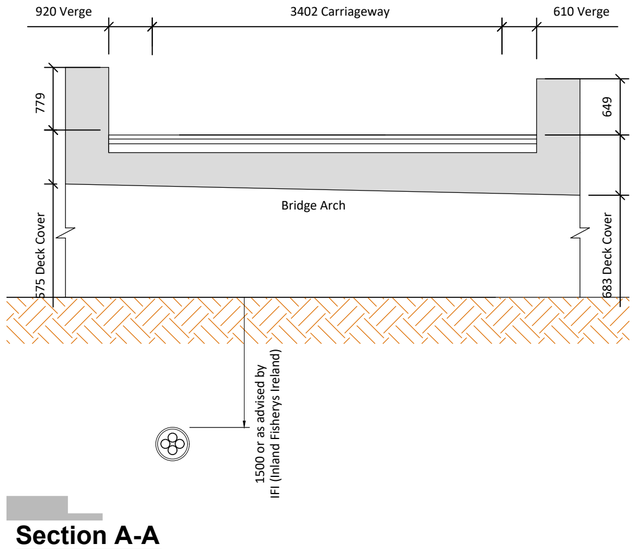
Project Management Initials: Designer: CH Checked: SK Approved: RG

ISO A2 420mm x 594mm



Plan View Bridge No 5

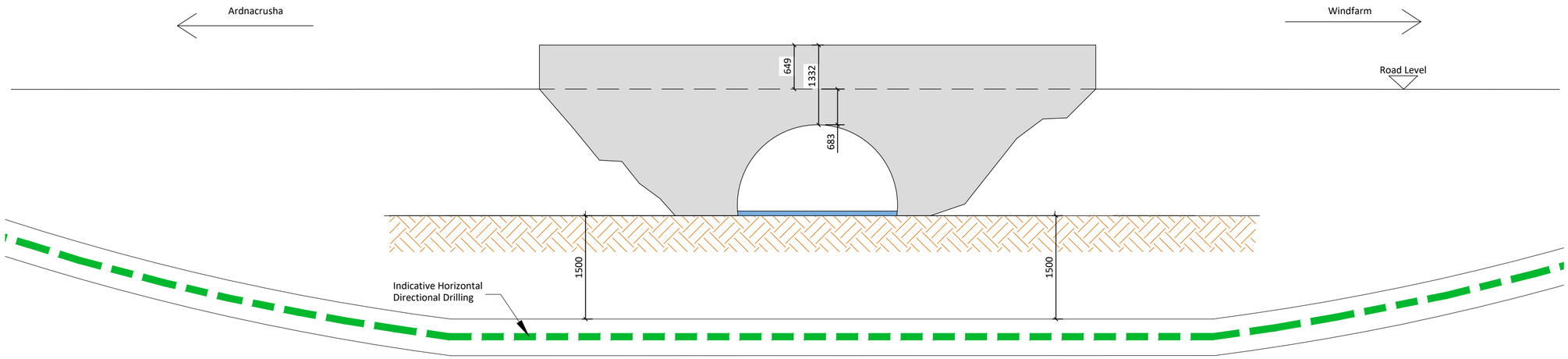
Scale : 1:250



Section A-A

Scale : 1:50

Photo No. 5



Section B-B

Scale : NTS

tli GROUP

Head Office
Beenreigh, Abbeydorney,
Tralee, Co. Kerry, Ireland
Tel: 00353 66 7135710

PROJECT

Carrowanagowan Windfarm
110kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

- No structural bridge surveys have been carried out and the proposal s are subject to detailed design.
- Bridge crossing designs will be submitted to Clare Co. Council for review.
- Drawings are in compliance with ESBN specification requirements for shallow formation, bridge crossings, etc.
- HDD launch and reception pits locations to be determined following site investigations.

LEGEND: -

Proposed 110kV UGC Design Route

ISSUE/REVISION

I/R	DATE	DESCRIPTION
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

SHEET TITLE

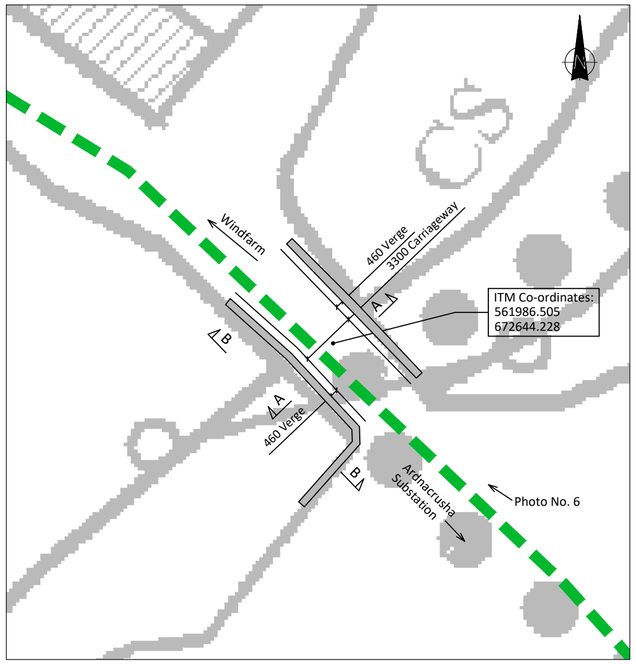
Bridge 5 - Proposed Crossing Details

SHEET NUMBER

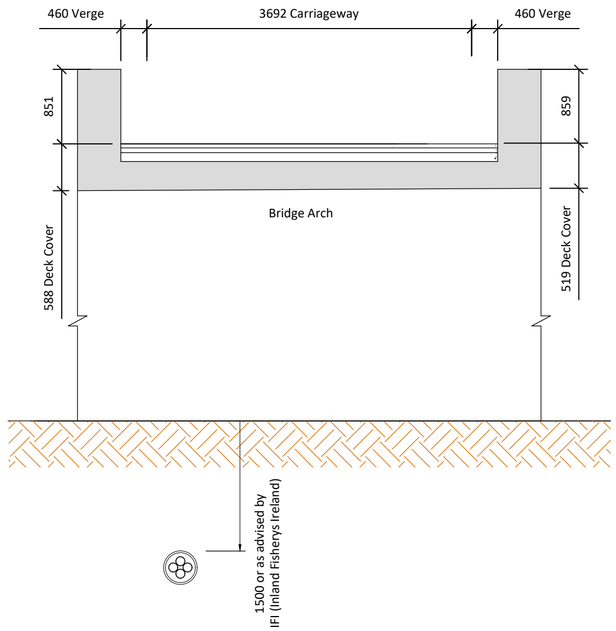
05641-235

Project Management Initials: Designer: CH Checked: SK Approved: RG

ISO A2 420mm x 594mm

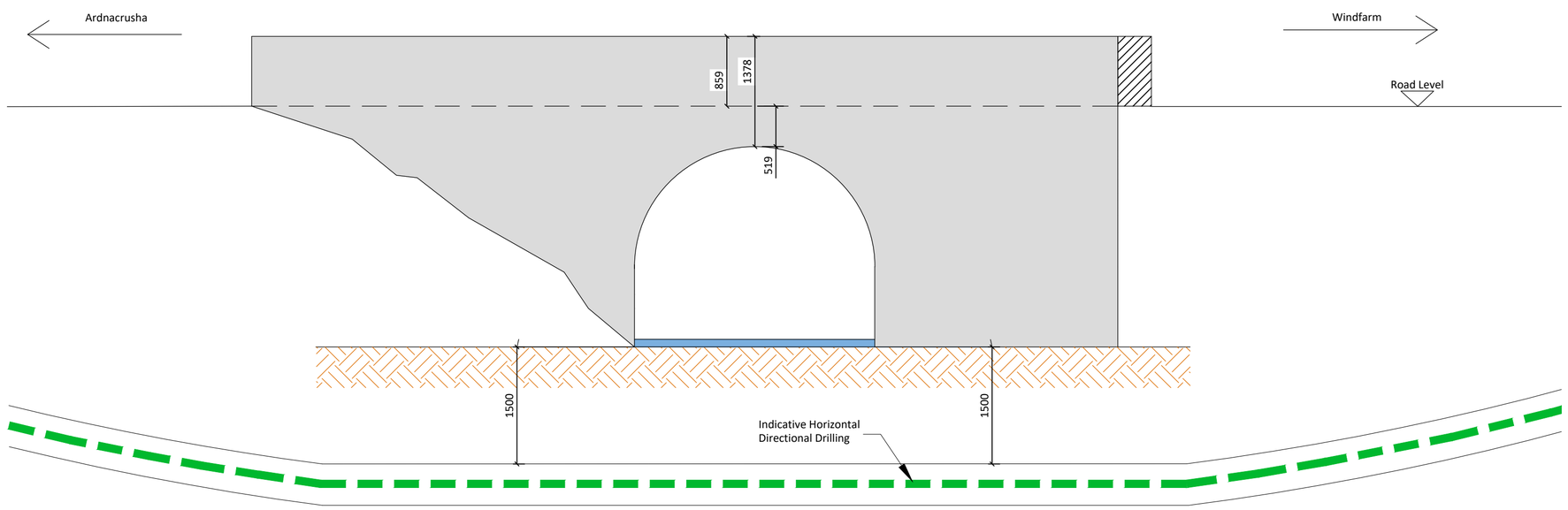


Plan View Bridge No 6
Scale : 1:250



Section A-A
Scale : 1:50

Photo No. 6



Section B-B
Scale : NTS

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh, Abbeydorney,
Tralee, Co. Kerry, Ireland
Tel: 00353 66 7135710

PROJECT

Carrowanagowan Windfarm
110kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

- No structural bridge surveys have been carried out and the proposal s are subject to detailed design.
- Bridge crossing designs will be submitted to Clare Co. Council for review.
- Drawings are in compliance with ESBN specification requirements for shallow formation, bridge crossings, etc.
- HDD launch and reception pits locations to be determined following site investigations.

LEGEND: -

Proposed 110kV UGC Design Route

ISSUE/REVISION

I/R	DATE	DESCRIPTION
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

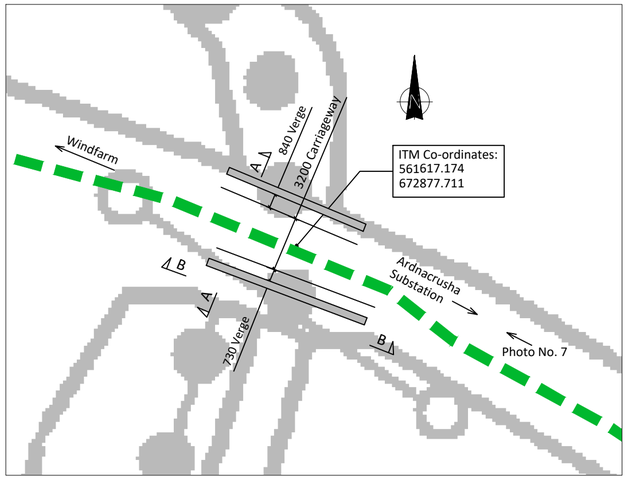
SHEET TITLE

Bridge 6 - Proposed Crossing Details

SHEET NUMBER

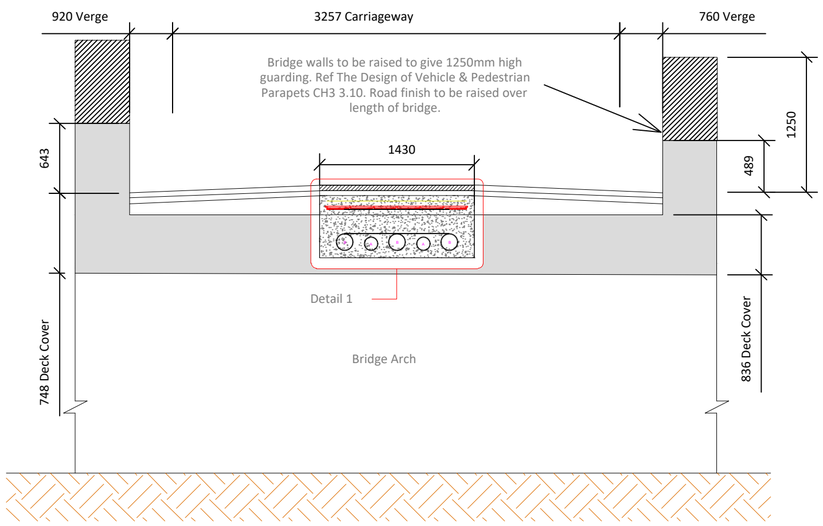
05641-236

ISO A2 420mm x 594mm

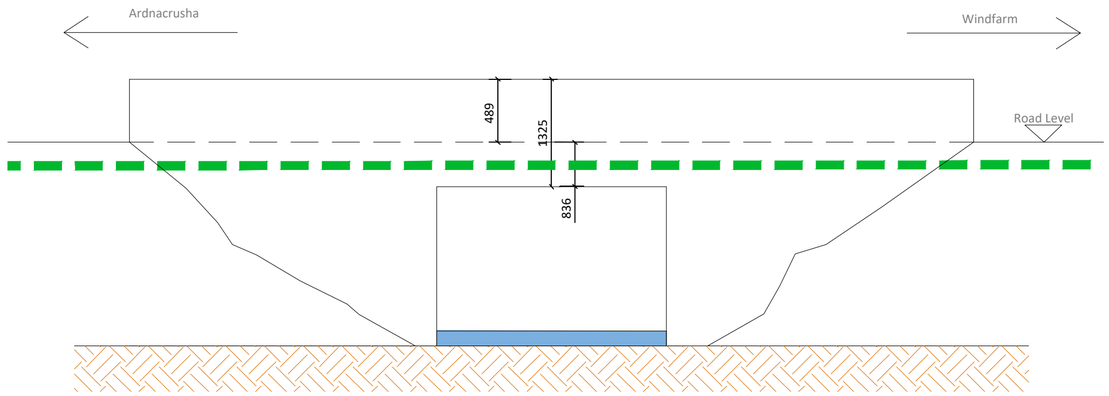


Plan View Bridge No 7
Scale : 1:250

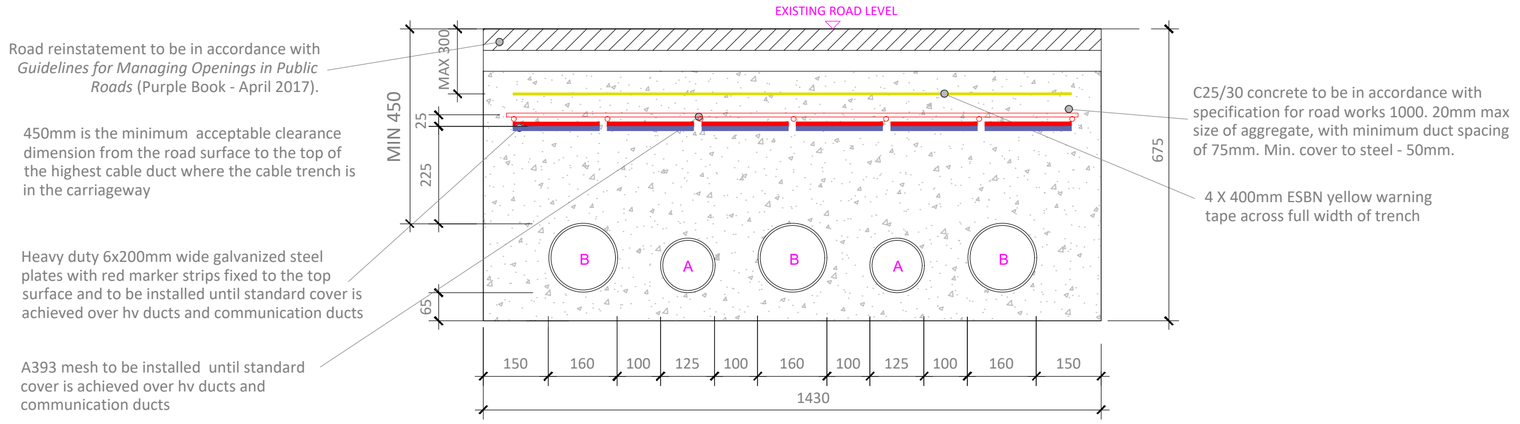
Photo No. 7



Section A-A
Scale : NTS



Section B-B
Scale : NTS



Detail 1
Scale : 1:10

A = 125mm: Outer Diameter HDPE ESB Approved Duct, SDR=17.6
B= 160mm : Outer Diameter HDPE ESB Approved Duct, SDR=21

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP
Head Office
Beenreigh, Abbeydorney,
Tralee, Co. Kerry, Ireland
Tel: 00353 66 7135710

PROJECT

Carrowanagowan Windfarm
110kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

- No structural bridge surveys have been carried out and the proposal s are subject to detailed design.
- Bridge crossing designs will be submitted to Clare Co. Council for review.
- Drawings are in compliance with ESBN specification requirements for shallow formation, bridge crossings, etc.

LEGEND: -

Proposed 110kV UGC Design Route

ISSUE/REVISION

02	18.05.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

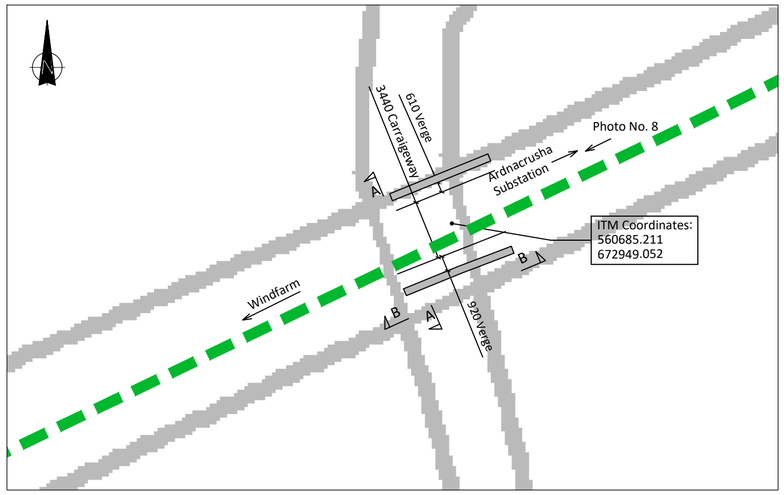
SHEET TITLE

Bridge 7 - Proposed Crossing Details

SHEET NUMBER

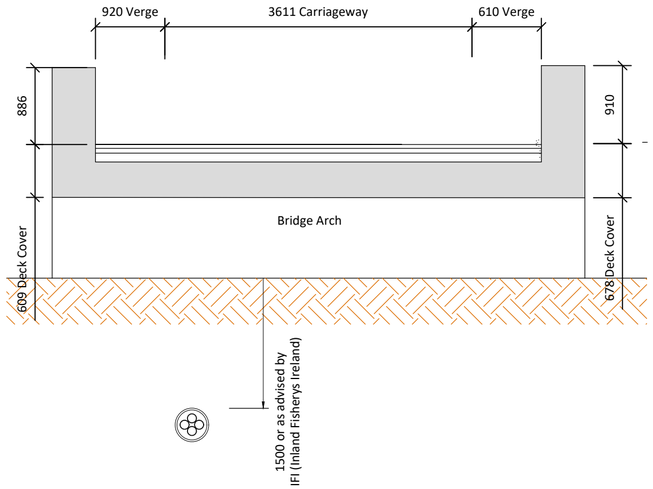
05641-237

ISO A2 420mm x 594mm



Plan View Bridge No 8

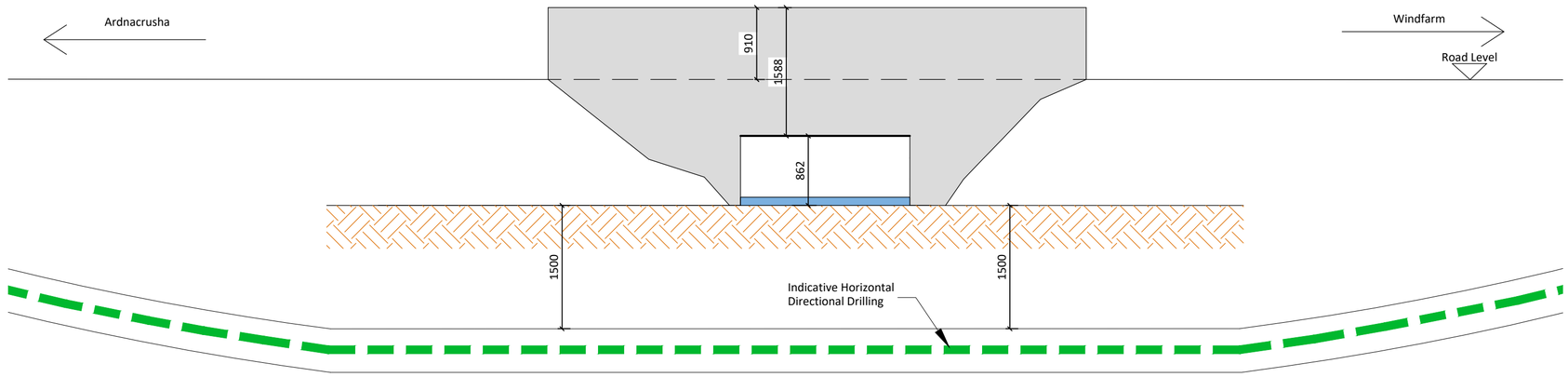
Scale : 1:250



Section A-A

Scale : 1:50

Photo No. 8



Section B-B

Scale : 1:50

tli GROUP

Head Office
Beenreigh, Abbeydorney,
Tralee, Co. Kerry, Ireland
Tel: 00353 66 7135710

PROJECT

Carrowanagowan Windfarm
110kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

- No structural bridge surveys have been carried out and the proposal s are subject to detailed design.
- Bridge crossing designs will be submitted to Clare Co. Council for review.
- Drawings are in compliance with ESBN specification requirements for shallow formation, bridge crossings, etc.
- HDD launch and reception pits locations to be determined following site investigations.

LEGEND: -

Proposed 110kV UGC Design Route

ISSUE/REVISION

I/R	DATE	DESCRIPTION
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

SHEET TITLE

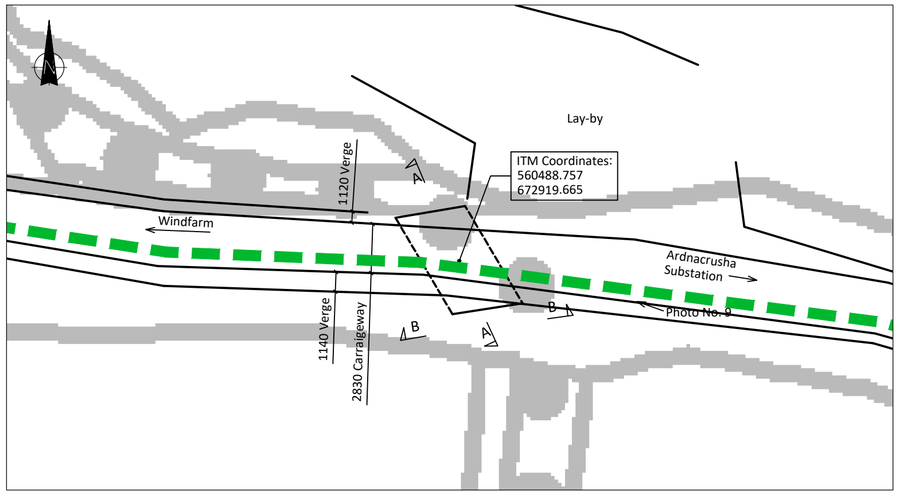
Bridge 8 - Proposed Crossing Details

SHEET NUMBER

05641-238

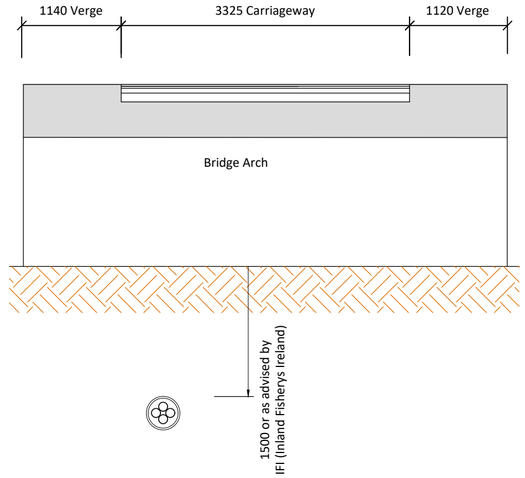
Project Management Initials: Designer: CH Checked: SK Approved: RG

ISO A2 420mm x 594mm



Plan View Bridge No 9

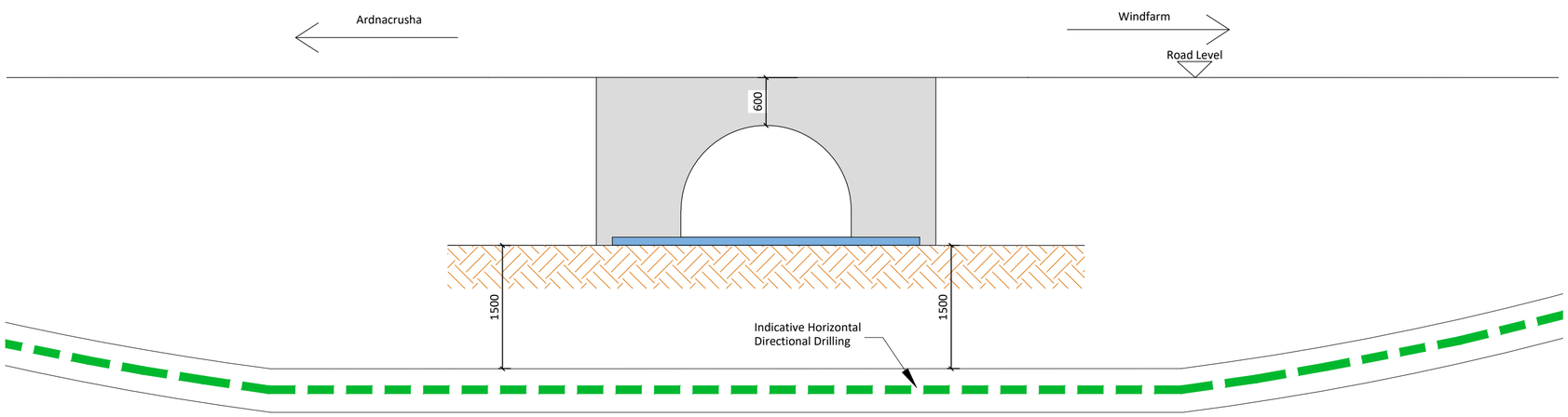
Scale : 1:250



Section A-A

Scale : 1:50

Photo No. 9



Section B-B

Scale : 1:50

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh, Abbeydorney,
Tralee, Co. Kerry, Ireland
Tel: 00353 66 7135710

PROJECT

Carrowanagowan Windfarm
110kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

- No structural bridge surveys have been carried out and the proposal s are subject to detailed design.
- Bridge crossing designs will be submitted to Clare Co. Council for review.
- Drawings are in compliance with ESBN specification requirements for shallow formation, bridge crossings, etc.
- HDD launch and reception pits locations to be determined following site investigations.

LEGEND: -

Proposed 110kV UGC Design Route

ISSUE/REVISION

01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

SHEET TITLE

Bridge 9 - Proposed Crossing Details

SHEET NUMBER

05641-239

ISO A2 420mm x 594mm

Culvert Crossing Schedule

Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Proposed Crossing Methodology	Photo
1.	350 Ø	Concrete	900	UNDERCROSSING	
2.	300 Ø	HDPE	200	UNDERCROSSING	
3.	2x600 Ø	Concrete	1800	OVERCROSSING	
4.	600 wide x 800 deep	Stone	1000	UNDERCROSSING	
5.	600 Ø	HDPE	200	UNDERCROSSING	
6.	250 Ø	Concrete	500	UNDERCROSSING	
7.	600 Ø	Concrete	700	UNDERCROSSING	
8.	400 wide x 500 deep	Stone	900	UNDERCROSSING	
9.	600 wide x 500 deep	Stone	900	UNDERCROSSING	

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh, Abbeydorney,
Tralee, Co. Kerry, Ireland
Tel: 00353 66 7135710

PROJECT

Carrowanagowan Windfarm
110kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

- No structural surveys have been carried out and the proposals are subject to detailed design.
- Crossings are in compliance with ESBN & Eirgrid specification requirements for shallow formation, min depth, etc.
- Additional culverts may be encountered on the route.

LEGEND: -

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information

PROJECT NUMBER

05-641

SHEET TITLE

Proposed Culvert Crossings
Sheet 1 of 3

SHEET NUMBER

05641-240

ISO A2 420mm x 594mm

Culvert Crossing Schedule

Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Proposed Crossing Methodology	Photo
10.	600 Ø	HDPE	500	UNDERCROSSING	
11.	300 Ø	HDPE	600	UNDERCROSSING	
12.	2x750 Ø	HDPE	2000	OVERCROSSING	
15.	300 Ø 375 Ø	HDPE HDPE	600 700	UNDERCROSSING	
16.	375 Ø	HDPE	700	UNDERCROSSING	
17.	375 Ø	HDPE	650	UNDERCROSSING	
18.	375 Ø	HDPE	350	UNDERCROSSING	
19.	600 Ø	HDPE	800	UNDERCROSSING	

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh, Abbeydorney,
Tralee, Co. Kerry, Ireland
Tel: 00353 66 7135710

PROJECT

Carrowanagowan Windfarm
110kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

- No structural surveys have been carried out and the proposals are subject to detailed design.
- Crossings are in compliance with ESBN & Eirgrid specification requirements for shallow formation, min depth, etc.
- Additional culverts may be encountered on the route.

LEGEND: -

ISSUE/REVISION

02	27.03.20	Issued for Planning
01	29.11.19	Issued for Planning
00	04.03.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-641

SHEET TITLE

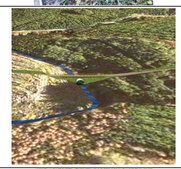
Proposed Culvert Crossings
Sheet 2 of 3

SHEET NUMBER

05641-241

ISO A2 420mm x 594mm

Culvert Crossing Schedule

Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Proposed Crossing Methodology	Photo
22.	600 Ø	Concrete	550	UNDERCROSSING	
23.	300 Ø	Concrete	600	UNDERCROSSING	
24.	250 Ø	HDPE	100	UNDERCROSSING	
25.		NEW CONCRETE ARCH CULVERT TO BE INSTALLED OVER RIVER		OVERCROSSING	
26.	450 Ø	CONCRETE	1000	UNDERCROSSING	
27.	300 Ø	CONCRETE	750	UNDERCROSSING	
28.	900 (Width per span)	Two Span Masonry	700	UNDERCROSSING	

Project Management Initials: Designer: CH Checked: SK Approved: RG

tli GROUP

Head Office
Beenreigh, Abbeydorney,
Tralee, Co. Kerry, Ireland
Tel: 00353 66 7135710

PROJECT

Carrowanagowan Windfarm
110kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

Malachy Walsh and Partners
Engineering and Environmental Consultants

NOTES: -

- No structural surveys have been carried out and the proposals are subject to detailed design.
- Crossings are in compliance with ESBN & Eirgrid specification requirements for shallow formation, min depth, etc.
- Additional culverts may be encountered on the route.

LEGEND: -

ISSUE/REVISION

I/R	DATE	DESCRIPTION
01	27.03.20	Issued for Planning
00	29.11.19	Issued for Planning

PROJECT NUMBER

05-641

SHEET TITLE

Proposed Culvert Crossings
Sheet 3 of 3

SHEET NUMBER

05641-242

TECHNICAL NOTE 2

Project: Carrownagowan WF – 110kV Grid Connection			Ref: rev0
Section: 110kV UGC Rating Check			Job No: 05-641
			Date: 04/03/2019
Made By: DB	Checked By: SK		Sheet No: 1 of 7

Instruction:

Technical Lead: Ruairi Geary (TLI Group)

Date of Writing: 04/03/2019

Scope of Note: Summary of cable rating check carried out for the 110kV grid connection cable

Documents & Data Issued for Review: N/A

Details:

TLI Group (the Consultant) were engaged by Coillte (the Client) working with Malachy Walsh and Partners to identify and design the 110kV grid connection for Carrownagowan Windfarm as part of the planning application process. The 110kV grid connection for Carrownagowan Windfarm will be rated for a maximum export capacity (MEC) of 90MW to the relevant transmission interface identified by the TSO as appropriate. Both overhead line and underground cable options were identified to Ardnacrusha and Ennis Substations, however the Client decided to progress an underground cable option from the prospective Carrownagowan Windfarm site location with the associated grid connection via Ardnacrusha substation.

A cable rating study was carried out to check the suitability of various 110kV cable sizes/types for the project's MEC and the current cable route design. The purpose of this exercise was to check the load capacity of each cable for the typical trench designs incorporated as part of the cable route design under max load conditions.

The following 110kV cable types/sizes were examined as part of this cable rating check:

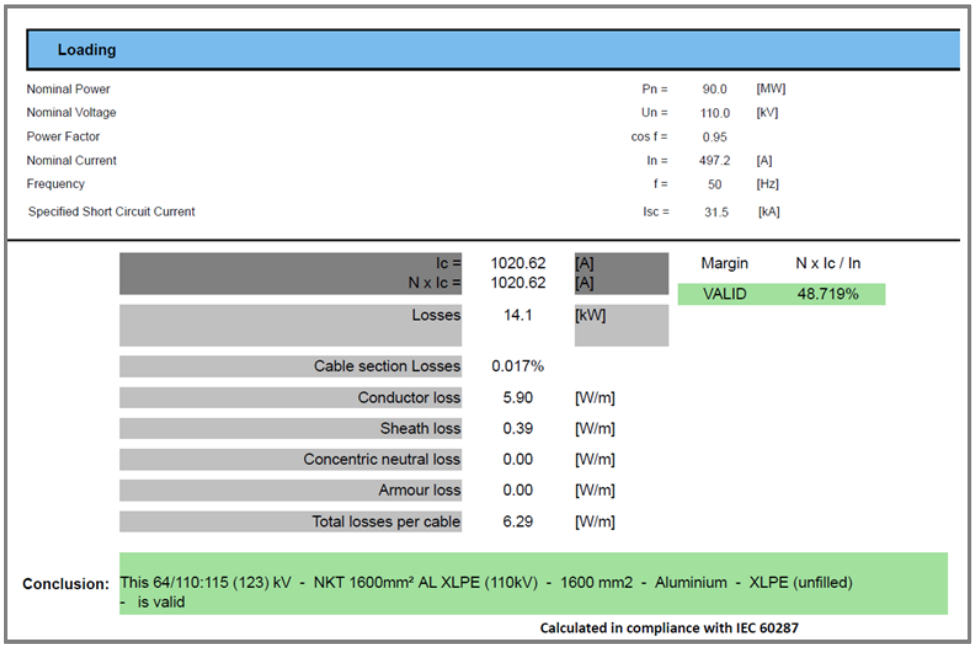
- NKT 1600mm.sq Al Cable
- NKT 1000mm.sq Al Cable

Cable Study Parameters	
Nominal Voltage:	110kV
Power:	90MW
Power Factor:	0.95
Cable Length:	750m *(avg. section length)*
Cable Trench Design:	See Appendix A, B, C
Ambient Temp (Soil)	20˚C *(Summer rating)*
Soil Thermal Resistivity	1.2 K·m/W *(Summer rating)*
Backfill Thermal Resistivity	1 K·m/W *(Summer rating)*

Cable Study Results

Trefoil Trench Design:

The cable study analysis found that installing an **NKT 1600mm² AL XLPE (110kV) UGC** over a distance of 750m using the standard trefoil trench design detailed in Appendix A, with the UGC in a Trefoil arrangement, a loading of 49% (Figure 1) on the UGC is well within the maximum design loading capacity of 90% which would generally be utilized. From this analysis a **loading capacity of 49%** offers the potential of extending this loading factor further up to a maximum design capacity of 90% and would indicate that there is sufficient capacity for load growth on the site.



Loading

Nominal Power	Pn =	90.0	[MW]
Nominal Voltage	Un =	110.0	[kV]
Power Factor	cos f =	0.95	
Nominal Current	In =	497.2	[A]
Frequency	f =	50	[Hz]
Specified Short Circuit Current	Isc =	31.5	[kA]

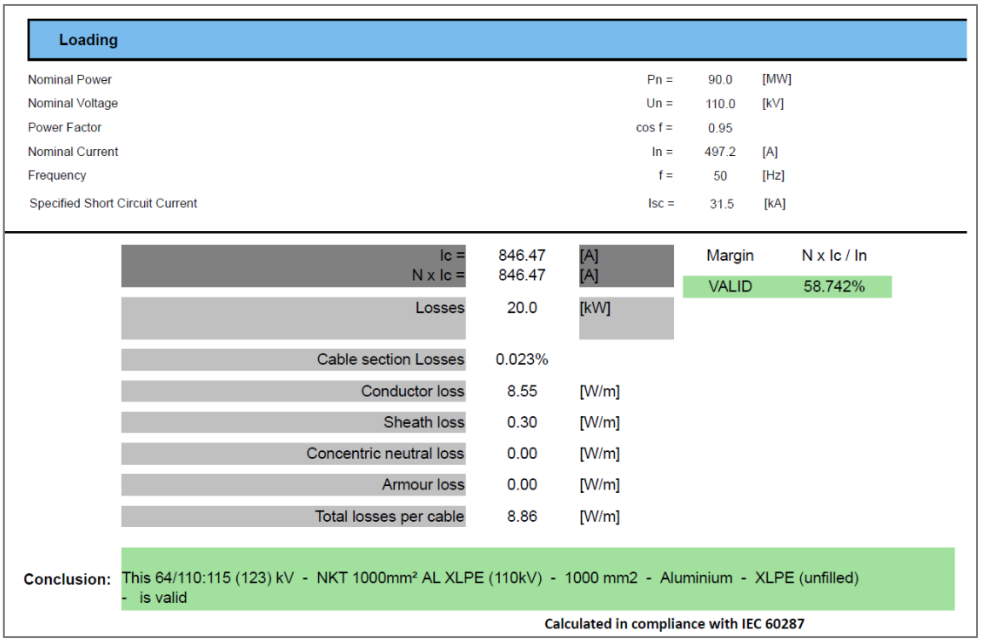
Ic =	1020.62	[A]	Margin	N x Ic / In
N x Ic =	1020.62	[A]	VALID	48.719%
Losses	14.1	[kW]		
Cable section Losses	0.017%			
Conductor loss	5.90	[W/m]		
Sheath loss	0.39	[W/m]		
Concentric neutral loss	0.00	[W/m]		
Armour loss	0.00	[W/m]		
Total losses per cable	6.29	[W/m]		

Conclusion: This 64/110:115 (123) kV - NKT 1600mm² AL XLPE (110kV) - 1600 mm2 - Aluminium - XLPE (unfilled) - is valid

Calculated in compliance with IEC 60287

Figure 1 Cable Study Results - 1600mm.sq Al

For comparison reasoning, an alternative cable study was generated incorporating an **NKT 1000mm² AL XLPE (110kV) UGC** again over a distance of 750m, installed within a Trefoil arrangement as per the trench detail in Appendix A and supplying a load of 90MW. It was found as a result that the cable being loaded to approximately **59% of its maximum loading capacity** (Figure 2). From these studies it can be concluded that either cable size would offer favourable potential loading capacity for Carrownagowan Windfarm under full load operating conditions



Loading

Nominal Power	Pn =	90.0	[MW]
Nominal Voltage	Un =	110.0	[kV]
Power Factor	cos f =	0.95	
Nominal Current	In =	497.2	[A]
Frequency	f =	50	[Hz]
Specified Short Circuit Current	Isc =	31.5	[kA]

			Margin	N x Ic / In
Ic =	846.47	[A]		
N x Ic =	846.47	[A]	VALID	58.742%
Losses	20.0	[kW]		
Cable section Losses	0.023%			
Conductor loss	8.55	[W/m]		
Sheath loss	0.30	[W/m]		
Concentric neutral loss	0.00	[W/m]		
Armour loss	0.00	[W/m]		
Total losses per cable	8.86	[W/m]		

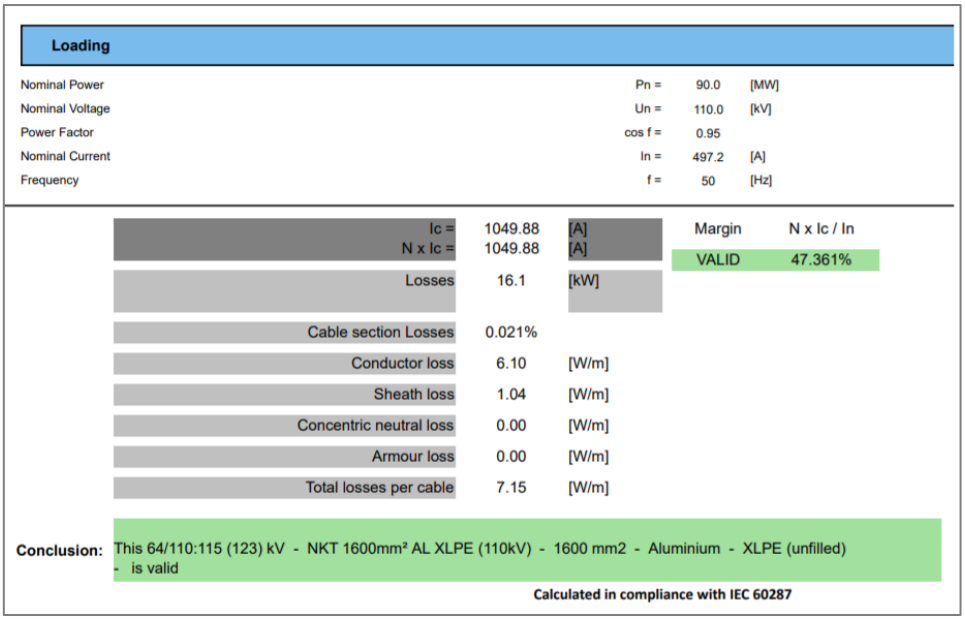
Conclusion: This 64/110:115 (123) kV - NKT 1000mm² AL XLPE (110kV) - 1000 mm2 - Aluminium - XLPE (unfilled) - is valid

Calculated in compliance with IEC 60287

Figure 2 Cable Study Results - 1000mm.sq Al

Flat Formation Trench Design:

The cable study analysis also incorporated the alternative cable trench design in a Flat Formation arrangement again using **NKT 1600mm² AL XLPE (110kV) UGC** with consideration to a depth level of 600mm as per the centre of duct with reference to the trench design detailed in Appendix B. With the UGC installed in a Flat Formation arrangement, supplying a load of 90MW, the result representation shows cable being loaded to approximately **48% of its maximum loading capacity** (Figure 3).



Loading

Nominal Power	Pn =	90.0	[MW]
Nominal Voltage	Un =	110.0	[kV]
Power Factor	cos f =	0.95	
Nominal Current	In =	497.2	[A]
Frequency	f =	50	[Hz]

			Margin	N x Ic / In
Ic =	1049.88	[A]		
N x Ic =	1049.88	[A]	VALID	47.361%
Losses	16.1	[kW]		
Cable section Losses	0.021%			
Conductor loss	6.10	[W/m]		
Sheath loss	1.04	[W/m]		
Concentric neutral loss	0.00	[W/m]		
Armour loss	0.00	[W/m]		
Total losses per cable	7.15	[W/m]		

Conclusion: This 64/110:115 (123) kV - NKT 1600mm² AL XLPE (110kV) - 1600 mm2 - Aluminium - XLPE (unfilled) - is valid

Calculated in compliance with IEC 60287

Figure 3 Flat formation cable study results - 1600mm.sq AL

Horizontal Directional Drilling Trench Design:

Another interpretation of the UGC installation is (HDD) method as per Appendix C, which consists of the potential crossing of (e.g. Bridge, watercourses etc.) that the cable may encounter. The study was carried out to illustrate this installation method again with **NKT 1600mm² AL XLPE (110kV) UGC** with consideration to a depth level of circa. 4000mm, ducts directly buried within native soil surround to comprehend the worst possible case scenario. The arrangement was installed as a trefoil, suppling a full load again of 90MW, the result would be that the UGC being loaded to approximately **55.4% of its maximum loading capacity** (Figure 4) under operating conditions.

Loading

Nominal Power	Pn =	90.0	[MW]
Nominal Voltage	Un =	110.0	[kV]
Power Factor	cos f =	0.95	
Nominal Current	In =	497.2	[A]
Frequency	f =	50	[Hz]

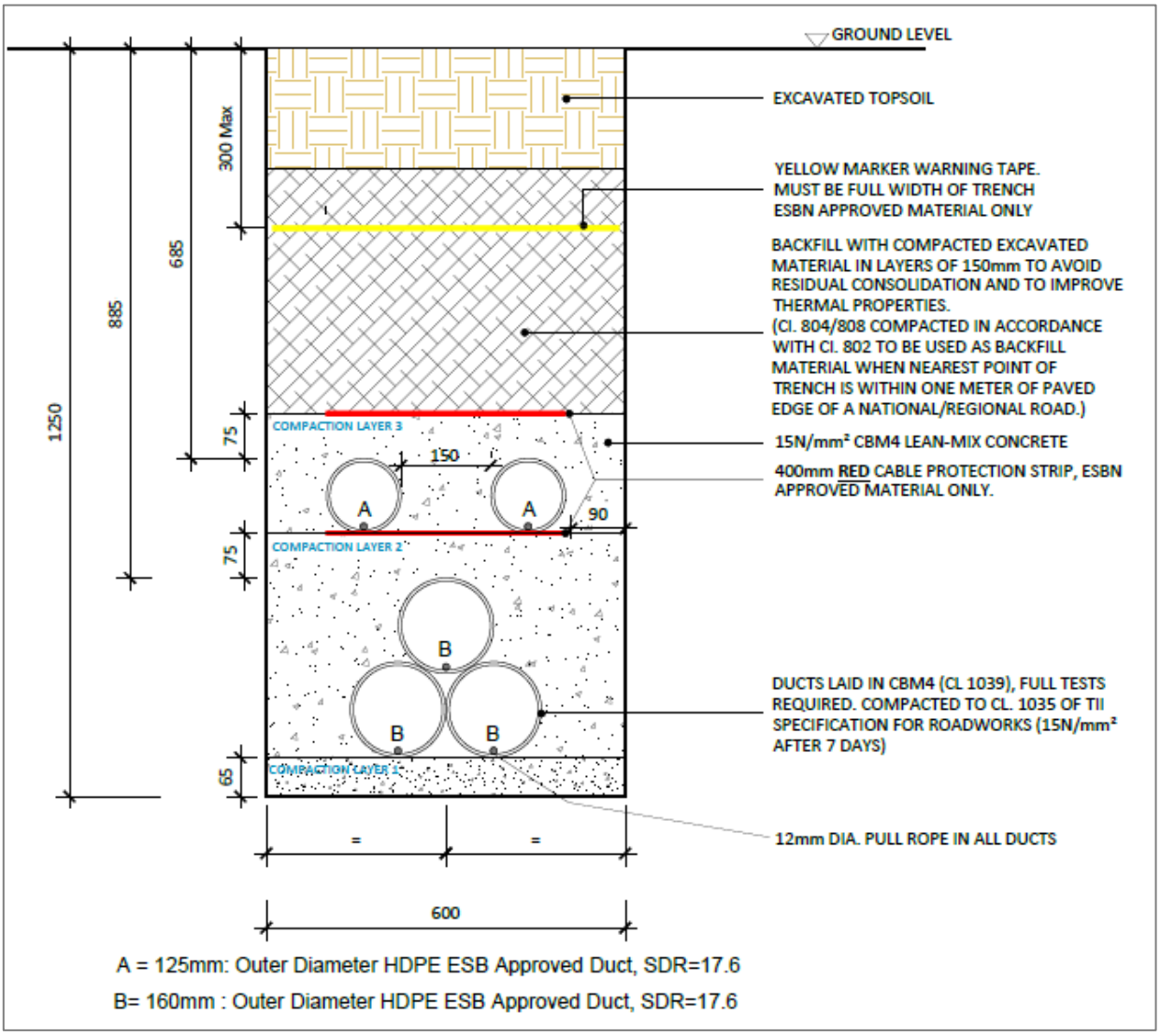
			Margin	N x Ic / In
Ic =	897.84	[A]		
N x Ic =	897.84	[A]	VALID	55.382%
Losses	11.5	[kW]		
Cable section Losses	0.014%			
Conductor loss	5.98	[W/m]		
Sheath loss	0.39	[W/m]		
Concentric neutral loss	0.00	[W/m]		
Armour loss	0.00	[W/m]		
Total losses per cable	6.37	[W/m]		

Conclusion: This 64/110:115 (123) kV - NKT 1600mm² AL XLPE (110kV) - 1600 mm2 - Aluminium - XLPE (unfilled) - is valid

Calculated in compliance with IEC 60287

Figure 4 HDD Trefoil cable arrangement study results - 1600mm.sq AL

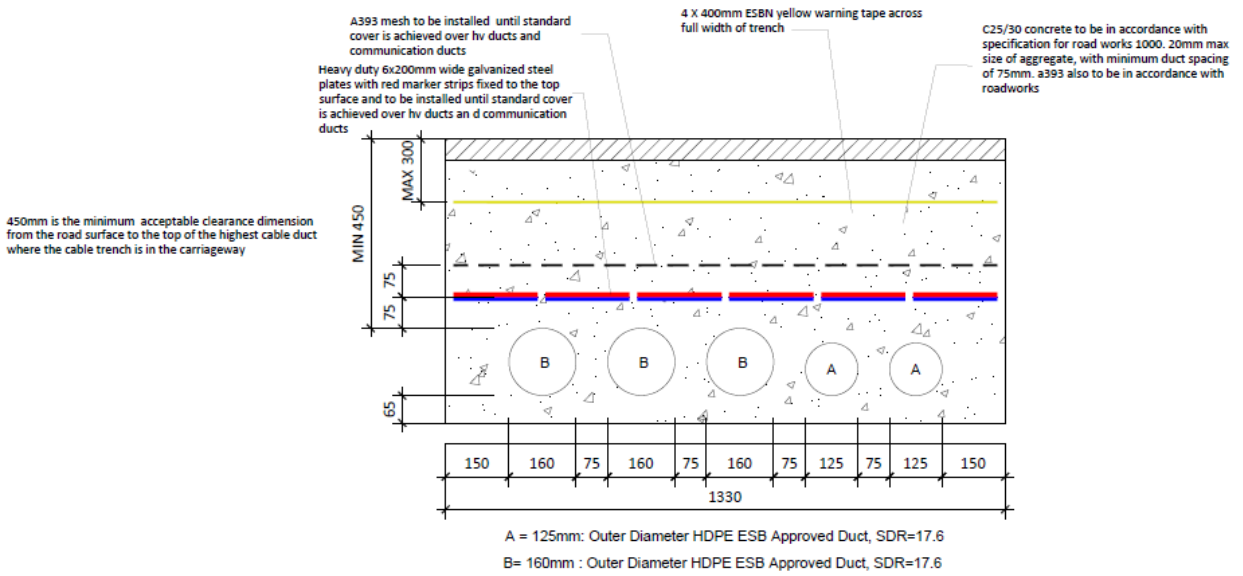
Appendix A – Standard Trefoil Trench Design



A = 125mm: Outer Diameter HDPE ESB Approved Duct, SDR=17.6

B= 160mm : Outer Diameter HDPE ESB Approved Duct, SDR=17.6

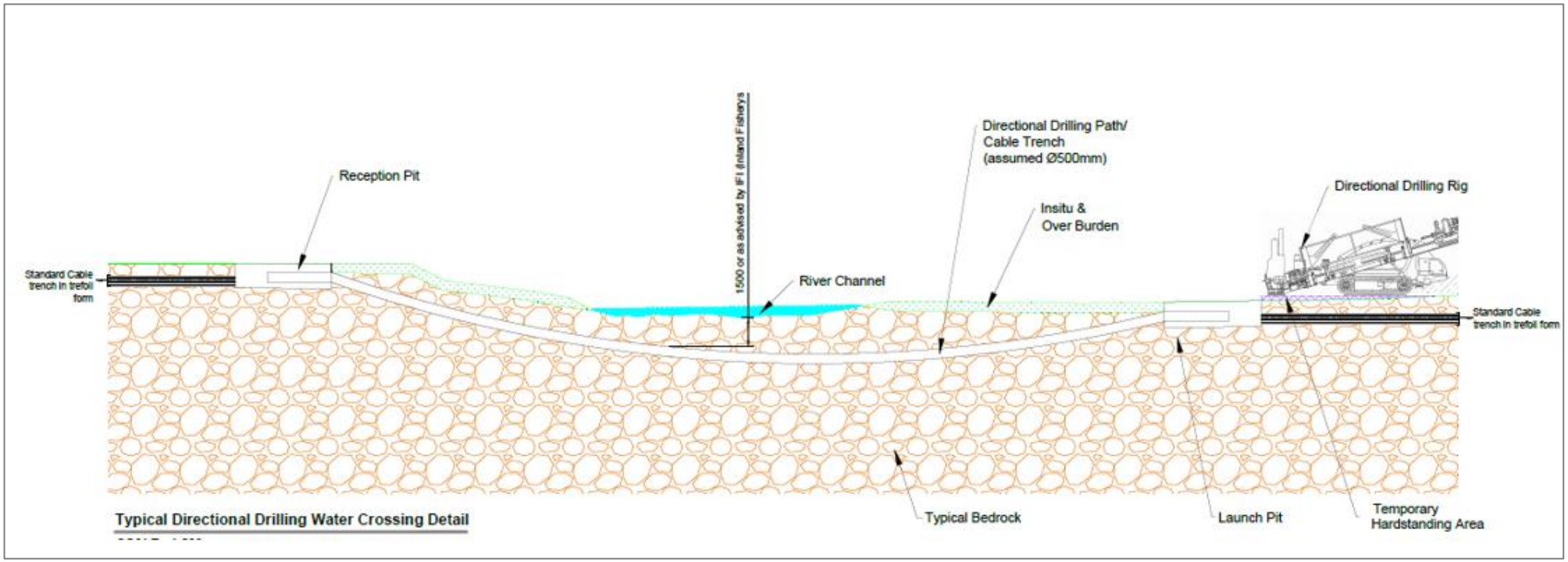
Appendix B – Flat Formation Trench Design



Typical Section Through Ducting in Flat Formation

SCALE 1:10

Appendix C – Horizontal Directional Drill Trench Design



TECHNICAL NOTE 3

Project:	Carrownagowan WF – 110kV Grid Connection	Ref:	Rev2
Section:	UG Cable Pulling Calculation Check	Job No:	05-641
		Date:	04/02/2020
Made By:	DB	Checked By: SK	Sheet No: 1 of 7

Instruction:

Technical Lead: Ruairi Geary (TLI Group)

Date of Writing: 04.02.20 (rev2)

Scope of Note: Summary of cable pulling calculations check on sections of the UGC route.

Documents & Data Issued for Review: N/A

Details:

TLI Group (the Consultant) were engaged by Coillte (the Client) working with Malachy Walsh and Partners to identify and evaluate Cable Pulling Calculations from 110kV Ardnacrusha Substation to Carrownagowan Windfarm for the proposed 110kV grid connection as part of the planning application process. The purpose of this Technical Note is to outline the calculations completed to ensure that the maximum pulling tension and side wall bearing pressure limits of the installed cable would not be exceeded during construction. These calculations were based on the current design, elevations and profile details for the UGC route recorded as part of the topographical survey which was carried out for the entire UGC route.

For the cable pulling calculations check it has been assumed that an NKT 1600mm.sq Al Cable is to be installed as part of this project. The following pulling tension and side wall bearing pressure limits apply to this cable and have been used as part of the calculations:

Cable Type:	**NKT 1600mm² AL XLPE (110kV)**
Max Pulling Tension	**4894.56 kg (force)**
Max Side Wall Bearing Pressure:	**1019.7 kg/m (force) for Cables installed within ducts**

These limits have been formulated, originating from **Item 16** and **Item 17** as per the cable functional specifications (See Appendix A) deriving from kilo-newton meter (kN/m) measurement units to kilogram meter unit for calculation purposes applying the following a conversion rate:

$$\mathbf{1}\boldsymbol{kN/m} \approx \mathbf{101.97}\,\boldsymbol{kg/m}$$

Section 1 – *JB07-JB08*

On review of the pinch point section highlighted within JB07-JB08. The cable pulling study analysis found that installing an **NKT 1600mm² AL XLPE (110kV) UGC** from either side would result in approximate pulling tension values of **896.23kg** and **1590.5kg** respectively in keeping with the manufactures specified limit of 4894.56kg

The cable pulling study also found consistent values for the maximum permissible sidewall force allowable with approx. **170.7kg/m** when installed from JB07 and approx. **53.18kg/m** when installed from JB08. This ensures that the maximum pulling tension and side wall bearing pressure limits of the cable to be installed would not be exceeded during construction based on the current design

SECTION DETAILS	
CIRCUIT	Ardnacrusha - Carrownagowan
ROUTE SECTION	1
CABLE SECTION	JB07-JB08
FROM	JB07
TO	JB08

CALCULATION PARAMETERS	
CABLE WEIGHT (kg/m)	9.7
C.O.F. (DUCT)	0.2
PULL TYPE	NOSE PULL

			STRAIGHT		BEND				CALCULATION RESULTS						
									JB07	TO	JB08	JB08	TO	JB07	
SEGMENT NO.	SEGMENT TYPE	DUCTED/DIRECT BURIAL	LENGTH	SLOPE	BEND ANGLE	RADIUS	ARC LENGTH	COF	NOSE TENSION	SWP	CHAINAGE	NOSE TENSION	SWP	CHAINAGE	REMARKS
			m	*deg*	*deg*	*m*	*m*		*kg*	*kg/m*	*m*	*kg*	*kg/m*	*m*	
0	ENTRY/EXIT TENSION								0	0	0	**1590.5**	**53.18**		
1	STRAIGHT PULL	DUCTED	14.7	0.0				0.2	28.5	-	14.7	1590.5	-	687.9	
2	HORIZONTAL BEND	DUCTED			17.0	29.4	8.7	0.2	45.5	1.55	23.4	1562.0	53.18	673.2	
3	STRAIGHT PULL	DUCTED	181.2	0.0			0.0	0.2	397.0	-	204.6	1470.5	-	664.5	BRIDGE 1 CROSSING
4	HORIZONTAL BEND	DUCTED			5.0	121.6	10.6	0.2	418.8	3.44	215.2	1119.0	9.20	483.3	
5	STRAIGHT PULL	DUCTED	97.5	2.0			0.0	0.2	640.8	-	312.7	1090.8	-	472.7	
6	HORIZONTAL BEND	DUCTED			6.0	44.8	4.7	0.2	657.1	14.68	317.3	868.8	19.41	375.2	
7	STRAIGHT PULL	DUCTED	222.1	4.0			0.0	0.2	1237.2	-	539.4	848.7	-	370.5	
6	HORIZONTAL BEND	DUCTED			92.0	10.0	16.1	0.2	1706.9	170.69	555.5	268.6	26.86	148.5	
7	STRAIGHT PULL	DUCTED	132.4	-3.0			0.0	0.2	1896.2	-	687.9	189.3	-	132.4	
0	ENTRY/EXIT TENSION								**1896.23**	**170.69**		0	0	0	

Figure 1 Cable Pulling Calculation – JB07-JB08

Section 2 – *JB11-JB12*

On review of the pinch point section highlighted within JB11-JB12. The cable pulling study analysis found that installing an **NKT 1600mm² AL XLPE (110kV) UGC** from either the Entry pit or Exit pit would result in approximate pulling tension values of **2727kg** and **2178.9kg** respectively in keeping with the manufactures specified limit of 4894.56kg

The cable pulling study also found consistent values for the maximum permissible sidewall force allowable with approx. **218.76kg/m** when installed from JB11 and approx. **70.28kg/m** when installed from JB12. This ensures that the maximum pulling tension and side wall bearing pressure limits of the cable to be installed would not be exceeded during construction based on the current design.

SECTION DETAILS	
CIRCUIT	Ardnacrusha - Carrownagowan
ROUTE SECTION	2
CABLE SECTION	JB11-JB12
FROM	JB11
TO	JB12

CALCULATION PARAMETERS	
CABLE WEIGHT (kg/m)	9.7
C.O.F. (DUCT)	0.2
PULL TYPE	NOSE PULL

			STRAIGHT SECTION		BEND SECTION			COF	CALCULATION RESULTS						REMARKS
SEGMENT NO.	SEGMENT TYPE	UCTED/DIRECT BURIA	LENGTH	SLOPE	BEND ANGLE	RADIUS	ARC LENGTH		JB11 NOSE TENSION	TO SWP	JB12 CHAINAGE	JB12 NOSE TENSION	TO SWP	JB11 CHAINAGE	
			m	deg	deg	m	m		kg	kg/m	m	kg	kg/m	m	
0	ENTRY/EXIT TENSION								0	0	0	**2178.9**	**70.28**	-	
1	STRAIGHT PULL	DUCTED	163	3				0.2	398.5	-	163.0	2178.9	-	805.52	
2	HORIZONTAL BEND	DUCTED			12	86.4	18.10	0.2	437.8	5.07	181.1	1780.4	20.61	642.52	
3	STRAIGHT PULL	DUCTED	144.43	3.5				0.2	803.0	-	325.5	1699.5	-	624.43	
4	HORIZONTAL BEND	DUCTED			15	34.32	8.98	0.2	849.6	24.76	334.5	1334.3	38.88	480.00	
5	STRAIGHT PULL	DUCTED	208	4.4				0.2	1406.7	-	542.5	1264.1	-	471.01	
6	HORIZONTAL BEND	DUCTED			128	10.06	22.5	0.2	2200.7	218.76	565.0	707.0	70.28	263.01	
7	STRAIGHT PULL	DUCTED	119.95	-1.5				0.2	2402.9	-	684.9	449.1	-	240.54	
8	HORIZONTAL BEND	DUCTED			2	191.34	6.7	0.2	2424.1	12.67	691.6	247.0	1.29	120.59	
9	STRAIGHT PULL	DUCTED	48.77	1.5				0.2	2531.1	-	740.4	233.9	-	113.91	
10	HORIZONTAL BEND	DUCTED			9	39.9	6.27	0.2	2612.8	65.48	746.7	126.9	3.18	65.14	
11	STRAIGHT PULL	DUCTED	58.87	0			0	0.2	2727.0	-	805.5	114.2	-	58.87	
0	ENTRY/EXIT TENSION		-	-	-	-	-	-	**2727.0**	**218.76**	-	0	0	0	

Figure 2 Cable Pulling Calculation - JB11-JB12

Section 4 – (*JB24-JB25, JB25-JB26, JB27-JB28)*

On review of the pinch point section highlighted within JB24-JB25. The cable pulling study analysis found that installing an **NKT 1600mm² AL XLPE (110kV) UGC** from either side would result in approximate pulling tension values of **2928.93kg** and **998.43kg** respectively in keeping with the manufactures specified limit of 4894.56kg

The cable pulling study also found consistent values for the maximum permissible sidewall force allowable with approx. **367.06kg/m** when installed from JB24 and approx. **54.19kg/m** when installed from JB25. This ensures that the maximum pulling tension and side wall bearing pressure limits of the cable to be installed would not be exceeded during construction based on the current design.

SECTION DETAILS	
CIRCUIT	Ardnacrusha - Carrownagowan
ROUTE SECTION	4
CABLE SECTION	JB24-JB25
FROM	JB24
TO	JB25

CALCULATION PARAMETERS	
CABLE WEIGHT (kg/m)	9.7
C.O.F. (DUCT)	0.2
PULL TYPE	NOSE PULL

			STRAIGHT SECTION		BEND SECTION			COF	CALCULATION RESULTS						REMARKS
SEGMENT NO.	SEGMENT TYPE	DUCTED/DIRECT BURIAL	LENGTH	SLOPE	BEND ANGLE	RADIUS	ARC LENGTH		JB24 NOSE TENSION	TO SWP	JB25 CHAINAGE	JB25 NOSE TENSION	TO SWP	JB24 CHAINAGE	
			m	*deg*	*deg*	*m*	*m*		*kg*	*kg/m*	*m*	*kg*	*kg/m*	*m*	
0	ENTRY/EXIT TENSION								0	0	0	**998.43**	**54.19**	-	
1	STRAIGHT PULL	DUCTED	53.00					0.20	102.82	-	53.00	998.43	-	693.03	
2	HORIZONTAL BEND	DUCTED			23.00	243.25	97.65	0.20	292.97	1.20	150.65	895.61	3.68	640.03	
3	STRAIGHT PULL	DUCTED	66.00					0.20	421.01	-	216.65	695.65	-	542.39	
4	HORIZONTAL BEND	DUCTED			18.00	131.33	41.26	0.20	506.20	3.85	257.91	567.61	4.32	476.39	
5	STRAIGHT PULL	DUCTED	28.77					0.20	562.01	-	286.68	481.05	-	435.13	
6	HORIZONTAL BEND	DUCTED			22.00	93.57	35.93	0.20	645.73	6.90	322.60	425.24	4.54	406.36	
7	STRAIGHT PULL	DUCTED	20.00					0.20	684.53	-	342.60	349.44	-	370.43	
8	HORIZONTAL BEND	DUCTED			8.00	224.13	31.29	0.20	748.45	3.34	373.90	310.64	1.39	350.43	
9	STRAIGHT PULL	DUCTED	71.24					0.20	886.66	-	445.14	249.43	-	319.13	
10	HORIZONTAL BEND	DUCTED			17.00	126.12	37.42	0.20	977.93	7.75	482.56	783.75	6.21	247.89	
11	STRAIGHT PULL	DUCTED	68.31					0.20	1110.45	-	550.87	698.86	-	210.47	
12	HORIZONTAL BEND	DUCTED			98.00	10.45	17.87	0.20	1565.00	149.76	568.74	566.34	54.19	142.16	
13	UPWARD SLOPE	DUCTED	20.70	9.00				0.20	1636.07	-	589.44	399.12	-	124.29	
14	HORIZONTAL BEND	DUCTED			42.00	6.34	4.65	0.20	1894.57	298.83	594.09	328.05	51.74	103.59	
15	UPWARD SLOPE	DUCTED	24.10	11.00				0.20	1985.07	-	618.19	282.47	-	98.94	
16	HORIZONTAL BEND	DUCTED			26.00	6.43	2.92	0.20	2173.75	338.06	621.11	191.97	29.86	74.84	
17	UPWARD SLOPE	DUCTED	8.65	15.00				0.20	2211.68	-	629.76	174.42	-	71.92	
18	HORIZONTAL BEND	DUCTED			51.00	7.20	6.41	0.20	2642.83	367.06	636.17	136.49	18.96	63.27	
19	STRAIGHT PULL	DUCTED	10.44					0.20	2663.08	-	646.61	111.22	-	56.87	
20	HORIZONTAL BEND	DUCTED			20.00	26.00	9.08	0.20	2856.47	109.86	655.68	90.97	3.50	46.43	
21	STRAIGHT PULL	DUCTED	37.35					0.20	2928.93	-	693.03	72.46	-	37.35	
0	ENTRY/EXIT TENSION		-	-	-	-	-	-	**2928.93**	**367.06**	-	0	0	0	

Figure 3 Cable Pulling Calculation - JB24-JB25

On review of the pinch point section highlighted within JB25-JB26. The cable pulling study analysis found that installing an **NKT 1600mm² AL XLPE (110kV) UGC** from JB26 and carrying predominantly in a downward gradient to the location of Joint Bay 25. The result of the approximate pulling exit tension value would be **3453.24kg**.

It was found during analysis when installing the cable from JB25, carrying in an upward gradient to the location of Joint Bay 26, the permissible pulling force exerted onto the cable exceeded the manufactures specified limit of 4894.56kg. The pulling tension value for this prospective install resulted in approx. **7304.48kg**

The cable pulling study findings for the maximum permissible sidewall force allowable were found to be within the specified limits with approx. **240.95kg/m** when installed from JB26 (downhill).

Findings show approx. **1340.97kg/m** of force exerted for the Side Wall Pressure analysis when the cable is installed from JB25 (uphill) respectively exceeding the specified limit of 1019.7kg/m

SECTION DETAILS	
CIRCUIT	Ardnacrusha - Carrownagowan
ROUTE SECTION	4
CABLE SECTION	JB25-JB26
FROM	JB25
TO	JB26

CALCULATION PARAMETERS	
CABLE WEIGHT (kg/m)	9.7
C.O.F. (DUCT)	0.2
PULL TYPE	NOSE PULL

			STRAIGHT SECTION		BEND SECTION			COF	CALCULATION RESULTS						REMARKS
									JB25	TO	JB26	JB26	TO	JB25	
SEGMENT NO.	SEGMENT TYPE	DUCTED/DIRECT BURIAL	LENGTH	SLOPE	BEND ANGLE	RADIUS	ARC LENGTH		NOSE TENSION	SWP	CHAINAGE	NOSE TENSION	SWP	CHAINAGE	
			m	deg	deg	m	m		kg	kg/m	m	kg	kg/m	m	
0	ENTRY/EXIT TENSION								0	0	0	**7304.48**	**1340.97**	-	
1	STRAIGHT PULL	DUCTED	7.79					0.20	15.11	-	7.79	7304.48	-	676.30	
2	HORIZONTAL BEND	DUCTED			26.00	5.86	2.66	0.20	20.52	3.50	10.45	7289.37	1243.92	668.51	
3	STRAIGHT PULL	DUCTED	2.94	0.00			0.00	0.20	26.22	-	13.39	6656.92	-	665.85	
4	HORIZONTAL BEND	DUCTED			31.00	4.96	2.68	0.20	32.32	6.52	16.07	6651.21	1340.97	662.91	
5	STRAIGHT PULL	DUCTED	14.52	1.00			0.00	0.20	62.94	-	30.59	5969.04	-	660.23	
6	HORIZONTAL BEND	DUCTED			42.00	4.96	3.64	0.20	75.28	15.18	34.23	5938.42	1197.26	645.71	
7	STRAIGHT PULL	DUCTED	13.74	2.00			0.00	0.20	106.57	-	47.97	5128.58	-	642.07	
8	HORIZONTAL BEND	DUCTED			16.00	18.26	5.10	0.20	118.28	6.48	53.07	5097.29	279.15	628.33	
9	STRAIGHT PULL	DUCTED	9.80	0.00			0.00	0.20	137.29	-	62.87	4820.24	-	623.23	
10	HORIZONTAL BEND	DUCTED			15.00	24.20	6.34	0.20	151.73	6.27	69.20	4801.22	198.40	613.43	
11	UPWARD SLOPE	DUCTED	23.15	9.00			0.00	0.20	231.21	-	92.35	4556.00	-	607.10	
12	HORIZONTAL BEND	DUCTED			14.00	13.02	3.18	0.20	244.37	18.77	95.53	4476.51	343.82	583.95	
13	UPWARD SLOPE	DUCTED	6.12	10.00			0.00	0.20	266.37	-	101.65	4262.32	-	580.77	
14	HORIZONTAL BEND	DUCTED			96.00	13.75	23.04	0.20	383.17	27.87	124.69	4240.32	308.43	574.65	
15	STRAIGHT PULL	DUCTED	26.40	3.00			0.00	0.20	447.72	-	151.09	3032.66	-	551.61	
16	HORIZONTAL BEND	DUCTED			89.00	9.33	14.49	0.20	613.70	65.78	165.59	2968.12	318.13	525.21	
17	UPWARD SLOPE	DUCTED	111.30	7.00			0.00	0.20	959.59	-	276.89	2175.07	-	510.71	
18	HORIZONTAL BEND	DUCTED			42.00	6.60	4.84	0.20	1111.42	168.40	281.72	1829.18	277.15	339.41	
19	UPWARD SLOPE	DUCTED	11.16	6.00			0.00	0.20	1144.26	-	292.88	1579.58	-	394.58	
20	HORIZONTAL BEND	DUCTED			23.00	13.36	5.36	0.20	1240.51	92.85	298.25	1546.73	115.77	383.42	
21	UPWARD SLOPE	DUCTED	11.72	6.00			0.00	0.20	1275.00	-	309.97	1426.97	-	378.05	
22	HORIZONTAL BEND	DUCTED			16.00	9.04	2.52	0.20	1348.41	143.16	312.43	1392.47	154.03	366.33	
23	UPWARD SLOPE	DUCTED	27.44	8.00			0.00	0.20	1438.17	-	339.93	1316.68	-	363.81	
24	HORIZONTAL BEND	DUCTED			23.00	13.04	5.23	0.20	1558.84	119.54	345.17	1226.32	94.09	336.37	
25	UPWARD SLOPE	DUCTED	7.67	7.00			0.00	0.20	1582.67	-	352.84	1131.75	-	331.13	
26	HORIZONTAL BEND	DUCTED			39.00	10.02	6.82	0.20	1813.89	181.03	359.66	1107.91	96.44	323.46	
27	UPWARD SLOPE	DUCTED	21.84	7.00			0.00	0.20	1881.77	-	381.50	966.32	-	316.64	
28	HORIZONTAL BEND	DUCTED			39.00	8.95	6.09	0.20	2156.47	240.95	387.59	898.45	87.54	294.80	
29	STRAIGHT PULL	DUCTED	41.91	5.00			0.00	0.20	2272.90	-	429.50	783.52	-	288.71	
30	HORIZONTAL BEND	DUCTED			11.00	21.11	4.05	0.20	2362.22	111.90	433.55	667.10	30.35	246.80	
31	UPWARD SLOPE	DUCTED	56.98	6.00			0.00	0.20	2529.93	-	490.53	640.79	-	242.75	
32	HORIZONTAL BEND	DUCTED			20.00	22.48	7.85	0.20	2713.52	120.71	498.38	473.08	19.48	185.77	
33	STRAIGHT PULL	DUCTED	87.03	4.00			0.00	0.20	2940.84	-	585.41	437.84	-	177.32	
34	HORIZONTAL BEND	DUCTED			33.00	52.49	30.23	0.20	3304.93	62.96	615.64	210.52	2.83	90.89	
35	STRAIGHT PULL	DUCTED	60.66	3.00			0.00	0.20	3453.24	-	676.30	148.31	-	60.66	
0	ENTRY/EXIT TENSION		-	-	-	-	-	-	**3453.24**	**240.95**	-	0	0	0	

Figure 4 Cable Pulling Calculation - JB25-JB26

On review of the pinch point section highlighted within JB27-JB28. The cable pulling study analysis found that installing an **NKT 1600mm² AL XLPE (110kV) UGC** from either side would result in approximate pulling tension values of **2609.7kg** and **3295.44kg** respectively in keeping with the manufactures specified limit of 4894.56kg.

The cable pulling study also found consistent values for the maximum permissible sidewall force allowable with approx. **107.71kg/m** when installed from JB27 and approx. **274.79kg/m** when installed from JB28. This ensures that the maximum pulling tension and side wall bearing pressure limits of the cable to be installed would not be exceeded during construction based on the current design.

SECTION DETAILS	
CIRCUIT	Ardnacrusha - Carrownagowan
ROUTE SECTION	4
CABLE SECTION	JB27-JB28
FROM	JB27
TO	JB28

CALCULATION PARAMETERS	
CABLE WEIGHT (kg/m)	9.7
C.O.F. (DUCT)	0.2
PULL TYPE	NOSE PULL

			STRAIGHT		BEND			COF	CALCULATION RESULTS						REMARKS
SEGMENT NO.	SEGMENT TYPE	DUCTED/DIRECT BURIAL	LENGTH	SLOPE	BEND ANGLE	RADIUS	ARC LENGTH		JB27 NOSE TENSION	TO SWP	JB28 CHAINAGE	JB28 NOSE TENSION	TO SWP	JB27 CHAINAGE	
			m	deg	deg	m	m		kg	kg/m	m	kg	kg/m	m	
0	ENTRY/EXIT TENSION	-	-	-	-	-	-	-	0	0	0	3295.44	274.79	-	
1	STRAIGHT PULL	DUCTED	10.09					0.20	19.57	-	10.09	3295.44	-	653.34	
2	HORIZONTAL BEND	DUCTED			29.00	15.60	7.90	0.20	35.15	2.25	17.99	3275.86	209.99	643.25	
3	STRAIGHT PULL	DUCTED	49.06	5.00				0.20	171.44	-	67.05	2960.13	-	635.36	
4	HORIZONTAL BEND	DUCTED			41.00	21.16	15.14	0.20	211.60	10.00	82.19	2823.84	133.45	586.30	
5	STRAIGHT PULL	DUCTED	4.55	0.00				0.20	220.43	-	86.74	2446.22	-	571.16	
6	HORIZONTAL BEND	DUCTED			42.00	8.87	6.50	0.20	257.62	29.04	93.24	2437.39	274.79	566.61	
7	UPWARD SLOPE	DUCTED	14.20	9.00				0.20	306.37	-	107.44	2104.79	-	560.11	
8	HORIZONTAL BEND	DUCTED			24.00	20.72	8.68	0.20	338.18	16.32	116.12	2056.03	99.23	545.91	
9	UPWARD SLOPE	DUCTED	10.70	12.00				0.20	380.06	-	126.82	1889.98	-	537.23	
10	HORIZONTAL BEND	DUCTED			72.00	11.57	14.54	0.20	492.78	42.59	141.36	1848.10	159.73	526.53	
11	STRAIGHT PULL	DUCTED	41.15	5.00				0.20	607.10	-	182.51	1436.53	-	511.99	
12	HORIZONTAL BEND	DUCTED			18.00	60.64	19.05	0.20	681.44	10.91	201.56	1322.21	21.80	470.84	
13	STRAIGHT PULL	DUCTED	59.95	5.00				0.20	827.99	-	261.51	1233.83	-	451.79	
14	HORIZONTAL BEND	DUCTED			18.00	45.21	14.20	0.20	888.53	19.65	275.71	1067.29	23.61	391.84	
15	UPWARD SLOPE	DUCTED	182.54	7.00				0.20	1455.80	-	458.25	996.85	-	377.63	
16	HORIZONTAL BEND	DUCTED			23.00	14.90	5.98	0.20	1578.08	105.91	464.23	429.58	28.83	195.09	
17	STRAIGHT PULL	DUCTED	6.69	0.00				0.20	1591.06	-	470.92	394.53	-	189.11	
18	HORIZONTAL BEND	DUCTED			21.00	15.90	5.83	0.20	1712.62	107.71	476.75	381.56	24.00	182.42	
19	STRAIGHT PULL	DUCTED	16.42	0.00				0.20	1744.47	-	493.17	352.39	-	176.59	
20	HORIZONTAL BEND	DUCTED			12.00	66.01	13.83	0.20	1823.86	27.63	507.00	320.53	4.86	160.17	
21	STRAIGHT PULL	DUCTED	17.94	0.00				0.20	1858.67	-	524.94	299.81	-	146.35	
22	HORIZONTAL BEND	DUCTED			18.00	55.75	17.51	0.20	1984.04	35.59	542.45	256.01	4.59	128.41	
23	STRAIGHT PULL	DUCTED	15.78	0.00				0.20	2014.66	-	558.23	218.89	-	110.89	
24	HORIZONTAL BEND	DUCTED			47.00	50.75	41.63	0.20	2383.61	46.97	599.86	188.28	3.71	95.11	
25	STRAIGHT PULL	DUCTED	23.49	0.00				0.20	2429.18	-	623.35	103.96	-	53.48	
26	HORIZONTAL BEND	DUCTED			16.00	34.07	9.51	0.20	2569.96	75.43	632.86	58.39	1.71	29.99	
27	STRAIGHT PULL	DUCTED	20.48	0.00				0.20	2609.69	-	653.34	39.73	-	20.48	
0	ENTRY/EXIT TENSION	-	-	-	-	-	-	-	2609.7	107.71	-	0	0	0	

Figure 5 Cable Pulling Calculation - JB27-JB28

Appendix A – Functional Cable Specification

SCHEDULE A
(continued)

Physical Characteristics of
110 kV Crosslinked Polyethylene Cable

Item	Query	Required	Offered
10	Nominal diameter of completed cable (mm)		96
11	Weight of finished cable (kg/m)		appr. 9,7
12	(a) Normal length per drum (m)		1000
	(b) Maximum length per drum (m)		tbd
13	(a) Normal gross weight of loaded drum (kg)		12000
	(b) Max gross weight of loaded drum (kg)		tbd
14	Drum dimensions width/height (m/m)		3,6 / 4,3
15	Minimum radius of bend around which cable can be pulled		
	(a) Laid direct (m)		2,4
	(b) In ducts (m)		2,4
	(c) Cable placed in position with former (m)		1,5
	(d) Cable placed in position without former (m)		2,4
16	Permissible pulling force allowed on conductors during installation (kN)		48
17	Maximum permissible sidewall forces (kN/m)		10

Carrownagowan WF - 110kV Grid Connection

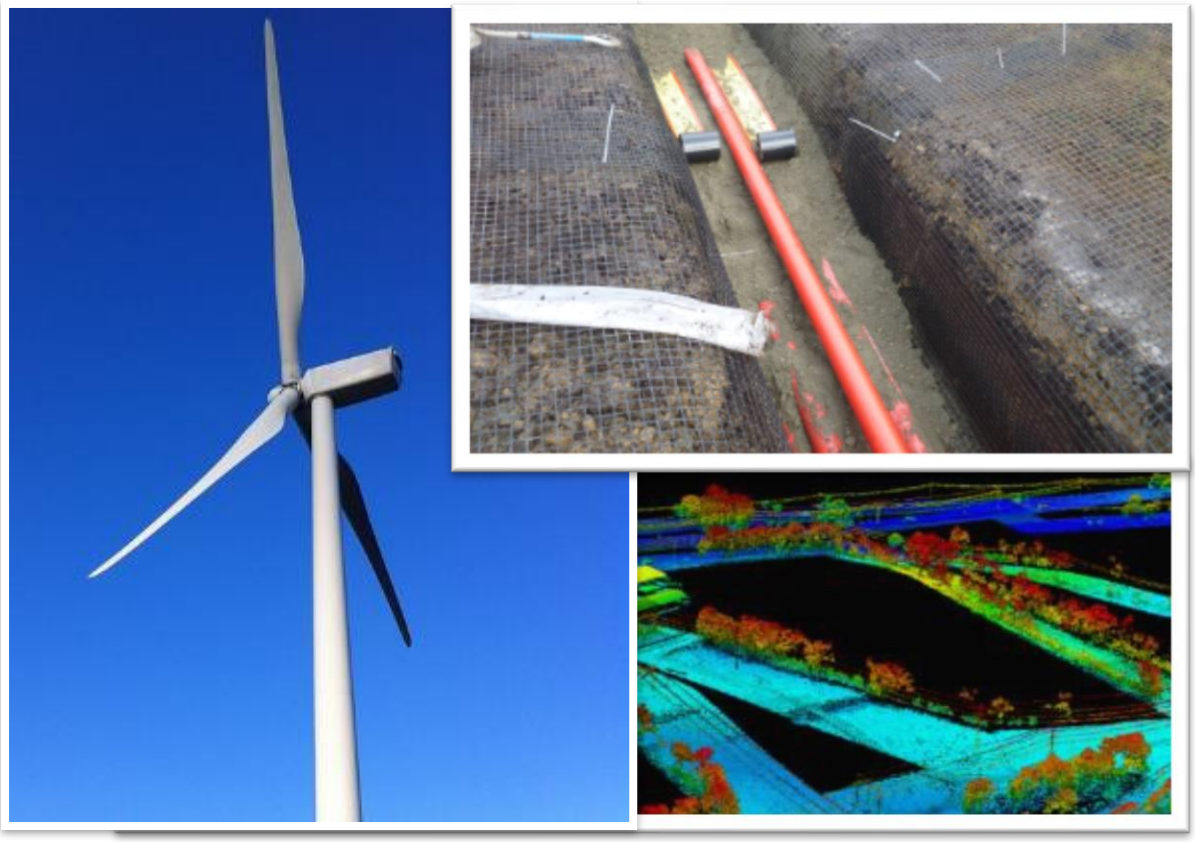
Route Summary & Joint Bay Locations

Rev3 (27.03.20)

Section From	*Section To*	*Section Length*	*Bonding Arrangement*	*No. of Watercourses*	*Watercourses*	*No. of Bridges*	*Bridges*	*Comments*	*Diff*
SS	JB-1	542	Single Point Bonded	-	-	-	-	*Route into SS to be determined by ESB*	
JB-1	JB-2	570	Cross Bonded	-	-	-	-		16
JB-2	JB-3	561	Cross Bonded	-	-	-	-		
JB-3	JB-4	554	Cross Bonded	1	C1	-	-		
JB-4	JB-5	673	Cross Bonded	-	-	-	-		35
JB-5	JB-6	638	Cross Bonded	-					
JB-6	JB-7	673	Cross Bonded	-					
JB-7	JB-8	688	Single Point Bonded	1	B1	1	B1	*B1 to be HDD*	
JB-8	JB-9	620	Cross Bonded	1	B2	1	B2		
JB-9	JB-10	660	Cross Bonded	1	C2	-			40
JB-10	JB-11	641	Cross Bonded	2	C3,B3	1	B3		
JB-11	JB-12	807	Cross Bonded	-					25
JB-12	JB-13	782	Cross Bonded	2	C4,C5				
JB-13	JB-14	789	Cross Bonded	-					
JB-14	JB-15	742	Cross Bonded	-					
JB-15	JB-16	722	Cross Bonded	1	C6				
JB-16	JB-17	760	Cross Bonded						38
JB-17	JB-18	768	Cross Bonded	1	C7				38
JB-18	JB-19	762	Cross Bonded	-					
JB-19	JB-20	730	Cross Bonded	1	B4	1	B4		
JB-20	JB-21	822	Cross Bonded	2	C8,B5	1	B5		33
JB-21	JB-22	789	Cross Bonded	1	B6	1	B6		
JB-22	JB-23	798	Cross Bonded	2	C9,B7	1	B7		
JB-23	JB-24	703	Cross Bonded	2	B8,B9	2	B8,B9		23
JB-24	JB-25	698	Cross Bonded	-					
JB-25	JB-26	680	Cross Bonded	-					
JB-26	JB-27	670	Cross Bonded	-					
JB-27	JB-28	672	Cross Bonded	-					
JB-28	JB-29	681	Cross Bonded	-					11
JB-29	JB-30	749	Cross Bonded	3	C10,C11,C12				
JB-30	JB-31	751	Cross Bonded	4	C15,C16,C17,C18				
JB-31	JB-32	752	Cross Bonded	1	C19				3
JB-32	JB-33	749	Cross Bonded	3	C22,C23,C24				
JB-33	JB-34	752	Cross Bonded	1	C25				3
JB-34	JB-35	749	Cross Bonded	4	C26,C27,C28,C29				
JB-35	WF SS	267	Single Point Bonded						
	Total:	**24,964**		**34**		**9**			

Outline Construction Methodology – 110kV Underground Cable Connection

Carrownagowan Wind Farm
Grid Connection



Report Ref: 05641-R03-03

Client: Coillte C/o Malachy Walsh Partners

Malachy Walsh and Partners
Engineering and Environmental Consultants

Revision:	Author:	Checked:	Date:	Notes:
00	DB	SK	04.03.19	*Issued for Client Review*
01	SK	RG	29.11.19	*Revised Substation Location*
02	SK	RG	27.03.20	Revised following Client Review
03	SK	RG	19.05.20	Updated as per new EirGrid Specifications

Table of Contents

Table of Figures

1.0 Introduction

The purpose of this document is to outline and explain the construction techniques and methodologies which will be implemented during construction of the proposed Carrownagowan Wind Farm 110kV grid connection to the existing ESB Ardnacrusha 110kV substation. The grid connection will consist entirely of underground cabling (UGC) with the majority of the UGC to be installed within the public road network.

The UGC works will consist of the installation of 5 No. ducts in an excavated trench to accommodate 3 No. power cables, and 1 No. fibre communications cable to allow communications between the Carrownagowan Wind Farm Substation and Ardnacrusha 110kV substation.

This document is intended to be used as an aid to understand the methodologies to be employed during construction and should be read in conjunction with all other specialist reports which accompany the planning application. In addition, this document is in outline form only and will be revised and updated prior to the commencement of any construction activities, detailed Method Statements will be prepared in respect of each aspect of the proposed development.

2.0 Proposed 110kV Underground Cable Route

The proposed UGC route is approximately 25km in length and runs in a northerly direction from the existing ESB Ardnacrusha 110kV substation to the proposed Carrownagowan Wind Farm substation location utilizing public local road networks, existing access tracks and private forestry access tracks.

The exact location of the UGC within the proposed site boundary is subject to minor modification following a further detailed assessment to be undertaken prior to construction and following consultation with Clare County Council and all other relevant stakeholders, having regard to all environmental protection measures outlined in the planning application and accompanying technical reports.

Below **(Figure 1)** which outlines the proposed UGC route, with each section of the route being formulated in detail within Table 1.

This proposed grid connection option is shown as an Overall Site layout Plan in Drawing No. 05641-200.

Figure 1 -Grid Connection Route Location

Table 1 of this report summaries the route location features of the underground cable connection and proposed route.

Table 1 – Approximate Route Location of Preliminary Design:		
Wind Farm Site/Forestry Roads (UGC)	**Public Roads (UGC)**	**ESB Access Track (UGC)**
5,504 m	18,875 m	585 m

Table 1: Carrownagowan Wind Farm to Ardnacrusha 110kV Substation – UGC Route Location Summary

Table 2 below separates the UGC route into a number of sections and describes the specific construction requirements of each individual section with access routes to the work areas. All plant and equipment employed

on the proposed works will be subject to good site organisation and hygiene, particularly during construction activities.

Table 2 - Summary of Preliminary Grid Connection Design Route	
Section	**Description**
Section 1 UGC 3,538 m	**UGC from Ardnacrusha 110kV substation to R-471 Road** The proposed underground cable route initially begins within the Ardnacrusha substation compound exiting the confines northerly provisionally turning right onto the local public route of the (L-3056). Approaching a crossroad junction, the UGC turns left opposite the main entrance of Ardnacrusha Power Station onto Lackyle Heights Rd and continuing along this route for approx. 2.8km. The UGC will predominantly be installed in the carriageway until encountering another road junction at which point the UGC will turn right onto an unpaved section of roadway. The UGC will continue north on this unpaved road where it will encounter the first proposed bridge crossing within the proposed route over the River Blackwater (Bridge 1). This bridge will be crossed using a horizontal directional drill method (HDD) before continuing along this unpaved section of roadway for approx. 1.37km. <u>Features</u> Section 1 contains 7 no. joint bays. Joint bays will be located below ground and finished/reinstated to the required roads specification. Joint bays will have associated communication chambers and link boxes which will have a surface access hatch which will match existing ground levels. • Joint Bay 01 (JB01) will be located approx. 542m north of Ardnacrusha 110kV Substation. The joint bay will be installed within the local public network west of the Power Station entrance road. • Joint Bay 02 (JB02) will be located approx. 570m north of JB01 within the local road network situated within Lackyle Road • Joint Bay 03 (JB03) will be located approx. 561m north of JB02 positioning the joint bay within the Lackyle Rd network. • Joint Bay 04 (JB04) will be located approx. 554m north of JB03. The position of JB04 will be located approx. 415m after departing Lackyle road positioned to an entrance to agricultural grassland. • Joint Bay 05 (JB05) will be located approx. 673m north of JB04 within the local authority carriageway. The joint bay will be situated adjacent to an uninhabited dwelling with the positioning within the shoulder of the roadway. • Joint Bay 06 (JB06) is located 638m northwest of JB05 within the shoulder of an unpaved section of roadway.

	• Joint Bay 07 (JB07) will be located approx. 673m north of JB06 adjacent to a gated agricultural entrance within this unpaved carriageway. JB07 is located immediately south of the first proposed Bridge crossing. Section 1 has 1 bridge crossing: • The proposed route crosses over the River Blackwater. Insufficient clearance exists within the bridge structure and it is proposed to cross this bridge adopting the HDD method before proceeding towards the (R-471). The HDD crossing will require a transition coupler to be installed at either side of the drill following the works, the location of these couplers is to be determined by the drilling contractor following site investigation.
Section 2 UGC 7,206 m	**UGC within R-471 and L-3046 Carriageway** Subsequent to this unpaved section of roadway, the UGC comes upon the regional road (R-471) with the prospective installation merging and turning right onto the regional carriageway heading in an eastward direction. The underground cable will continue eastwards passing first the church of Truagh before encountering a junction that will require the UGC to cross both lanes of a merging roadway after circa 372m before continuing along the (R-471). Within the regional road, the first of two-bridge crossings in this section exists after 172m (Bridge 2). Continuing on for a further circa 664m prior to approaching the regional road (R-465). At this junction the UGC will be required to cross underground services (Water, Telecoms, etc) which are evident within the surrounding layout and the lanes of carriageway proceeding straight along the (R-471). Subsequent to cable trenching along this route for circa. 453m, the UGC reaches the second proposed bridge crossing of the Glenmora Wood Stream (Bridge 3) which will be crossed using HDD. Once the UGC crosses this structure, the route continues for a further circa 905m before turning left onto a local route (L-3046) leaving the (R-471) carriageway. The underground cable will carry along this route on the (L-3046) for approximately 4.24km. <u>Features</u> Section 2 contains 10 no. joint bays. Joint bays will be located below ground and finished/reinstated to the required national roads specification. Joint bays will have associated communication chambers and link boxes which will have a surface access hatch which will match existing ground levels. • Joint Bay 08 (JB08) will be located 689m after JB07 on the regional road (R-471) within the shoulder of this roadway prior to entering Truagh. An existing ESB MV OHL crosses this (R-471) roadway 107m east of JB07 • Joint Bay 09 (JB09) will be located within the (R-471) roadway, approx. 620m east of JB08. Noted is an OHL MV line running parallel to the (R-471)

	• Joint Bay 10 (JB10) will be located within the (R-471) roadway, approx. 660m east of JB09 and 208m subsequent to crossing the regional carriageway (R-465). • Joint Bay 11 (JB11) will be located within the (R-471) roadway approx. 640m southeast of JB10. The Joint bay will reside within a gated agricultural entrance. • Joint Bay 12 (JB12) will be located within the (L-3046) local roadway, approx. 807m east of JB11. JB11 is located north of the (R-471) post a road junction. • Joint Bay 13 (JB13) will be located within the (L-3046) local roadway, approx. 782m north of JB12. • Joint Bay 14 (JB14) will be located within the (L-3046) local roadway, approx. 789m north of JB13. • Joint Bay 15 (JB15) will be located within the (L-3046) roadway approx. 782m north east of JB14. The Joint bay will reside adjacent to a gated forestry access entrance. • Joint Bay 16 (JB16) will be located within the (L-3046) local roadway, approx. 764m north of JB15. Section 2 has 2 bride crossing: • The first bridge crosses over the Glenmora Wood Stream within the (R-471) approx. 160m prior to encountering JB09. Insufficient clearance exists within the bridge structure and it is proposed to cross this bridge utilizing the HDD method. • The second bridge crossing again exists within the (R-471) carriageway and is situated approx. 238m subsequent to JB10. The structure is twin arched and crossing by means of HDD will be utilized.
Section 3 OHL 6,140 m	**UGC within R-466 Carriageway, local roadway, Kilbane Village** Section 3 of the grid connection route joins onto the regional route (R-466) which requires passing two lanes of roadway at this junction before continuing for another circa 644m of carriageway before leaving this regional route onto a local public route. The UGC route carries for circa 474m, before encountering a fourth bridge (Bridge 4). This crossing will be carried out by means of installing the UGC within the bridge deck as it has been found that sufficient cover exists in the structure. Continuing along the proposed route for approx. 1.06km, a fifth proposed bridge (Bridge 5) crossing over the Glenomra River which will be crossed using HDD. On passing this structure the UGC continues for another circa. 903m to encounter a sixth bridge crossing over the along the proposed route which is situated within the small village area of Kilbane (Bridge 6), this bridge will also be crossed using HDD. Once passed the bridge structure over the crossed over the Kilbane stream, the UGC exits the Kilbane village and heads in a north-westerly direction past the townland of Upper Kilbane until the proposed route encounter a seventh bridge crossing over the Clonagaheen east stream (Bridge 7), it is proposed to cross this bridge by raising the level in the road in order to achieve sufficient depth to install the cable trench. Another bridge structure is situated circa

443m after the subsequent which crosses over the Clonagaheen west stream (Bridge 8), it is proposed to cross this bridge using HDD. The final bridge structure is situated circa 215m after the previous which crosses over O'Shea's Acres stream (Bridge 9).

Features

Section 3 contains 7 No. joint bays. Joint bays will be located below ground and finished/reinstated to the required national roads specification. Joint bays will have associated communication chambers and link boxes which will have a surface access hatch which will match existing ground levels.

- Joint Bay 17 (JB17) will be located approx. 768m north east of JB16 on the regional road of the (R-466)
- Joint Bay 18 (JB18) will be located within a paved local roadway, approx. 768m north east of JB17 and approx. 360m subsequent to the regional road (R-466). The Joint Bay will reside within a gated entrance to agricultural parcel.
- Joint Bay 19 (JB19) will be located within this paved local roadway, approx. 762m north of JB18. Prior to encountering this Joint Bay location, the UGC route will be required to cross beneath an existing TSO 400kV OHL transmission line, approx. 115m before JB19.
- Joint Bay 20 (JB20) will also be located within this paved local roadway, approx. 730m north of JB19.
- Joint Bay 21 (JB21) will also be located within this paved local roadway, approx. 822m north west of JB20. JB21 is located approx. 260m north of Kilbane village.
- Joint Bay 22 (JB22) will also be located within this paved local roadway, approx. 789m west of JB21. The Joint bay will reside within a shouldered road junction within this paved carriageway.
- Joint Bay 23 (JB23) will also be located within this paved local roadway, approx. 798m west of JB22.

Section 3 has 6 bridge crossings:

- The first bridge crossing within this section is (Bridge 4). This crossing will be carried out by means of installing the UGC within the bridge deck as it has been found that sufficient cover exists in the structure.
- The second bridge in this section is (Bridge 5) where the bridge crosses over the Glenmora River. Insufficient clearance exists within the bridge structure and it is proposed to cross this bridge adopting the HDD method before proceeding.
- The third bridge crossing within this section is (Bridge 6), where the proposed route crosses over a watercourse within the village of Kilbane. Insufficient clearance exists within the bridge structure and it is proposed to cross this bridge adopting the HDD method before proceeding.
- The forth bridge crossing within the section is (Bridge 7), where the UGC route crosses over the Clonagaheen east stream. Sufficient clearance exists within

	the bridge structure and it is proposed to cross this bridge within the deck of a new raised road level. • The fifth bridge crossing within this section is (Bridge 8), where the roadway crosses over the Clonagaheen west stream. Insufficient clearance exists within the bridge structure and it is proposed to cross this bridge adopting the HDD method before proceeding. • The sixth bridge crossing within this section is (Bridge 9), this structure is the crossing point over O'Shea's Acres stream. Insufficient clearance exists within the bridge structure and it is proposed to cross this bridge adopting the HDD method before proceeding towards the Windfarm site.
Section 4 UGC 8,080 m	**UGC within Access Roadway to Windfarm** The UGC route continues along the local road subsequent to Joint bay 23 for an additional 600m in a westerly direction until reaching a local roadway on the right-hand side. Thus, the UGC accesses this route and continues uphill for approximately 1.74km before the road becomes unpaved. From this point on, the unpaved roadway forms a forestry access track continuing in a northerly direction. On this route, the cable accesses the proposed Carrownagowan Wind Farm site boundary within, carrying on the use of these forestry access tracks further for approximately 5km until reaching the proposed location for the Independent Power Provider (IPP) substation. <u>Features</u> Section 4 contains 13 no. joint bays. Joint bays will be located below ground and finished/reinstated to the required roads specification or landowner requirements. Joint bays will have associated communication chambers and link boxes which will have a surface access hatch which will match existing ground levels. • Joint Bay 24 (JB24) will be located approx. 703m after JB23 on this access roadway heading in a north westerly direction. • Joint Bay 25 (JB25) will be located within the access roadway, approx. 701m north of JB24. • Joint Bay 26 (JB26) will be located within this access roadway also the joint bay will be set up approx. 681m after JB25 in a north westerly direction heading towards the Windfarm. • Joint Bay 27 (JB27) will be located approx. 670m after JB26, at this point the roadway will have become unpaved prior to accessing the privately-owned forestry lands. • Joint Bay 28 (JB28) will be located within this unpaved section and will have accessed the privately-owned forestry. Its location will exist approx. 674m north of JB27. • Joint Bay 29 (JB29) will be located within the privately-owned forestry access trackway approx. 681m north after JB28.

	• Joint Bay 30 (JB30) will be located within the windfarm access track approx. 749m north east of JB29. • Joint Bay 31 (JB31) will exist within the proposed windfarm access track approx. 751m north east of JB30. • Joint Bay 32 (JB32) will exist within the proposed windfarm access track approx. 752m north east of JB31. • Joint Bay 33 (JB33) will exist within the proposed windfarm access track approx. 749m north east of JB32. • Joint Bay 34 (JB34) will exist within the proposed windfarm access track approx. 752m north east of JB33. • Joint Bay 35 (JB35) will exist within the proposed windfarm access track approx. 749m north east of JB34. JB35 is approx. 267m outside of the windfarm substation.
Refer to Figure 1 and to the planning drawings submitted for location details. Note: The precise location of the proposed route within the planning application boundary is subject to change as result of existing services/utility locations, ground conditions and any environmental constraints.	

3.0 Access Routes to Work Area

The majority of the proposed underground cable will be installed within the public road network and therefore will be accessed via the existing road network. Where the cable route is located on private lands, contractor(s) will be required to utilise the local public road network in the vicinity of the work area and from there utilise private access tracks, where appropriate.

A detailed Traffic Management Plan will be prepared, and agreed with Clare County Council, prior to the commencement of construction. Some work areas will require a road closure where it is not possible to safely implement a Stop/Go system. Where road closures are necessary, a suitable diversion will be implemented using appropriate signage, following consultation with Clare County Council.

Careful and considered local consultation will be carried out, to minimise the amount of disturbance caused during works. Prior to the commencement of construction, the contractor will assess all access routes and determine any additional access requirements which will be incorporated as part of the method statement. All plant and equipment employed during the proposed works (e.g. diggers, tracked machines, footwear etc.) will be inspected prior to arrival on site and on leaving site and cleaned where necessary to prevent the spread of invasive aquatic / riparian species.

4.0 Traffic Management

Traffic management and road signage will be in accordance with the Department of Transport: Traffic Signs Manual - Chapter 8: Temporary Traffic Measures and Signs for Road Works and in agreement with Clare County

Council. All work on public roads will be subject to the approval of a road opening license application. The contractor will prepare detailed traffic management plans for inclusion as part of the road opening applications. Where road widths allow, the UGC installation works will allow for one side of the road to be open to traffic at all times by means of a 'Stop/Go' type traffic management system, where a minimum 2.5m roadway will be maintained at all times. Where it is not possible to implement a 'Stop/Go' system a full road closure will be required. Temporary traffic signals will be implemented to allow road users safely pass through the works area by channelling them onto the open side of the road. Typically, the UGC will be installed in 100m sections, and no more than 100m will be excavated without the majority of the previous section being reinstated. Where the construction requires the crossing of a road, works on one carriageway will be completed before the second carriageway is opened, to maintain traffic flows.

All construction vehicles will be parked within the works area so as not to cause additional obstruction or inconvenience to road users or residents. The traffic signals will be in place prior to the works commencing and will remain in place until after the works are completed. The public road will be checked regularly and maintained free of mud and debris. Road sweeping will be carried out as appropriate to ensure construction traffic does not adversely affect the local road condition.

In the event of emergency; steel plates, which will be available on site, can be put in place across the excavation to allow traffic to flow on both sides of the road.

All traffic management measures will comply with those outlined in the accompanying Traffic Management Report and will be incorporated into a detailed Traffic Management Plan to be prepared, in consultation with Clare County Council, prior to the commencement of development.

5.0 Road Opening Licence

The proposed grid connection works will require a road opening licence under Section 254 of the Planning and Development Act 2000-2015 from Clare County Council. A Traffic Management Plan (TMP) will be agreed with Clare County Council prior to the commencement of the development. The TMP will outline the location of traffic management signage, together with the location of any necessary road closures and the routing of appropriate diversions. Where diversions are required, these will be agreed with Clare County Council in advance of the preparation of the TMP.

6.0 Construction Hours

Standard working hours for construction will be 8.00am to 8.00pm Monday to Friday and 8.00am to 6.00pm on Saturday (if required), with no works on Sundays or Bank Holidays except in exceptional circumstances or in the event of an emergency. All site personnel will be required to wear project notification labelling on high visibility vests and head protection so that they can be easily identified by all workers on-site.

7.0 UGC Construction Methodology

The proposed UGC will consist of 3 No. 160mm diameter HDPE power cable ducts and 2 No. 125mm diameter HDPE communications duct to be installed in an excavated trench, typically 600mm wide by 1,315mm deep, with variations on this design to adapt to bridge crossings, service crossings and watercourse crossings, etc. The

power cable ducts will accommodate 3 No. power cables. The communications duct will accommodate a fibre cable to allow communications between the Carrownagowan Wind Farm substation and Ardnacrusha 110kV substation. The ducts will be installed, the trench reinstated in accordance with landowner/Clare County Council specification, and then the electrical cabling/fibre cable is pulled through the installed ducts in approximately 650/750m sections. Construction methodologies to be implemented and materials to be used will ensure that the UGC is installed in accordance with the requirements and specifications of ESB.

7.1 Trenching Methodology

The following section outlines the methodology to be followed during trenching works:-

- The Contractor, and their appointed Site Manager, will prepare a targeted Method Statement concisely outlining the construction methodology and incorporating all mitigation and control measures included within the planning application and accompanying reports and as required by planning conditions where relevant;
- All existing underground services shall be identified on site prior to the commencement of construction works;
- At watercourse crossings, the contractor will be required to adhere to the environmental control measures outlined within the planning application and accompanying reports, the detailed Construction Environmental Management Plan (CEMP) to be prepared prior to the commencement of construction, and best practice construction methodologies;
- Where the cable route intersects with culverts, the culvert will remain in place (where possible) and the ducting will be installed either above or below the culvert to provide minimum separation distances in accordance with ESB and Irish Water specifications;
- In the event that culverts require removal for ducting installation, it is proposed that a suitable method of damming the water source and pumping the water around the work area would be set out in a method statement and agreed with the relevant stakeholders. Once the ducts are installed the culvert will be reinstated to match existing levels and dimensions. If works of this nature are required, the contractor will liaise with Inland Fisheries Ireland in advance of works;
- Traffic management measures will be implemented in accordance with those included in the Traffic Management Report, and a detailed Traffic Management Plan will be prepared and agreed with Clare County Council;
- Excavated material will be temporarily stockpiled onsite for re-use during reinstatement. Stockpiles will be restricted to less than 2m in height. Stockpiles will be located a minimum of 50m from surface water features and all stockpiling locations will be subject to approval by the Site Manager and Project Ecological Clerk of Works (ECoW);
- Excavated material shall be employed to backfill the trench where appropriate and any surplus material will be transported off site and disposed of at a fully authorised soil recovery site;
- Any earthen (sod) banks to be excavated will be carefully opened with the surface sods being stored separately and maintained for use during reinstatement;
- The excavated trench will be dewatered if required, from a sump installed within the low section of the opened trench. Where dewatering is required, dirty water will be fully and appropriately attenuated, through silt bags, before being appropriately discharged to vegetation or surface water drainage feature;

- Where required, grass will be reinstated by either seeding or by replacing with grass turves;
- No more than a 100m section of trench will be opened at any one time. The second 100m will only be excavated once the majority of reinstatement has been completed on the first;
- The excavation, installation and reinstatement process will take on average of 1 no. day to complete a 100m section;
- Where the cable is being installed in a roadway, temporary reinstatement may be provided to allow larger sections of road to be permanently reinstated together;
- Following the installation of ducting, pulling the cable will take approximately 1 no. day between each joint bay, with the jointing of cables taking approximately 1 week per joint bay location.

Figure 2 Typical 110kV Underground Duct Installation

7.2 Ducting Installation Methodology

For the trenching and ducting works the following step by step methodology will apply:

1. Grade, smooth and trim trench floor when the required 1315mm depth and 600mm width have been obtained.
2. Place bedding layer of Cement Bound Granular Mixture B (CBGM B) material in accordance with the specification and compact it so that the compacted thickness is as per the drawings.
3. Lay the bottom row of ducts in trefoil formation as detailed on the design drawings. Use spacers as appropriate to establish horizontal duct spacing. Fit a secure cap / bung to the end of each duct run to prevent the ingress of dirt or water.
4. Carefully surround and cover ducts with CBGM B in accordance with the design drawings and specifications and thoroughly compact without damaging ducts.
5. Place cable protection strips on compacted CBGM B directly over the ducts.
6. Lay the top row of ducts onto the freshly compacted CBGM B including the cable protection strips above the bottom row of ducts. Place a secure cap at the end of each duct to prevent the ingress of dirt or water.

7. Carefully surround and cover ducts with CBGM B material in accordance with the drawings and thoroughly compact without damaging ducts.
8. Place red cable protection strip on top of compacted CBGM B over each set of ducts as shown on the drawings.
9. Place and thoroughly compact CBGM B material or Clause 804 backfill or soil backfill as specified and place warning tape at the depth shown on the drawings.
10. For concrete and asphalt/bitmac road sections, carry out immediate permanent reinstatement in accordance with the specification and to the approval of the local authority and/or private landowners, unless otherwise agreed with local authorities **(Figure 3)**.
11. For unsurfaced/grass sections, backfill with suitable excavated material to ground level leaving at least 100 mm topsoil or match existing level at the top to allow for seeding or replace turves as per the specification of the local authority or landowner **(Figure 4)**.
12. Clean and test the ducts in accordance with the specification by pulling through a brush and mandrel. Install 12 mm polypropylene draw rope in each duct and seal all ducts using robust duct end seals fitted with rope attachment eyes in preparation for cable installation at a later date. All the works should be witnessed by ESBN Clerk of Works (CoW) as required.

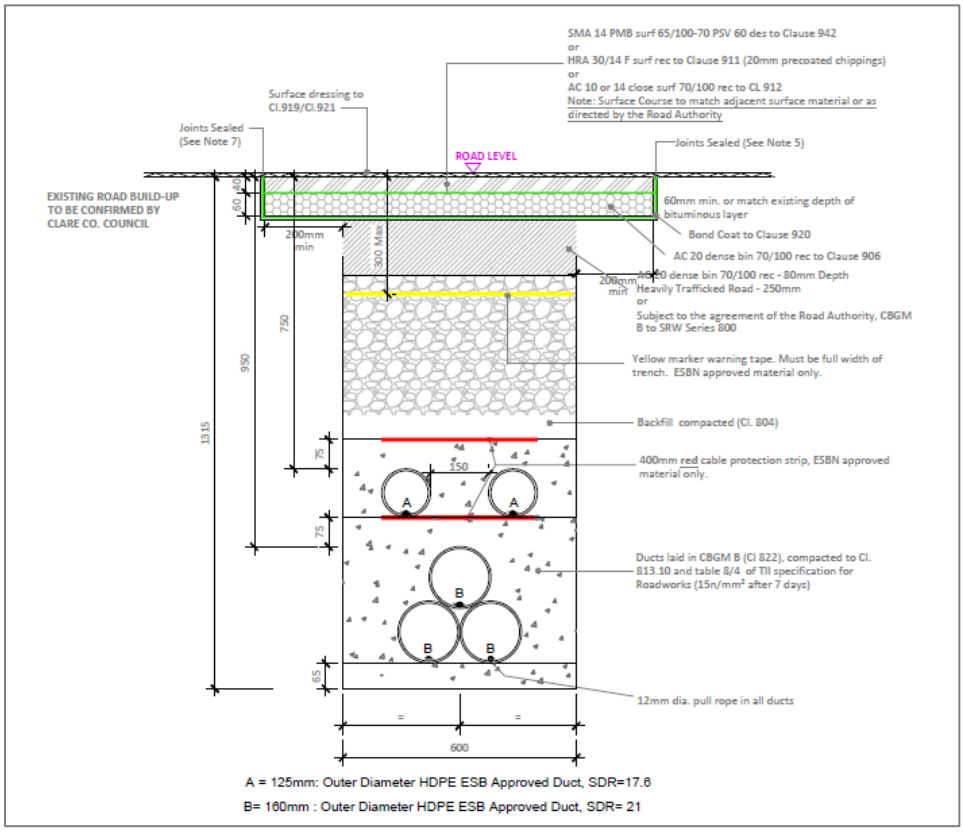


Figure 3 Typical Trench in Roadway

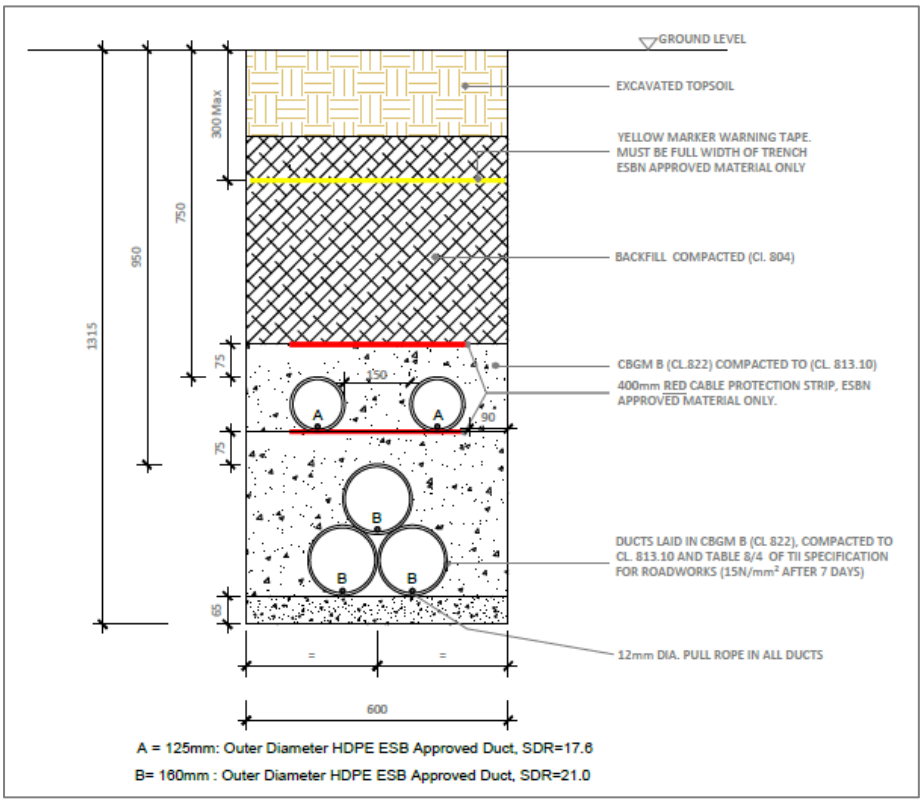


Figure 4 Typical Trench in Off Road Section

Equipment:

- 2-3 General Operatives;
- 1 Excavator Operator;
- 1 no. tracked excavator (only rubber tracked machines will be allowed on public roads);
- 1 no. dumper or tractor and trailer.

Materials:

- Sand for pipe bedding;
- Ready-mix Concrete where necessary (delivered to site);
- Trench backfilling material (excavated material and aggregates) to relevant specifications;
- 160mm diameter HDPE ducting;
- 125mm diameter HDPE ducting;
- Temporary Surface Reinstatement Materials

7.2.1 On Public Road

The majority of the 110kV route is located within road carriages and where applicable the trench will be in the non-trafficked strip between the wheel marks on the road, presence of exiting utilities and the nature of the road and the adjoining terrain. It is preferable to excavate a trench within the middle of the lane, or the middle of the roadway to reduce load on the cable.

7.2.2 On Private Tracks

Where the cable is installed in private tracks the location where the cable is laid will depend on several factors, width of track, bends along the track and crossings. Where the track needs to be widened stone will be brought in to build up the area to the same level of the track. The excess material from the track will be used elsewhere on reinstatement works.

7.3 Marker posts

Surface cable markers will be placed along the route where cable depth is unavoidably shallow, due to constraints such as existing services, to indicate the precise location of the UGC. These markers will be metallic plates in accordance with ESB standards.

Marker posts will be used on non-roadway routes to delineate the cable route and joint bay positions. Corrosion proof aluminium triangular danger sign, with 700mm base, and with centred lightning symbol, on engineering grade fluorescent yellow background shall be installed in adequately sized concrete foundations. Marker post shall also be placed in the event that burial depth is not to standard. Siting of marker posts to be dictated by ESBN as part of the detailed design process. **(Figure 5)** below

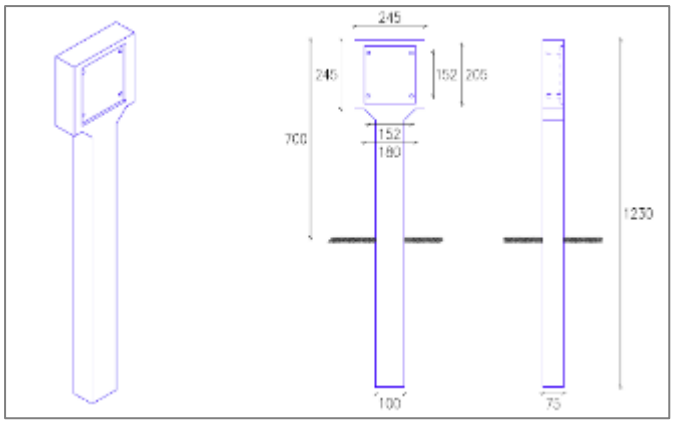


Figure 5 Typical ESB Marker Posts Example

7.4 Horizontal Direction Drilling (HDD)

Horizontal Direction Drilling (HDD) is a method of drilling under obstacles such as bridges, railways, water courses, etc. in order to install cable ducts under the obstacle. This method is employed where installing the ducts using standard installation methods is not possible. There are a number of bridges on this UGC route which will require HDD due to there being insufficient cover and depth in the bridge to cross within the bridge deck. The proposed drilling methodology is as follows: -

1. A works area of circa .40m^2 will be fenced on both sides of the river crossing,
2. The drilling rig and fluid handling units will be located on one side of the bridge and will be stored on double bunded 0.5mm PVC bunds which will contain any fluid spills and storm water run-off.
3. Entry and exit pits (1m x 1m x 2m) will be excavated using an excavator, the excavated material will be temporarily stored within the works area and used for reinstatement or disposed of to a licensed facility.
4. A 1m x 1m x 2m steel box will be placed in each pit. This box will contain any drilling fluid returns from the borehole.

5. The drill bit will be set up by a surveyor, and the driller will push the drill string into the ground and will steer the bore path under the watercourse.
6. A surveyor will monitor drilling works to ensure that the modelled stresses and collapse pressures are not exceeded.
7. The drilled cuttings will be flushed back by drilling fluid to the steel box in the entry pit.
8. Once the first pilot hole has been completed a hole-opener or back reamer will be fitted in the exit pit and will pull a drill pipe back through the bore to the entry side.
9. Once all bore holes have been completed, a towing assembly will be set up on the drill and this will pull the ducting into the bore.
10. The steel boxes will be removed, with the drilling fluid disposed of to a licensed facility.
11. The ducts will be cleaned and proven and their installed location surveyed.
12. The entry and exit pits will be reinstated to the specification of ESB Networks and Clare County Council.
13. A transition coupler will be installed at either side of the bridge/ following the horizontal directional drilling as per ESB requirements, this will join the HDD ducts to the standard ducts.

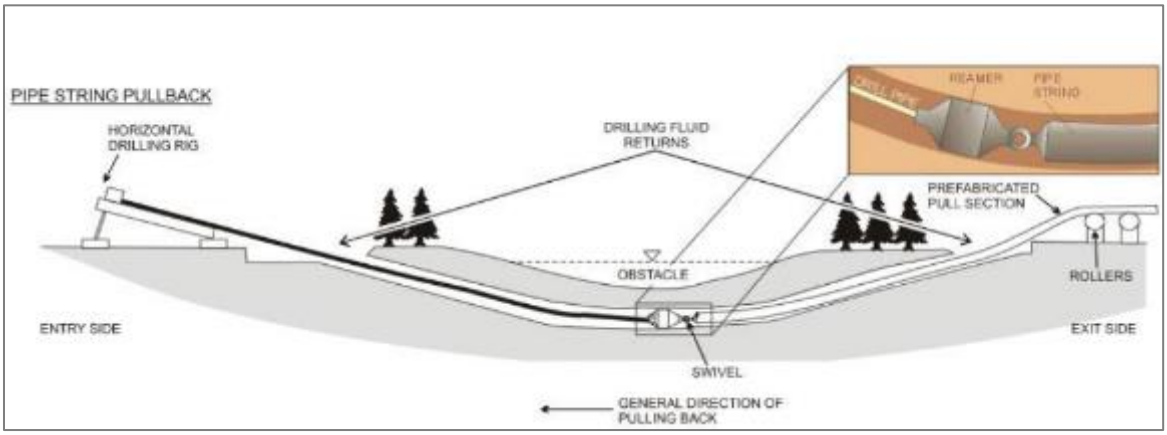


Figure 6 - Typical HDD Installation

7.5 Managing Excess Material from Trench

All excavated material will be temporarily stored adjacent to the trench prior to re-use in the trench reinstatement (where applicable). Stockpiles will be restricted to less than 2m in height. Where excess material exists, it may be used in the reinstatement of the Carrownagowan Wind Farm site or disposed of to a licensed facility.

7.6 Storage of Plant and Machinery

All plant, machinery and equipment will be stored on site within the works area or within the temporary construction compound to be located within Carrownagowan Wind Farm. Oils and fuels will not be stored on site and will be stored in an appropriately bunded area within the temporary storage compound.

7.7 Joint Bays and Associated Chambers

Joints Bays are to be installed approximately every 650m - 750m along the UGC route to facilitate the jointing of 2 No. lengths of UGC. Joint Bays are typically 2.5m x 6m x 1.75m pre-cast concrete structures installed below finished ground level. Joint Bays will be located in the non-wheel bearing strip of roadways, however given the narrow profile of local roads this may not always be possible.

In association with Joint Bays, Communication Chambers are required at every joint bay location to facilitate communication links between the Carrownagowan Wind Farm substation and the existing 110kV substation at Ardnacrusha. Earth Sheath Link Chambers are also required at every joint bay along the cable route. Earth Sheath Links are used for earthing and bonding cable sheaths of underground power cables, so that the circulating currents and induced voltages are eliminated or reduced. Earth Sheath Link Chambers and Communication Chambers are located in close proximity to Joint Bays. Earth Sheath Link Chambers and Communication Chambers will typically be pre-cast concrete structures with an access cover at finished surface level.

The precise siting of all Joint Bays, Earth Sheath Link Chambers and Communication Chambers is subject to approval by ESBN. Marker posts will be used on non-roadway routes to delineate the duct route and joint bay positions.

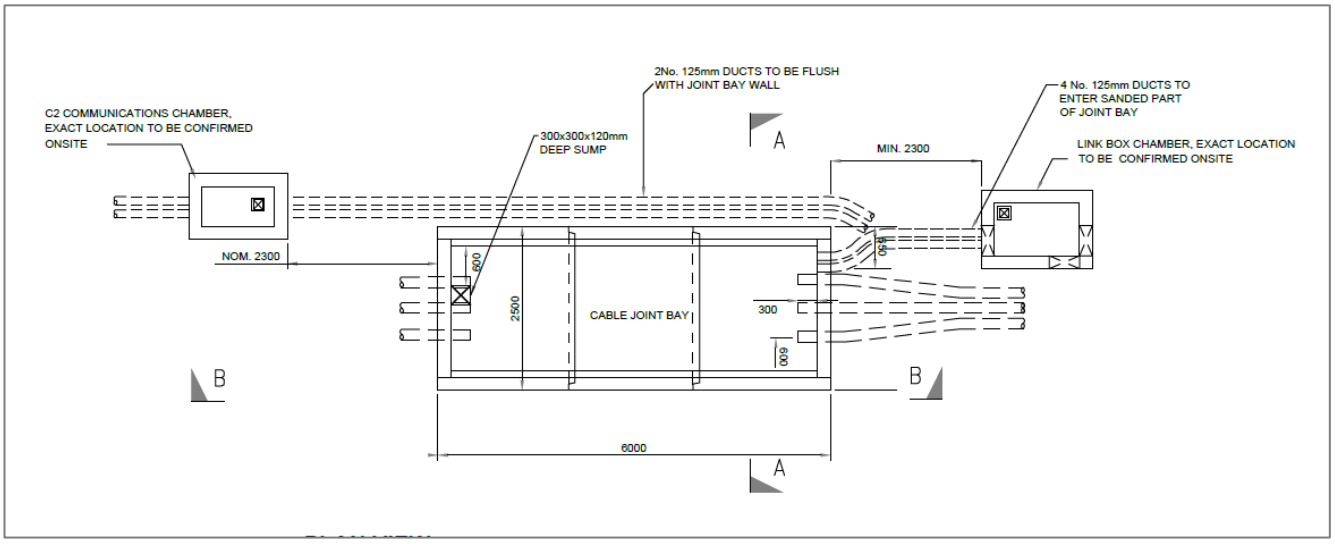


Figure 7 - 110kV Joint Bay Plan Layout

7.8 Joint Bay Construction and Cable Installation

Before starting to construct, the area around the edge of the proposed joint bay which will be used by heavy vehicles will be surfaced with a terram cover if required and stone aggregate to minimise ground damage. Any roadside drains within the temporary works area will be culverted and check dams made from stone or sandbags covered with terram will be inserted upstream and downstream of these culverts to intercept any solids generated during the insertion or which wash out during the works. If the ground slopes from the working area toward a watercourse or if there is evidence of solids washing off the works area toward nearby watercourses or drains, a silt fence with straw bales, will be interposed between the works area and the watercourse.

All excavated material will be stored near the excavations and reused for reinstatement works. Any soil required for reinstatement that will be temporarily stockpiled on site will be placed at least 15m back from the nearest watercourse on level ground and will be ringed at the base by silt fencing and be regularly monitored by a

designated competent person for signs of solids escape. In which case an additional line of silt fencing with straw bales will be added in line with the relevant ECM.

If the joint bay needs to be dewatered, this will be pumped to a percolation area if the soil is not saturated, otherwise a settlement tank will be used to remove any solids from the dewatering process to comply with the ECM.

The risk of concrete reaching surface waters is considered very low given that all concrete will be poured into the pit excavated for the joint bay so that spills will be contained. The basic requirement therefore is that all pouring operations be constantly supervised to prevent accidental spillages occurring outside the pit.

Temporary storage of cement bound sand (if required) will be on hardstand areas only where there is no direct drainage to surface waters and where the area has been bunded e.g. using sand-bags and geotextile sheeting or silt fencing to contain any solids in run-off.

The following steps outline the methodology for joint bay construction and reinstatement:

1. The contractor will excavate a pit for joint bay construction, including for a sump in one corner.
2. Grade and smooth floor; then lay a 75 mm depth of blinding concrete (for in situ construction) or 50 mm thick sand (for pre-cast concrete construction) on 200 mm thick Clause 804 granular material.
3. In situ construction. Construct 200 mm thick reinforced concrete floor slab with sump and starter bars placed for walls as detailed on the drawings.
4. In situ construction. Construct 200 mm thick reinforced concrete sidewalls as detailed on the drawings. (**Figure 7**)

Figure 8 - Typical joint bay under construction (in-situ)

5. In situ construction. Remove formwork and backfill with suitable backfill material in grassed areas or Clause 804 material once ducting has been placed in the bay. Backfill externally with granular material to Co. Council/TII Specification for Roadworks. (**Figure 8**)

Figure 9 - Completed joint bay prior to cable installation (in-situ)

6. Pre-cast concrete construction. Place pre-cast concrete sections on sand bedding. (**Figure 9**)

Figure 10 - Typical joint bay under construction (pre-cast)

7. Where joint bays are located under the road surface the joint bay will be backfilled with compacted layers of Clause 804 and the road surface temporarily reinstated as specified by the local authority.

8. Precast concrete covers may be used as temporary reinstatement of joint bays at off road locations. These covers are placed over the constructed joint bay and are then removed at the cable installation stage of the project.

9. At a later date to facilitate cable installation and jointing, reinstate traffic management signage, secure individual sites, re-excavate three consecutive joint bays and store excavated material for reuse.

10. The cable is supplied in pre-ordered lengths on large cable drums (**Figure 10**). Installing "one section" of cable normally involves pulling three individual conductors into three separate ducts. The cable pulling winch must be set at a predetermined cut off pulling tension as specified by the designer. The cable will be connected to the winch rope using approved suitably sized and rated cable pulling stocking and swivel or the pulling head fitted by the cable manufacturer**.** A sponge may also be secured to the winch rope to disperse lubricant through the duct. Lubrication is also applied to the cable in the joint bay before it enters the duct.

Figure 11 - HV cable pulling procedure (Typical drum set-up)

11. Once the "two sections" of cable (total of 6 conductors) are pulled into the joint bay, a jointing container is positioned over the joint bay and the cable jointing procedure is carried out in this controlled environment. (**Figure 12**)

Figure 12 - HV cable jointing container

12. Following the completion of jointing and duct sealing works in the joint bay, place and thoroughly compact cement-bound sand in approximately 200 mm layers to the level of the cable joint base to provide vertical support. Install additional layers of cement-bound sand and compact each layer until the cement-bound sand is level with the top of the joint. Install an additional 100 mm cement-bound sand layer. Install cable protection strip. Backfill with cement-bound sand to a depth of 250 mm below surface and carry out permanent reinstatement including placement of warning tape at 400 mm depth below finished surface.

Equipment:

- 2-3 General Operatives
- 1 Excavator Operator
- 360˚ tracked excavator (13 ton normally, 22 ton for rock breaker)
- 1 no. tracked dumper or tractor and trailer

Materials:

- Sand for pipe bedding
- Blinding Concrete where necessary
- Clause 804 Material
- 160mm diameter HDPE ducting;
- 125mm diameter HDPE ducting;
- Precast Chamber Units / Relevant construction materials for chambers
- Link Box

8.0 Relocation of Existing Services

In order to facilitate the installation of the proposed underground cable, it may be necessary to relocate existing underground services such as water mains, gas networks or existing cables. In advance of any construction activity, the contractor will undertake detailed surveys and scans of the proposed route to confirm the presence or otherwise of any services. If found to be present, the relevant service provider will be consulted with in order to determine the requirement for specific excavation or relocation methods and to schedule a suitable time to carry out works.

9.0 Major Watercourse Crossings

The proposed cable route will involve 9 No. bridge crossings including 7 No. HDD crossings and 2 No. crossings in the road on the bridge. Where the cable route intersects with existing watercourses, a detailed construction method statement will be prepared by the Contractor prior to the commencement of construction and is to be approved by the Local Authority and relevant environmental agencies. The cable will be located within the bridge deck where there is sufficient depth and width available on the bridge, where there is insufficient depth and width available horizontal directional drilling (HDD) may be employed as an alternative.

Inland Fisheries Ireland have published guidelines relating to construction works along water bodies entitled 'Requirements for the Protection of Fisheries Habitats during Construction and Development Works at River Sites", and these guidelines will be adhered to during the construction of the proposed development.

Numerous other minor watercourses crossing locations have been noted along the proposed cable route i.e. culverts, pipe drains. The majority of these minor watercourses have been identified as part of the survey works and a proposed crossing schedule has been included as part of this report, see Appendix A.

9.1 Bridge 1 - Horizontal Directional Drilling

Coordinates: 52.740281, -8.616893

Bridge 1 has insufficient room to install the cable to ESB specification (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. It is proposed to horizontal directional drill (HDD) approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.**

See Drawing 05641-231 for further details.

Figure 14 - Bridge 1

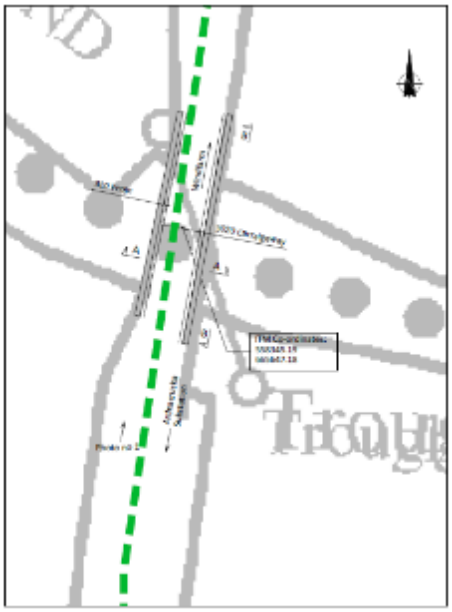


Figure 13 - Bridge 1 Location

9.2 Bridge 2 - Horizontal Directional Drilling

Coordinates: 52.743186, -8.60830

Bridge 2 has insufficient room to install the cable to ESB specification (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. It is proposed to horizontal directional drill (HDD) approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.**

See Drawing 05641-232 for further details.

Figure 15 Bridge 2

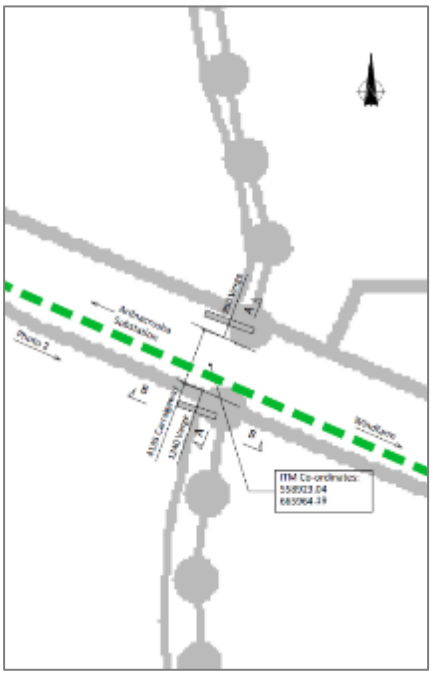


Figure 16 Bridge 2 Location

9.3 Bridge 3 - Horizontal Directional Drilling

Coordinates: 52.742639, -8.592507

Bridge 3 has insufficient room to install the cable to ESB specification (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. It is proposed to horizontal directional drill (HDD) approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.**

See Drawing 05641-233 for further details.

Figure 17 Bridge 3

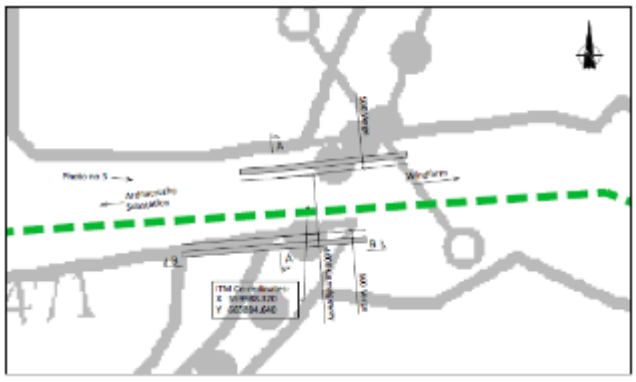


Figure 18 Bridge 3 Location

9.4 Bridge 4 – Instatement within Road deck

Coordinates: 52.786869, -8.558068

Bridge 4 has been found to have sufficient deck cover within the structure to accommodate UGC to comply with specifications. The installation can be carried out within a Trefoil arrangement with a depth of 1315mm. This permanent reinstatement of a local route can be seen as per Drawing No. 05441-222 with reinstatement of the bridge deck to be carried and will be completed to the specification of the Local Authority.

See Drawing 05641-234 for further details.

Figure 19 Bridge 4

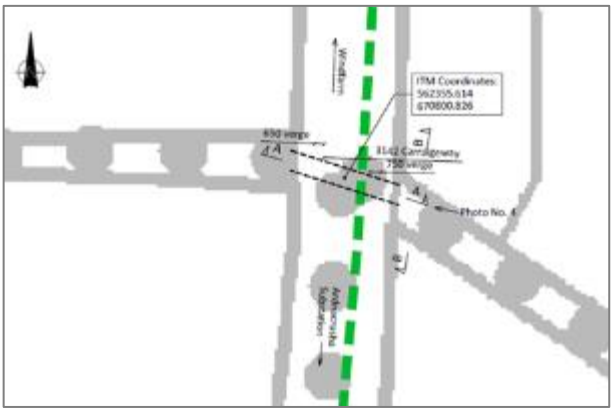


Figure 20 Bridge 4 Location

9.5 Bridge 5 - Horizontal Directional Drilling

Coordinates: 52.796315, -8.557663

Bridge 5 has insufficient room to install the cable to ESB specification (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. It is proposed to horizontal directional drill (HDD) approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway.

See Drawing 05641-235 for further details.

Figure 21 - Bridge 5

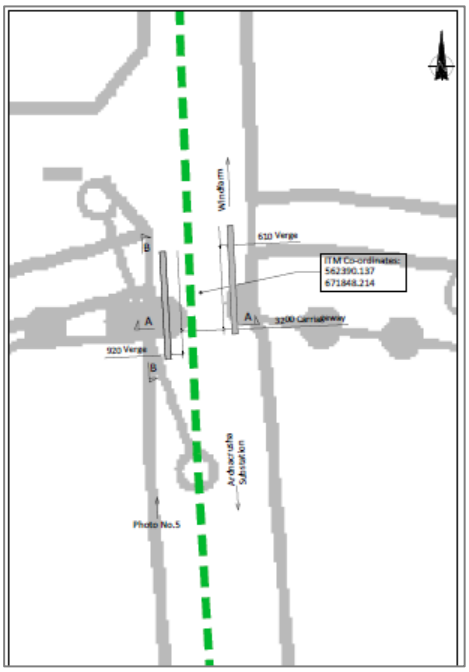


Figure 22 - Bridge 5 Location

9.6 Bridge 6 - Horizontal Directional Drilling

Coordinates: 52.803452, -8.563740

Bridge 6 has insufficient room to install the cable to ESB specification (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. It is proposed to horizontal directional drill (HDD) approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway.

See Drawing 05641-236 for further details.

Figure 24 Bridge 6

Figure 23 Bridge 6 location

9.7 Bridge 7 – Raise Road Level

Coordinates: 52.805521, -8.569268

It is proposed to cross Bridge 7 by installing the cable ducts in a trench on the deck of the bridge. Initial visual surveys have indicated insufficient room to install the cable to ESB specification (450mm cover to ducts) as per the current bridge design. The road finish will therefore need to be raised over the length of the bridge in order to achieve the required cover for the ducts. The height of the bridge parapets will also need to be raised in order to achieve 1250mm high guarding with the need road height. Reinstatement of works will be completed to the specification of the Local Authority.

A surface cable marker (metallic plate; 300mm x150mm to ESB standard) will be placed on the bridge where cable depth is unavoidably shallow.

Further consultation with the County Council's Roads Department will be necessary to agree if a handrail is required at 1100mm in height from the highest surface on the bridge.

See Drawing 05641-237 for further details.

Figure 26 Bridge 7

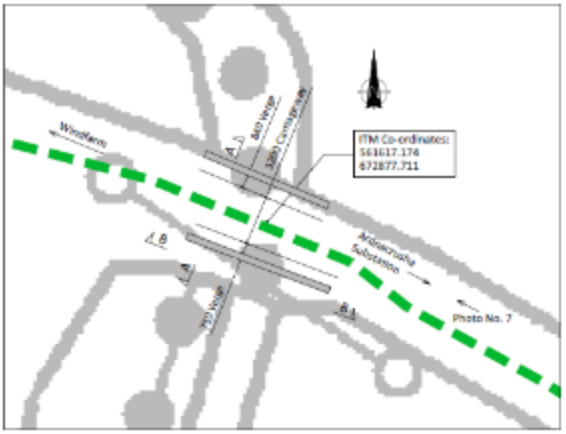


Figure 25 - Bridge 7 Location

9.8 Bridge 8 - Horizontal Directional Drilling

Coordinates: 52.806140, -8.583065

Bridge 8 has insufficient room to install the cable to ESB specification (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. It is proposed to horizontal directional drill (HDD) approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway.

See Drawing 05641-238 for further details.

Figure 27 - Bridge 8

Figure 28 - Bridge 8 Location

9.9 Bridge 9 - Horizontal Directional Drilling

Coordinates: 52.805843, -8.586053

Bridge 9 has insufficient room to install the cable to ESB specification (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. It is proposed to horizontal directional drill (HDD) approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway.

See Drawing 05641-239 for further details.

Figure 29 - Bridge 9

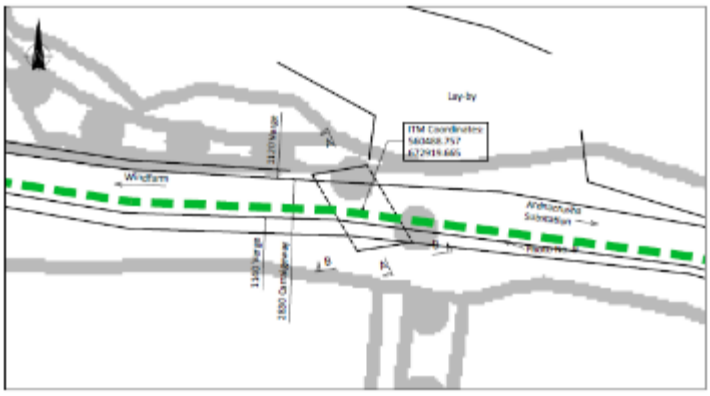


Figure 30 - Bridge 9 Location

10.0 Reinstatement of Private Land

Once all construction works are complete, the work areas will be reinstated with excavated soil and either seeded out with native species, allowed to vegetate naturally or reinstated with excavated grass turves and will be restored to their original condition. This work will be carried out in in consultation with the landowner and in line with any relevant measures outlined in the planning application, CEMP and planning conditions.

11.0 Best Practice Design and Construction & Environmental Management Methodology

Prior to commencement of construction works the contractor will draw up detailed Method Statements which will be informed by this Outline Construction Methodology, environmental protection measures included within the planning application, measures proposed within the CEMP, and the guidance documents and best practice measures listed below. This method statement will be adhered to by the contractors and will be overseen by the Project Manager, Environmental Manager and ECoW where relevant.

The following documents will contribute to the preparation of the method statements in addition to those measures proposed below: -

- Inland Fisheries Ireland (2016) *Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters*. Inland Fisheries Ireland*, Dublin,*
- *National Roads Authority (2008) Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*. National Roads Authority, Dublin;
- E. Murnane, A. Heap and A. Swain. (2006) *Control of water pollution from linear construction projects.* Technical guidance (C648). CIRIA;
- E. Murnane et al., (2006) *Control of water pollution from linear construction projects*. Site guide (C649). CIRIA.
- Murphy, D. (2004) Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites. Eastern Regional Fisheries Board, Dublin;
- H. Masters-Williams et al (2001) *Control of water pollution from construction sites. Guidance for consultants and contractors* (C532);
- Enterprise Ireland (unknown). *Best Practice Guide (BPGCS005) Oil storage guidelines;*
- Law, C. and D'Aleo, S. (2016) *Environmental good practice on site pocket book*. (C762) 4th edition. CIRIA;
- CIRIA *Environmental Good Practice on Site (fourth edition) (C741) 2015*.

The proposed works will be carried out by employing accepted good work practices during construction, and environmental management measures such as those discussed below. Please note that the following measures will be supplemented by further specific environmental protection measures that will be included in method statements prepared for specific tasks during the works and will form part of the detailed CEMP.

- All materials shall be stored at the temporary compound within the Carrownagowan Wind Farm site and transported to the works zone immediately prior to construction;
- Where drains and watercourses are crossed with underground cables, the release of sediment will be prevented through the implementation of best practice construction methodologies.

- Weather conditions will be considered when planning construction activities to minimise risk of run off from site;
- Provision of 50m exclusion zones and barriers (silt fences) between any excavated material and any surface water features to prevent sediment washing into the receiving water environment;
- If dewatering is required as part of the proposed works e.g. in trenches for underground cabling or in wet areas, water must be treated prior to discharge;
- The contractor shall ensure that silt fences are regularly inspected and maintained during the construction phase;
- If very wet ground must be accessed during the construction process bog mats/aluminium panel tracks will be used to enable access to these areas by machinery. However, works will be scheduled to minimise access requirements during winter months;
- The contractor shall ensure that all personnel working on site are trained in pollution incident control response. A regular review of weather forecasts of heavy rainfall is required, with the Contractor required to prepare a contingency plan for before and after such events;
- The contractor will carry out visual examinations of local watercourses from the proposed works during the construction phase to ensure that sediment is not above baseline conditions. In the unlikely event of water quality concerns, the Environmental Manager and ECoW will be consulted;
- Excavations will be left open for minimal periods to avoid acting as a conduit for surface water flows.
- Only emergency breakdown maintenance will be carried out on site. Emergency procedures and spillage kits will be available and construction staff will be familiar with emergency procedures.
- Appropriate containment facilities will be provided to ensure that any spills from vehicles are contained and removed off site. Adequate stocks of absorbent materials, such as sand or commercially available spill kits shall be available;
- Concrete or potential concrete contaminated water run-off will not be allowed to enter any watercourses. Any pouring of concrete (delivered to site ready mixed) will only be carried out in dry weather. Washout of concrete trucks shall be strictly confined to a designated and controlled wash-out area within the Carrownagowan Wind Farm site; remote from watercourses, drainage channels and other surface water features;
- Entry by plant equipment, machinery, vehicles and construction personnel into watercourses or wet drainage ditches shall not be permitted. All routes used for construction traffic shall be protected against migration of soil or waste water into watercourses;
- Cabins, containers, workshops, plant, materials storage and storage tanks shall not be located near any surface water channels and will be located beyond the 50m hydrological buffer at all times.

12.0 Invasive Species Best Practice Measures

Invasive species can be introduced into a location by contaminated plant, machinery and equipment which were previously used in locations that contained invasive species. Good site organisation and hygiene management shall be maintained always on site, and best practice measures will be implemented, as follows:

- The contractor will prepare an Invasive Species Action Plan to be implemented during construction, and all personnel will be made aware of the requirements contained within;
- Plant and machinery will be inspected upon arrival and departure from site and cleaned/washed as necessary to prevent the spread of invasive aquatic / riparian species such as Japanese knotweed

Fallopia japonica and Himalayan Balsam *Impatiens glandulifera*. A sign off sheet will be maintained by the contractor to confirm the implementation of measures;

- Site hygiene signage will be erected in relation to the management of non-native invasive material.

13.0 Waste Management

All waste arising during the construction phase will be managed and disposed of in a way that ensures the provisions of the Waste Management Act 1996 and associated amendments and regulations and the Waste Management Plan. Soil will be reinstated into trenches where possible. In the event, there is excess material with no defined purpose, it will be transported to an authorised soil recovery site.

Appendix A – Culvert Crossings

Culvert Crossing Schedule					
Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Proposed Crossing Methodology	Photo
1.	350 Ø	Concrete	900	UNDERCROSSING	
2.	300 Ø	HDPE	200	UNDERCROSSING	
3.	2x600 Ø	Concrete	1800	OVERCROSSING	
4.	600 wide x 800 deep	Stone	1000	UNDERCROSSING	
5.	600 Ø	HDPE	200	UNDERCROSSING	
6.	250 Ø	Concrete	500	UNDERCROSSING	
7.	600 Ø	Concrete	700	UNDERCROSSING	
8.	400 wide x 500 deep	Stone	900	UNDERCROSSING	
9.	600 wide x 500 deep	Stone	900	UNDERCROSSING	

Culvert Crossing Schedule					
Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Proposed Crossing Methodology	Photo
10.	600 Ø	HDPE	500	UNDERCROSSING	
11.	300 Ø	HDPE	600	UNDERCROSSING	
12.	2x750 Ø	HDPE	2000	OVERCROSSING	
15.	300 Ø 375 Ø	HDPE HDPE	600 700	UNDERCROSSING	
16.	375 Ø	HDPE	700	UNDERCROSSING	
17.	375 Ø	HDPE	650	UNDERCROSSING	
18.	375 Ø	HDPE	350	UNDERCROSSING	
19.	600 Ø	HDPE	800	UNDERCROSSING	

Culvert Crossing Schedule					
Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Proposed Crossing Methodology	Photo
22.	600 Ø	Concrete	550	UNDERCROSSING	
23.	300 Ø	Concrete	600	UNDERCROSSING	
24.	250 Ø	HDPE	100	UNDERCROSSING	
25.		NEW CONCRETE ARCH CULVERT TO BE INSTALLED OVER RIVER		OVERCROSSING	
26.	450 Ø	CONCRETE	1000	UNDERCROSSING	
27.	300 Ø	CONCRETE	750	UNDERCROSSING	
28.	900 (Width per span)	Two Span Masonry	700	UNDERCROSSING