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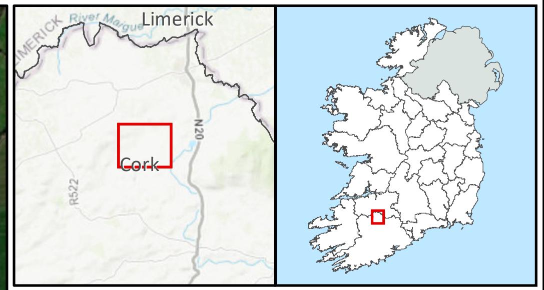

Legend

- Site Boundary
- Turbine Layout 500m Buffer
- Turbine Layout

Flightlines

ID, Date, Time:

- 67, 25/05/2020, 14:46
- 211, 04/09/2020, 08:34
- 212, 04/09/2020, 08:51
- 214, 04/09/2020, 09:32
- 215, 04/09/2020, 09:57
- 216, 04/09/2020, 11:14
- 217, 04/09/2020, 12:37

TITLE:	Summer 2020 Flightlines Lesser Black-backed Gull		
PROJECT:	Annagh Wind Farm, Co. Cork		
FIGURE NO:	8E.2		
CLIENT:	EMPower		
SCALE:	1:12500	**REVISION:**	0
DATE:	13/10/2021	**PAGE SIZE:**	A3

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0.5 0.25 0 0.5 Kilometers

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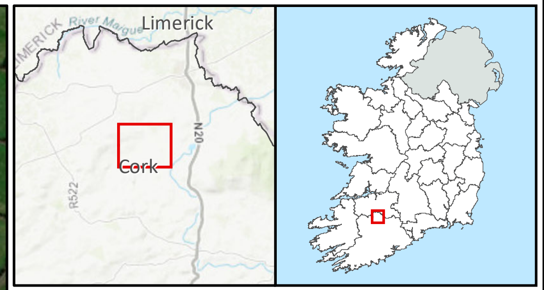

Legend

Site Boundary

Turbine Layout 500m Buffer

Turbine Layout

Flightlines

ID, Date, Time:

53, 27/04/2020, 18:22

TITLE:	Summer 2020 Flightlines Little Egret
PROJECT:	Annagh Wind Farm, Co. Cork
FIGURE NO:	8F.2
CLIENT:	EMPower
SCALE: 1:12500	**REVISION:** 0
DATE: 13/10/2021	**PAGE SIZE:** A3

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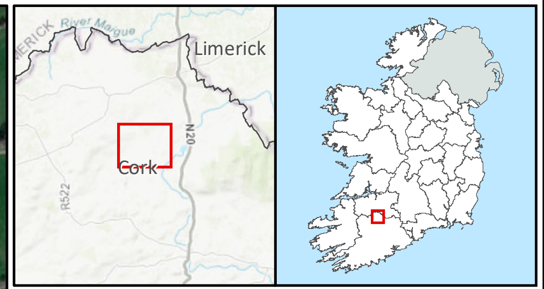

Legend

Site Boundary

Turbine Layout 500m Buffer

Turbine Layout

Flightlines

ID, Date, Time:

213, 04/09/2020, 08:59

TITLE:	Summer 2020 Flightlines Mallard		
PROJECT:	Annagh Wind Farm, Co. Cork		
FIGURE NO:	8Y.2		
CLIENT:	EMPower		
SCALE:	1:12500	**REVISION:**	0
DATE:	13/10/2021	**PAGE SIZE:**	A3

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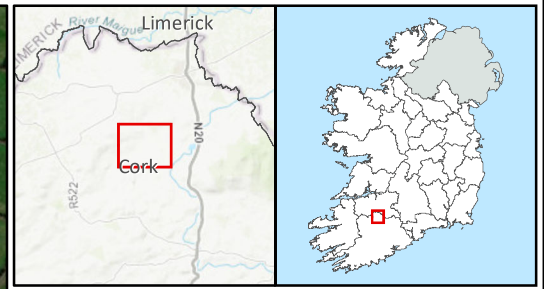

Legend

Site Boundary

Turbine Layout 500m Buffer

Turbine Layout

Flightlines

ID, Date, Time:

92, 04/11/2020, 14:54

TITLE:	Winter 2020 - 2021 Flightlines Mallard
PROJECT:	Annagh Wind Farm, Co. Cork
FIGURE NO:	8Y.2
CLIENT:	EMPower
SCALE: 1:12500	**REVISION:** 0
DATE: 13/10/2021	**PAGE SIZE:** A3

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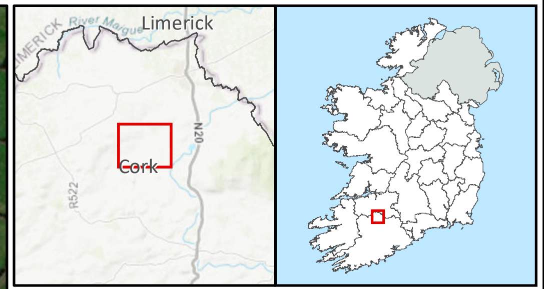

Legend

Site Boundary

Turbine Layout 500m Buffer

Turbine Layout

Flightlines

ID, Date, Time:

101, 18/12/2020, 13:05

137, 15/02/2021, 16:06

TITLE:	Winter 2020 - 2021 Flightlines Peregrine
PROJECT:	Annagh Wind Farm, Co. Cork
FIGURE NO:	8T.2
CLIENT:	EMPower
SCALE: 1:12500	**REVISION:** 0
DATE: 13/10/2021	**PAGE SIZE:** A3

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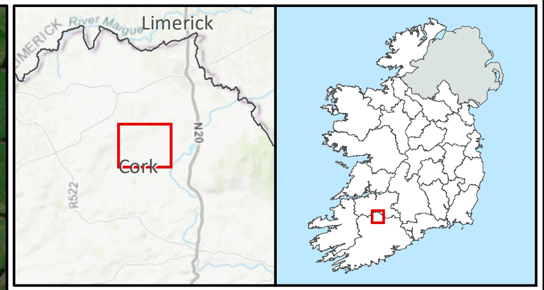

Legend

Site Boundary

Turbine Layout 500m Buffer

Turbine Layout

Flightlines

ID, Date, Time:

114, 18/01/2021, 11:00

115, 18/01/2021, 11:06

118, 18/01/2021, 14:07

121, 18/01/2021, 16:19

144, 04/03/2021, 12:12

145, 04/03/2021, 12:16

146, 04/03/2021, 12:17

148, 04/03/2021, 12:27

TITLE:	Winter 2020 - 2021 Flightlines Snipe
PROJECT:	Annagh Wind Farm, Co. Cork
FIGURE NO:	8Q.2
CLIENT:	EMPower

SCALE:	1:12500	**REVISION:**	0
DATE:	13/10/2021	**PAGE SIZE:**	A3

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Kilometers

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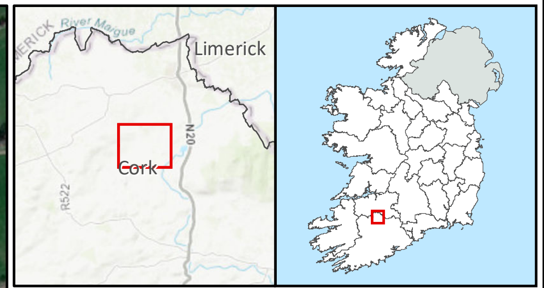

Legend

- Site Boundary
- Turbine Layout 500m Buffer
- Turbine Layout

Flightlines

ID, Date, Time:

- 54, 27/04/2020, 18:23
- 218, 15/06/2020, 10:53

TITLE:	Summer 2020 Flightlines Sparrowhawk
PROJECT:	Annagh Wind Farm, Co. Cork
FIGURE NO:	8Z.2
CLIENT:	EMPower
SCALE: 1:12500	**REVISION:** 0
DATE: 13/10/2021	**PAGE SIZE:** A3

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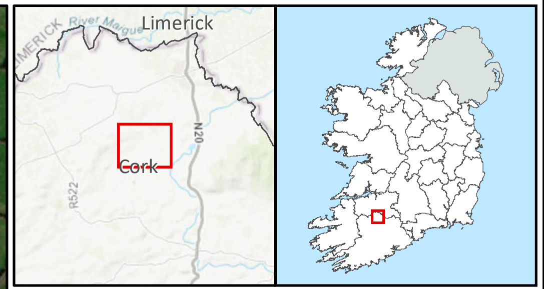

Legend

- Site Boundary
- Turbine Layout 500m Buffer
- Turbine Layout

Flightlines

ID, Date, Time:

- 87, 14/10/2020, 11:35
- 105, 18/12/2020, 15:51
- 112, 28/12/2020, 16:10
- 123, 19/01/2021, 11:46
- 129, 19/01/2021, 15:31
- 140, 15/02/2021, 17:33
- 155, 04/03/2021, 17:16
- 160, 31/03/2021, 13:41

TITLE:	Winter 2020 - 2021 Flightlines Sparrowhawk		
PROJECT:	Annagh Wind Farm, Co. Cork		
FIGURE NO:	8R.2		
CLIENT:	EMPower		
SCALE:	1:12500	**REVISION:**	0
DATE:	13/10/2021	**PAGE SIZE:**	A3

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APPENDIX 4

Hinterland Survey Results

Hinterland Survey Data 2020/21

Site	Date	Cloud	Visibility	Rain	Wind	Common Name	Quantity
River Blackwater SAC/Annagh Bridge	27/04/2020	6/8	excellent	dry	f0-1	No target or additional species	-
Kilcolman Bog SPA	27/04/2020	6/8	excellent	dry	f0-1	No target or additional species	-
Ballyhouras	27/04/2020	6/8	excellent	dry	f0-1	No target or additional species	-
Casual Obs. East of Buttevant (ITM 558383 609600)	29/05/2020	7/8	excellent	dry	f3	Kestrel	1
ITM 560586 617793 (Ballyhouras)	29/05/2020	7/8	excellent	dry	f3	Kestrel	1
Kilcolman Bog SPA	29/05/2020	7/8	excellent	dry	f3	No target or additional species	
Large Quarry Lake (Ballinadrideen)	15/06/2020	5/8	excellent	dry	f1-2	Grey Heron	3
Large Quarry Lake (Ballinadrideen)	15/06/2020	5/8	excellent	dry	f1-2	Kestrel	1
Large Quarry Lake (Ballinadrideen)	15/06/2020	5/8	excellent	dry	f1-2	Black-headed Gull	5
River Blackwater SAC/Annagh Bridge	15/06/2020	5/8	excellent	dry	f1-2	No target or additional species	
Kilcolman Bog SPA	16/06/2020	8/8	very good	dry	f1	Reed Bunting	1
Ballyhoura Mountains SAC	26/06/2020	8/8	good - excellent	dry	f1-2	Mistle Thrush	1
Ballyhoura Mountains SAC	26/06/2020	8/8	good - excellent	dry	f1-2	Wren	1
Ballyhoura Mountains SAC	26/06/2020	8/8	good - excellent	dry	f1-2	Coal Tit	1
Ballyhoura Mountains SAC	26/06/2020	8/8	good - excellent	dry	f1-2	Jay	1
Ballyhoura Mountains SAC	26/06/2020	8/8	good - excellent	dry	f1-2	Meadow Pipit	Abundant
Ballyhoura Mountains SAC	26/06/2020	8/8	good - excellent	dry	f1-2	Greenfinch	1

Site	Date	Cloud	Visibility	Rain	Wind	Common Name	Quantity
River Blackwater SAC/Annagh Bridge	04/09/2020	8/8	very good	dry	f2 W	Swallow	6
River Blackwater SAC/Annagh Bridge	04/09/2020	8/8	very good	dry	f2 W	Blackbird	1
River Blackwater SAC/Annagh Bridge	04/09/2020	8/8	very good	dry	f2 W	Wren	1
River Blackwater SAC/Annagh Bridge	04/09/2020	8/8	very good	dry	f2 W	Blue Tit	1
River Blackwater SAC/Annagh Bridge	04/09/2020	8/8	very good	dry	f2 W	Dunnock	1
River Blackwater SAC/Annagh Bridge	04/09/2020	8/8	very good	dry	f2 W	Rook	4
River Blackwater SAC/Annagh Bridge	04/09/2020	8/8	very good	dry	f2 W	Jackdaw	2
Kilcolman Bog SPA	04/09/2020	8/8	very good	dry	f2 W	Kestrel	1
Kilcolman Bog SPA	04/09/2020	8/8	very good	dry	f2 W	Meadow Pipit	4
Kilcolman Bog SPA	04/09/2020	8/8	very good	dry	f2 W	Willow Warbler	1
Kilcolman Bog SPA	04/09/2020	8/8	very good	dry	f2 W	Hooded Crow	4
Kilcolman Bog SPA	04/09/2020	8/8	very good	dry	f2 W	Wren	1
Kilcolman Bog SPA	04/09/2020	8/8	very good	dry	f2 W	Goldfinch	3
Kilcolman Bog SPA	04/09/2020	8/8	very good	dry	f2 W	Chaffinch	1
Large Quarry Lake (Ballinadrideen)	04/09/2020	8/8	very good	dry	f2 W	Cormorant	1
Large Quarry Lake (Ballinadrideen)	04/09/2020	8/8	very good	dry	f2 W	Lesser Black-backed Gull	5
Large Quarry Lake (Ballinadrideen)	04/09/2020	8/8	very good	dry	f2 W	Swallow	4
Large Quarry Lake (Ballinadrideen)	04/09/2020	8/8	very good	dry	f2 W	Hooded Crow	4
Large Quarry Lake (Ballinadrideen)	04/09/2020	8/8	very good	dry	f2 W	Rook	2
Ballyhoura Mountains SAC	04/09/2020	8/8	very good	dry	f2 W	Kestrel	1
Ballyhoura Mountains SAC	04/09/2020	8/8	very good	dry	f2 W	Swallow	Not counted
Ballyhoura Mountains SAC	04/09/2020	8/8	very good	dry	f2 W	Stonechat	Not counted
Ballyhoura Mountains SAC	04/09/2020	8/8	very good	dry	f2 W	Meadow Pipit	Not counted

Site	Date	Cloud	Visibility	Rain	Wind	Common Name	Quantity
River Blackwater SAC/ Buttevant	22/10/2020	6/8	good	dry	f2 W	Little Egret	2
River Blackwater SAC/ Buttevant	22/10/2020	6/8	good	dry	f2 W	Grey Heron	1
River Blackwater SAC/ Buttevant	22/10/2020	6/8	good	dry	f2 W	Green Sandpiper	1
River Blackwater SAC/ Buttevant	22/10/2020	6/8	good	dry	f2 W	Rook	Not counted
River Blackwater SAC/ Buttevant	22/10/2020	6/8	good	dry	f2 W	Jackdaw	Not counted
River Blackwater SAC/ Buttevant	22/10/2020	6/8	good	dry	f2 W	Woodpigeon	Not counted
River Blackwater SAC/ Buttevant	22/10/2020	6/8	good	dry	f2 W	Blackbird	Not counted
River Blackwater SAC/ Buttevant	22/10/2020	6/8	good	dry	f2 W	Redwing	Not counted
River Blackwater SAC/ Buttevant	22/10/2020	6/8	good	dry	f2 W	Pied/White Wagtail	Not counted
River Blackwater SAC/ Buttevant	22/10/2020	6/8	good	dry	f2 W	Robin	Not counted
River Blackwater SAC/ Buttevant	22/10/2020	6/8	good	dry	f2 W	Hooded Crow	Not counted
Eagle Lough pNHA	22/10/2020	6/8	good	dry	f2 W	No target or additional species	
Kilcolman Bog SPA	22/10/2020	6/8	good	dry	f2 W	Teal	12
Kilcolman Bog SPA	22/10/2020	6/8	good	dry	f2 W	Mallard	2
Kilcolman Bog SPA	22/10/2020	6/8	good	dry	f2 W	Dunnock	Not counted
Kilcolman Bog SPA	22/10/2020	6/8	good	dry	f2 W	Blackbird	Not counted
Kilcolman Bog SPA	22/10/2020	6/8	good	dry	f2 W	Robin	Not counted
Kilcolman Bog SPA	22/10/2020	6/8	good	dry	f2 W	Wren	Not counted
Kilcolman Bog SPA	22/10/2020	6/8	good	dry	f2 W	Hooded Crow	Not counted
Kilcolman Bog SPA	22/10/2020	6/8	good	dry	f2 W	Rook	Not counted
Kilcolman Bog SPA	22/10/2020	6/8	good	dry	f2 W	Long-tailed Tit	Not counted
Ballinvonear Pond	22/10/2020	6/8	good	dry	f2 W	No target or additional species	-
Ballyhoura Mountains SAC	22/10/2020	6/8	good	dry	f2 W	Golden Plover	c40

Site	Date	Cloud	Visibility	Rain	Wind	Common Name	Quantity
Ballyhoura Mountains SAC	22/10/2020	6/8	good	dry	f2 W	Sparrowhawk	1
Large Quarry Lake (Ballinadrideen)	22/10/2020	6/8	good	dry	f2 W	Mute Swan	3
Large Quarry Lake (Ballinadrideen)	22/10/2020	6/8	good	dry	f2 W	Grey Heron	1
Small Quarry Lake (Ballyroe)	22/10/2020	6/8	good	dry	f2 W	Buzzard	1
Small Quarry Lake (Ballyroe)	22/10/2020	6/8	good	dry	f2 W	No target or additional species	-
Castle Lake (Milltown)	22/10/2020	6/8	good	dry	f2 W	Mute Swan	2
Castle Lake (Milltown)	22/10/2020	6/8	good	dry	f2 W	Teal	20
Castle Lake (Milltown)	22/10/2020	6/8	good	dry	f2 W	Mallard	2
River Blackwater SAC/Annagh Bridge	22/10/2020	6/8	good	dry	f2 W	Whooper Swan	8
River Blackwater SAC/Annagh Bridge	22/10/2020	6/8	good	dry	f2 W	Mallard	17
River Blackwater SAC/Annagh Bridge	22/10/2020	6/8	good	dry	f2 W	Wigeon	17
River Blackwater SAC/Annagh Bridge	22/10/2020	6/8	good	dry	f2 W	Lapwing	39
River Blackwater SAC/Annagh Bridge	22/10/2020	6/8	good	dry	f2 W	Teal	24
River Blackwater SAC/Annagh Bridge	22/10/2020	6/8	good	dry	f2 W	Golden Plover	15
River Blackwater SAC/Annagh Bridge	22/10/2020	6/8	good	dry	f2 W	Mute Swan	2
River Awbeg	22/10/2020	6/8	good	dry	f2 W	Mute Swan	2
Kilcolman Bog SPA	06/11/2020	7/8	good	dry	f3SW	Shoveler	70
Kilcolman Bog SPA	06/11/2020	7/8	good	dry	f3SW	Wigeon	100
Kilcolman Bog SPA	06/11/2020	7/8	good	dry	f3SW	Teal	50
Kilcolman Bog SPA	06/11/2020	7/8	good	dry	f3SW	Coot	1
Kilcolman Bog SPA	06/11/2020	7/8	good	dry	f3SW	Mallard	11
Kilcolman Bog SPA	06/11/2020	7/8	good	dry	f3SW	Redwing	Not Counted
Kilcolman Bog SPA	06/11/2020	7/8	good	dry	f3SW	Fieldfare	Not Counted

Site	Date	Cloud	Visibility	Rain	Wind	Common Name	Quantity
Kilcolman Bog SPA	06/11/2020	7/8	good	dry	f3SW	Blackbird	Not Counted
Kilcolman Bog SPA	06/11/2020	7/8	good	dry	f3SW	Robin	Not Counted
Kilcolman Bog SPA	06/11/2020	7/8	good	dry	f3SW	Wren	Not Counted
Ballyhoura Mountains SAC	06/11/2020	7/8	good	dry	f3SW	No target or additional species	-
Glanmore Flats	06/11/2020	7/8	good	dry	f3SW	Mute Swan	3
River Blackwater SAC/Annagh Bridge	06/11/2020	7/8	good	dry	f3SW	Wigeon	16
River Blackwater SAC/Annagh Bridge	06/11/2020	7/8	good	dry	f3SW	Lapwing	25
River Blackwater SAC/Annagh Bridge	06/11/2020	7/8	good	dry	f3SW	Mallard	1
River Blackwater SAC/Annagh Bridge	06/11/2020	7/8	good	dry	f3SW	Mute Swan	7
River Blackwater SAC/Annagh Bridge	06/11/2020	7/8	good	dry	f3SW	Whooper Swan	24
River Blackwater SAC/Annagh Bridge	06/11/2020	7/8	good	dry	f3SW	Grey Heron	1
River Blackwater SAC/Annagh Bridge	06/11/2020	7/8	good	dry	f3SW	Greylag Goose	52
River Blackwater SAC/Annagh Bridge	06/11/2020	7/8	good	dry	f3SW	Canada Goose	2
Castle Lake (Milltown)	06/11/2020	7/8	good	dry	f3SW	No target or additional species	-
Small Quarry Lake (Ballyroe)	06/11/2020	7/8	good	dry	f3SW	Curlew	7
Large Quarry Lake (Ballinadrideen)	06/11/2020	7/8	good	dry	f3SW	Mallard	5
Large Quarry Lake (Ballinadrideen)	06/11/2020	7/8	good	dry	f3SW	Lapwing	8
River Awbeg	06/11/2020	7/8	good	dry	f3SW	Mute Swan	2
River Awbeg	06/11/2020	7/8	good	dry	f3SW	Mallard	37
River Awbeg	06/11/2020	7/8	good	dry	f3SW	Lapwing	48
Eagle Lough pNHA	06/11/2020	7/8	good	dry	f3SW	No target or additional species	-
River Blackwater SAC/ Buttevant	06/11/2020	7/8	good	dry	f3SW	Mute Swan	2
Kilcolman Bog SPA	26/11/2020	8/8	good	dry	f1 NE	Mallard	23

Site	Date	Cloud	Visibility	Rain	Wind	Common Name	Quantity
Kilcolman Bog SPA	26/11/2020	8/8	good	dry	f1 NE	Teal	200
Kilcolman Bog SPA	26/11/2020	8/8	good	dry	f1 NE	Wigeon	220
Kilcolman Bog SPA	26/11/2020	8/8	good	dry	f1 NE	Tufted Duck	2
Kilcolman Bog SPA	26/11/2020	8/8	good	dry	f1 NE	Gadwall	2
Kilcolman Bog SPA	26/11/2020	8/8	good	dry	f1 NE	Shoveler	51
Kilcolman Bog SPA	26/11/2020	8/8	good	dry	f1 NE	Moorhen	1
Kilcolman Bog SPA	26/11/2020	8/8	good	dry	f1 NE	Coot	1
Ballyhoura Mountains SAC	26/11/2020	8/8	good	dry	f1 NE	No target or additional species	
Castle Lake (Milltown)	26/11/2020	8/8	good	dry	f1 NE	Mute Swan	2
River Blackwater SAC/Annagh Bridge	26/11/2020	8/8	good	dry	f1 NE	Whooper Swan	13
River Awbeg	26/11/2020	8/8	good	dry	f1 NE	Cormorant	1
Glanmore Flats	26/11/2020	8/8	good	dry	f1 NE	No target or additional species	-
Large Quarry Lake (Ballinadrideen)	26/11/2020	8/8	good	dry	f1 NE	Curlew	46
Large Quarry Lake (Ballinadrideen)	26/11/2020	8/8	good	dry	f1 NE	Lapwing	150
Large Quarry Lake (Ballinadrideen)	26/11/2020	8/8	good	dry	f1 NE	Mallard	32
Large Quarry Lake (Ballinadrideen)	26/11/2020	8/8	good	dry	f1 NE	Wigeon	9
Large Quarry Lake (Ballinadrideen)	26/11/2020	8/8	good	dry	f1 NE	Teal	48
Large Quarry Lake (Ballinadrideen)	26/11/2020	8/8	good	dry	f1 NE	Lesser Black-backed Gull	1
Small Quarry Lake (Ballyroe)	26/11/2020	8/8	good	dry	f1 NE	No target or additional species	-
Eagle Lough pNHA	26/11/2020	8/8	good	dry	f1 NE	Mallard	4
Eagle Lough pNHA	26/11/2020	8/8	good	dry	f1 NE	Moorhen	1
Eagle Lough pNHA	26/11/2020	8/8	good	dry	f1 NE	Little Grebe	1
River Blackwater SAC/ Buttevant	26/11/2020	8/8	good	dry	f1 NE	Mute Swan	2

Site	Date	Cloud	Visibility	Rain	Wind	Common Name	Quantity
River Blackwater SAC/ Buttevant	26/11/2020	8/8	good	dry	f1 NE	Little Egret	1
River Blackwater SAC/ Buttevant	26/11/2020	8/8	good	dry	f1 NE	Grey Heron	1
River Blackwater SAC/ Buttevant	26/11/2020	8/8	good	dry	f1 NE	Teal	5
River Blackwater SAC/ Buttevant	07/12/2020	8/8	fair	dry	calm	Mallard	25
Eagle Lough pNHA	07/12/2020	8/8	fair	dry	calm	Mute Swan	2
Eagle Lough pNHA	07/12/2020	8/8	fair	dry	calm	Mallard	33
Eagle Lough pNHA	07/12/2020	8/8	fair	dry	calm	Teal	20
Eagle Lough pNHA	07/12/2020	8/8	fair	dry	calm	Wigeon	35
Ballyhouras	07/12/2020	8/8	poor	dry	calm	No target or additional species	-
Castle Lake (Milltown)	07/12/2020	8/8	fair	dry	calm	Mute Swan	2
River Blackwater SAC/Annagh Bridge	07/12/2020	8/8	fair	dry	calm	Whooper Swan	52
River Blackwater SAC/Annagh Bridge	07/12/2020	8/8	fair	dry	calm	Greylag Goose	7
River Blackwater SAC/Annagh Bridge	07/12/2020	8/8	fair	dry	calm	Little Egret	1
River Awbeg	07/12/2020	8/8	poor	dry	calm	No target or additional species	-
Glanmore Flats	07/12/2020	8/8	poor	dry	calm	No target or additional species	-
Large Quarry Lake (Ballinadrideen)	07/12/2020	8/8	poor	dry	calm	No target or additional species	-
Small Quarry Lake (Ballyroe)	07/12/2020	8/8	poor	dry	calm	No target or additional species	-
Kilcolman Bog SPA	07/12/2020	8/8	fair	dry	calm	Teal	150
Kilcolman Bog SPA	07/12/2020	8/8	fair	dry	calm	Wigeon	215
Kilcolman Bog SPA	07/12/2020	8/8	fair	dry	calm	Mallard	13
Kilcolman Bog SPA	07/12/2020	8/8	fair	dry	calm	Shoveler	50
Kilcolman Bog SPA	07/12/2020	8/8	fair	dry	calm	Gadwall	2
Kilcolman Bog SPA	07/12/2020	8/8	fair	dry	calm	Little Grebe	1

Site	Date	Cloud	Visibility	Rain	Wind	Common Name	Quantity
Kilcolman Bog SPA	07/12/2020	8/8	fair	dry	calm	Mute Swan	1
Kilcolman Bog SPA	07/12/2020	8/8	fair	dry	calm	Greylag Goose	40
Kilcolman Bog SPA	07/12/2020	8/8	fair	dry	calm	White-fronted Goose	1
Kilcolman Bog SPA	07/12/2020	8/8	fair	dry	calm	Pink-footed Goose	1
River Awbeg	16/12/2020	7/8	good	dry	f3 SW	No target or additional species	-
Glanmore Flats	16/12/2020	7/8	good	dry	f3 SW	No target or additional species	-
Large Quarry Lake (Ballinadrideen)	16/12/2020	7/8	good	dry	f3 SW	Curlew	53
Large Quarry Lake (Ballinadrideen)	16/12/2020	7/8	good	dry	f3 SW	Wigeon	25
Large Quarry Lake (Ballinadrideen)	16/12/2020	7/8	good	dry	f3 SW	Teal	147
Large Quarry Lake (Ballinadrideen)	16/12/2020	7/8	good	dry	f3 SW	Grey Heron	2
Large Quarry Lake (Ballinadrideen)	16/12/2020	7/8	good	dry	f3 SW	Mallard	5
Small Quarry Lake (Ballyroe)	16/12/2020	7/8	good	dry	f3 SW	No target or additional species	-
Ballyhouras	16/12/2020	7/8	good	dry	f3 SW	No target or additional species	-
River Blackwater SAC/Annagh Bridge	16/12/2020	7/8	good	dry	f3 SW	Whooper Swan	92
River Blackwater SAC/Annagh Bridge	16/12/2020	7/8	good	dry	f3 SW	Greylag Goose	101
River Blackwater SAC/Annagh Bridge	16/12/2020	7/8	good	dry	f3 SW	Canada Goose	2
Large Quarry Lake (Ballinadrideen)	29/12/2020	5/8	good	dry	f3 NW	Teal	150
Large Quarry Lake (Ballinadrideen)	29/12/2020	5/8	good	dry	f3 NW	Wigeon	50
Large Quarry Lake (Ballinadrideen)	29/12/2020	5/8	good	dry	f3 NW	Mallard	15
River Blackwater SAC/ Buttevant	26/01/2021	8/8	good	dry	f1 SW	Teal	26
River Blackwater SAC/ Buttevant	26/01/2021	8/8	good	dry	f1 SW	Grey Heron	1
Eagle Lough pNHA	26/01/2021	8/8	good	dry	f1 SW	Snipe	4
Eagle Lough pNHA	26/01/2021	8/8	good	dry	f1 SW	Mallard	2

Site	Date	Cloud	Visibility	Rain	Wind	Common Name	Quantity
Eagle Lough pNHA	26/01/2021	8/8	good	dry	f1 SW	Shoveler	2
Eagle Lough pNHA	26/01/2021	8/8	good	dry	f1 SW	Wigeon	18
Eagle Lough pNHA	26/01/2021	8/8	good	dry	f1 SW	Little Grebe	2
Kilcolman Bog SPA	26/01/2021	8/8	good	dry	f1 SW	Teal	49
Kilcolman Bog SPA	26/01/2021	8/8	good	dry	f1 SW	Wigeon	59
Kilcolman Bog SPA	26/01/2021	8/8	good	dry	f1 SW	Mallard	11
Kilcolman Bog SPA	26/01/2021	8/8	good	dry	f1 SW	Shoveler	47
Kilcolman Bog SPA	26/01/2021	8/8	good	dry	f1 SW	Coot	5
Kilcolman Bog SPA	26/01/2021	8/8	good	dry	f1 SW	Little Grebe	2
Kilcolman Bog SPA	26/01/2021	8/8	good	dry	f1 SW	Mute Swan	2
Kilcolman Bog SPA	26/01/2021	8/8	good	dry	f1 SW	Moorhen	1
Glanmore Flats	26/01/2021	8/8	good	dry	f1 SW	Mute Swan	2
River Awbeg	26/01/2021	8/8	good	dry	f1 SW	No target or additional species	-
Ballyhoura Mountains SAC	26/01/2021	8/8	good	dry	f1 SW	No target or additional species	-
Large Quarry Lake (Ballinadrideen)	26/01/2021	8/8	good	dry	f1 SW	Wigeon	27
Large Quarry Lake (Ballinadrideen)	26/01/2021	8/8	good	dry	f1 SW	Curlew	1
Large Quarry Lake (Ballinadrideen)	26/01/2021	8/8	good	dry	f1 SW	Teal	29
Large Quarry Lake (Ballinadrideen)	26/01/2021	8/8	good	dry	f1 SW	Cormorant	1
Large Quarry Lake (Ballinadrideen)	26/01/2021	8/8	good	dry	f1 SW	Mallard	1
Large Quarry Lake (Ballinadrideen)	26/01/2021	8/8	good	dry	f1 SW	Grey Heron	1
Small Quarry Lake	26/01/2021	8/8	good	dry	f1 SW	No target or additional species	
Castle Lake (Milltown)	26/01/2021	8/8	good	dry	f1 SW	Mute Swan	2
River Blackwater SAC/Annagh Bridge	26/01/2021	8/8	good	dry	f1 SW	No target or additional species	-

Site	Date	Cloud	Visibility	Rain	Wind	Common Name	Quantity
River Blackwater SAC/Annagh Bridge	15/02/2021	4/8	good	dry	f1 S	Whooper Swan	20
River Blackwater SAC/Annagh Bridge	15/02/2021	4/8	good	dry	f1 S	Greylag Goose	14
Kilcolman Bog SPA	16/02/2021	3/8	good	dry	f2 W	Whooper Swan	22
Kilcolman Bog SPA	16/02/2021	3/8	good	dry	f2 W	Mute Swan	2
Kilcolman Bog SPA	16/02/2021	3/8	good	dry	f2 W	Gadwall	4
Kilcolman Bog SPA	16/02/2021	3/8	good	dry	f2 W	Coot	6
Kilcolman Bog SPA	16/02/2021	3/8	good	dry	f2 W	Shoveler	84
Kilcolman Bog SPA	16/02/2021	3/8	good	dry	f2 W	Little Grebe	2
Kilcolman Bog SPA	16/02/2021	3/8	good	dry	f2 W	Moorhen	2
Kilcolman Bog SPA	16/02/2021	3/8	good	dry	f2 W	Teal	28
Kilcolman Bog SPA	16/02/2021	3/8	good	dry	f2 W	Wigeon	92
Kilcolman Bog SPA	16/02/2021	3/8	good	dry	f2 W	Greylag Goose	80
River Blackwater SAC/Annagh Bridge	16/02/2021	3/8	good	dry	f2 W	Whooper Swan	107
River Blackwater SAC/Annagh Bridge	16/02/2021	3/8	good	dry	f2 W	Greylag Goose	26
River Awbeg	16/02/2021	3/8	good	dry	f2 W	No target or additional species	-
North of Buttevant (R504110)	16/02/2021	3/8	good	dry	f2 W	Whooper Swan	14
River Blackwater SAC/ Buttevant	16/02/2021	3/8	good	dry	f2 W	Teal	2
Eagle Lough pNHA	26/02/2021	5/8	good	dry	f3 W	Shoveler	7
Eagle Lough pNHA	26/02/2021	5/8	good	dry	f3 W	Moorhen	2
Eagle Lough pNHA	26/02/2021	5/8	good	dry	f3 W	Mallard	2
Eagle Lough pNHA	26/02/2021	5/8	good	dry	f3 W	Little Grebe	1
Kilcolman Bog SPA	26/02/2021	5/8	good	dry	f3 W	Mallard	14
Kilcolman Bog SPA	26/02/2021	5/8	good	dry	f3 W	Tufted Duck	8

Site	Date	Cloud	Visibility	Rain	Wind	Common Name	Quantity
Kilcolman Bog SPA	26/02/2021	5/8	good	dry	f3 W	Little Grebe	7
Kilcolman Bog SPA	26/02/2021	5/8	good	dry	f3 W	Coot	14
Kilcolman Bog SPA	26/02/2021	5/8	good	dry	f3 W	Moorhen	3
Kilcolman Bog SPA	26/02/2021	5/8	good	dry	f3 W	Wigeon	90
Kilcolman Bog SPA	26/02/2021	5/8	good	dry	f3 W	Teal	27
Kilcolman Bog SPA	26/02/2021	5/8	good	dry	f3 W	Gadwall	1
Kilcolman Bog SPA	26/02/2021	5/8	good	dry	f3 W	Shoveler	10
Ballyhoura Mountains SAC	26/02/2021	5/8	good	dry	f3 W	Buzzard	1
Large Quarry Lake (Ballinadrideen)	26/02/2021	5/8	good	dry	f3 W	Shoveler	8
Large Quarry Lake (Ballinadrideen)	26/02/2021	5/8	good	dry	f3 W	Cormorant	6
Large Quarry Lake (Ballinadrideen)	26/02/2021	5/8	good	dry	f3 W	Curlew	8
Large Quarry Lake (Ballinadrideen)	26/02/2021	5/8	good	dry	f3 W	Mallard	5
Large Quarry Lake (Ballinadrideen)	26/02/2021	5/8	good	dry	f3 W	Wigeon	9
Large Quarry Lake (Ballinadrideen)	26/02/2021	5/8	good	dry	f3 W	Teal	46
Large Quarry Lake (Ballinadrideen)	26/02/2021	5/8	good	dry	f3 W	Grey Heron	3
Small Quarry Lake	26/02/2021	5/8	good	dry	f3 W	Whooper Swan	38
Small Quarry Lake	26/02/2021	5/8	good	dry	f3 W	Mallard	2
Castle Lake (Milltown)	26/02/2021	5/8	good	dry	f3 W	Mute Swan	2
River Blackwater SAC/Annagh Bridge	26/02/2021	5/8	good	dry	f3 W	Whooper Swan	6
River Blackwater SAC/Annagh Bridge	26/02/2021	5/8	good	dry	f3 W	Grey Heron	1
Nth of Buttevant R504110	26/02/2021	5/8	good	dry	f3 W	Whooper Swan	3
Railway crossing north of Buttevant	26/02/2021	5/8	good	dry	f3 W	Little Egret	1
Kilcolman Bog SPA	23/03/2021	7/8	excellent	dry	f3-4 S	Greylag Goose	40
Kilcolman Bog SPA	23/03/2021	7/8	excellent	dry	f3-4 S	Greenland White-fronted Goose	1

Site	Date	Cloud	Visibility	Rain	Wind	Common Name	Quantity
Kilcolman Bog SPA	23/03/2021	7/8	excellent	dry	f3-4 S	Whooper Swan	23
Kilcolman Bog SPA	23/03/2021	7/8	excellent	dry	f3-4 S	Coot	3
Kilcolman Bog SPA	23/03/2021	7/8	excellent	dry	f3-4 S	Wigeon	23
Kilcolman Bog SPA	23/03/2021	7/8	excellent	dry	f3-4 S	Shoveler	5
Kilcolman Bog SPA	23/03/2021	7/8	excellent	dry	f3-4 S	Teal	25
Kilcolman Bog SPA	23/03/2021	7/8	excellent	dry	f3-4 S	Mallard	2
Eagle Lough pNHA	23/03/2021	7/8	excellent	dry	f3-4 S	Coot	1
Eagle Lough pNHA	23/03/2021	7/8	excellent	dry	f3-4 S	Moorhen	2
Eagle Lough pNHA	23/03/2021	7/8	excellent	dry	f3-4 S	Mallard	1
Glanmore Flats	23/03/2021	7/8	excellent	dry	f3-4 S	Buzzard	1
River Awbeg	23/03/2021	7/8	excellent	dry	f3-4 S	Cormorant	4
River Blackwater SAC/Annagh Bridge	23/03/2021	7/8	excellent	dry	f3-4 S	Whooper Swan	22
Castle Lake (Milltown)	23/03/2021	7/8	excellent	dry	f3-4 S	Teal	2
Castle Lake (Milltown)	23/03/2021	7/8	excellent	dry	f3-4 S	Moorhen	2
Castle Lake (Milltown)	23/03/2021	7/8	excellent	dry	f3-4 S	Little Grebe	1
Large Quarry Lake (Ballinadrideen)	23/03/2021	7/8	excellent	dry	f3-4 S	No target or additional species	-
Large Quarry Lake (Ballinadrideen)	23/03/2021	7/8	excellent	dry	f3-4 S	Whooper Swan	1
Large Quarry Lake (Ballinadrideen)	23/03/2021	7/8	excellent	dry	f3-4 S	Mallard	3
Large Quarry Lake (Ballinadrideen)	23/03/2021	7/8	excellent	dry	f3-4 S	Grey Heron	1
Large Quarry Lake (Ballinadrideen)	23/03/2021	7/8	excellent	dry	f3-4 S	Teal	50
Large Quarry Lake (Ballinadrideen)	23/03/2021	7/8	excellent	dry	f3-4 S	Wigeon	13
Large Quarry Lake (Ballinadrideen)	23/03/2021	7/8	excellent	dry	f3-4 S	Great Crested Grebe	2
Ballyhoura Mountains SAC	23/03/2021	7/8	excellent	dry	f3-4 S	Buzzard	3
Ballyhoura Mountains SAC	23/03/2021	7/8	excellent	dry	f3-4 S	Red Grouse (Droppings)	-

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APPENDIX 3

Aquatic Ecology Report

Aquatic Ecological Impact Assessment Report (EIAR) for Annagh wind farm, Co. Cork

Prepared by Triturus Environmental Ltd. for Fehily Timoney & Company

October 2021

Please cite as:

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Table of contents

1. Introduction

1.1 Background

This report assesses the potential impact of the proposed Annagh wind farm on aquatic ecology, through its various developmental phases of construction, operation and decommissioning. Key elements of the design proposals have been assessed in the context of aquatic ecological sensitivities of the receiving environment.

The following report provides a baseline assessment of the aquatic ecology including fisheries and biological water quality as well as protected aquatic species and habitats in the vicinity of the project. This report also assesses the potential impacts of the proposed wind farm on the receiving aquatic environment based on its known sensitivities (i.e. quality of water, ecological status, presence of protected species etc.) along with proposed mitigation measures and any residual impacts of the proposed project (**sections 5, 6 & 7**). An assessment of the hydrological impacts of the proposed wind farm project on the receiving aquatic environment are discussed in Chapter 10 (Hydrology and Water Quality).

Undertaken on a catchment-wide scale, the baseline surveys focused on aquatic habitats in relation to fisheries potential (including both salmonid and lamprey habitat), white-clawed crayfish (*Austropotamobious pallipes*), freshwater pearl mussel (*Margaritifera margaritifera*), otter (*Lutra lutra*), macro-invertebrates, macrophytes, aquatic invasive species, and fish of conservation value which may use the watercourses in the vicinity of the proposed project. Aquatic surveys were undertaken in September 2020, with environmental DNA (eDNA) analysis for white-clawed crayfish and crayfish plague (*Aphanomyces astaci*) carried out in April 2021.

The proposed survey sites were located on numerous watercourses within the Awbeg [Buttevant]_SC_010 river sub-catchment near Charleville, Co. Cork. The survey area also overlapped with the Munster Blackwater *Margaritifera* sensitive area (**Figure 2.1**). Whilst the proposed wind farm site was not located within a European site, several watercourses draining the site (i.e. the Fiddane Stream, Ardglass River and Oakfront River) shared downstream hydrological connectivity with the Blackwater River SAC (site code: 002170). Furthermore, the proposed grid cable route (GCR) crosses the Rathnacally Stream which shares downstream hydrological connectivity with the Blackwater River SAC (002170). A proposed internal access track crosses the Oakfront River at a single location within the proposed wind farm boundary. **Figure 1.1** gives the location of the proposed Annagh Wind Farm with respect to relevant watercourses and their connectivity with European sites.

1.2 Project description

The proposed Annagh Wind Farm is located in a lowland agricultural area within the townlands of Annagh North, Coolcaum, Fiddane and Cooliney in County Cork, approximately 6km south-west of Charleville (**Figure 1.1**). A full description of the proposed project is provided in Chapter 3 of the main EIAR report.

In summary, the project will consist of a wind farm with 6 no. turbines, access roads, hardstand areas, sub-station, tree-felling, grid connection and turbine delivery route.

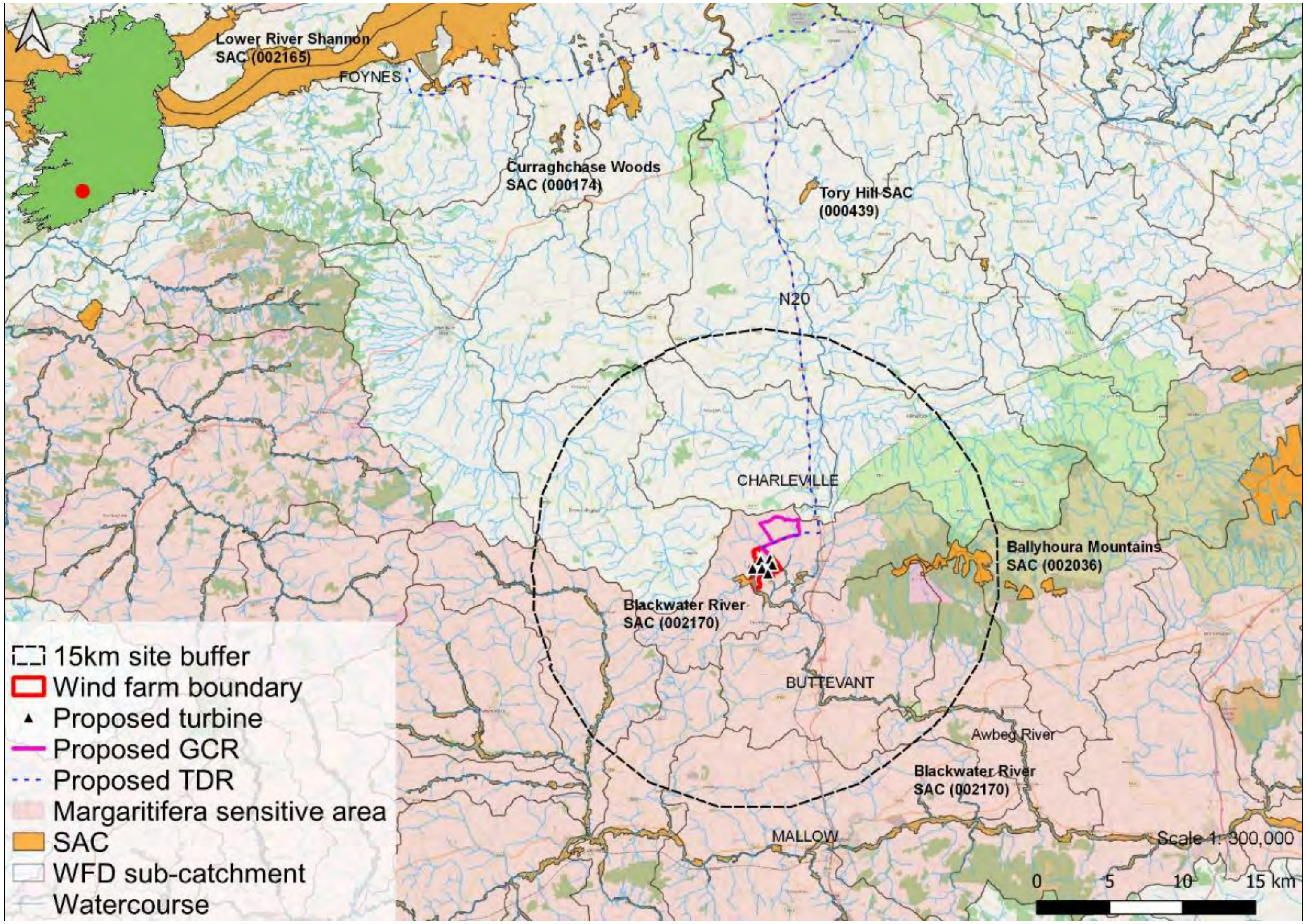


Figure 1.1 Location of the proposed Annagh wind farm project, Co. Cork showing European sites within a 15km buffer.

2. Methodology

2.1 Relevant guidance

The general approach used for the evaluation of ecological receptors and assessment of potential impacts for this current assessment is based on the 'Guidelines for Ecological Impact Assessment in the UK and Ireland' (CIEEM, 2018). The evaluation of ecological receptors contained within this report uses the geographic scale and criteria defined in the Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009).

The assessment of potential impacts uses the impact significance scale defined in the 'Guidelines on the Information to Be Contained in Environmental Impact Assessment Reports' (EPA, 2017), as follows:

Imperceptible → Not significant → Slight → Moderate → Significant → Very significant → Profound

An impact assessed as 'imperceptible' using this scale is considered to be a negligible impact. An impact assessed as 'significant', 'very significant' or 'profound' corresponds to a significant impact in the context of the EIA Directive. Such an impact is considered to represent an impact "that supports [positive impact] or undermines [negative impact] biodiversity conservation objectives" for the relevant receptor (CIEEM, 2019). Duration of impacts will is also be considered according to Environmental Protection Agency (EPA) guidance (EPA, 2017). The magnitude of an impact will depend on the nature and sensitivity of the ecological features and will be influenced by intensity, duration (temporary/permanent), timing, frequency and reversibility of the potential impact (CIEEM, 2016).

Other guidance considered in the preparation of this report included the following;

- DHPLG (2019). Draft Revised Wind Energy Development Guidelines. December 2019. Prepared by the Department of Housing, Planning and Local Government.
- EPA (2015). Advice Notes for Preparing Environmental Impact Statements.
- IFI (2016). Guidelines on protection of fisheries during construction works in and adjacent to waters. Inland Fisheries Ireland.
- Irish Wind Energy Association (2012). Best Practice Guidelines for the Irish Wind Energy Industry. Irish Wind Energy Association.
- NRA (2008). Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes. National Roads Authority.

2.2 Selection of watercourses for assessment

All freshwater watercourses which could be affected directly or indirectly by the proposed wind farm project were considered as part of the current assessment. This included watercourses draining the proposed wind farm site as well as those crossed by the proposed grid connection route and turbine delivery route (where any works had potential to cause impacts). A total of *n*=11 sites were selected for detailed aquatic assessment (see **Table 2.1, Figure 2.1** below). The nomenclature for the watercourses surveyed is as per the Environmental Protection Agency's (EPA) online map viewer.

Surveys at each of these sites included a fisheries assessment (electro-fishing, habitat appraisal), white-clawed crayfish survey (sweep netting, hand searching) and biological water quality sampling (Q-sampling) (**Figure 2.1**). A Stage 1 freshwater pearl mussel survey was undertaken in September 2020. In addition to traditional surveys, environmental DNA (eDNA) analysis was also undertaken on water samples from the Awbeg River for white-clawed crayfish and crayfish plague (*Aphanomyces astaci*). This holistic approach informed the overall aquatic ecological evaluation of each site in context of the proposed wind farm project.

Please note this aquatic report should be read in conjunction with the final Environmental Impact Assessment Report (EIAR) prepared for the proposed project. More specific aquatic methodology is outlined below and in the appendices of this report.

Table 2.1 Aquatic survey locations for the proposed Annagh wind farm project, Co. Cork (watercourse names are according to the EPA)

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
A1	Fiddane Stream	18F19	Annagh Bogs	549427	617248
A2	Ardglass River	18A23	Annagh Bogs	549606	616770
A3	Awbeg River	18A09	Annagh Bridge	549823	615649
B1	Milltown Stream	18M57	Milltown	550461	619714
B2	Oakfront River	18O02	Cooliney Bridge	550181	618654
B3	Oakfront River	18O02	Milltown	550651	617869
B4	Oakfront River	18O02	Springfort	550775	617421
B5	Oakfront River	18O02	Bridge at Coolcaum	551050	616256
C1	Rathnacally Stream	18R32	Clashganniv	552439	620511
C2	Rathnacally Stream	18R32	Bridge at Rathnacally	552633	619468
C3	Rathnacally Stream	18R32	Bridge at Ballynadrideen	552222	618157

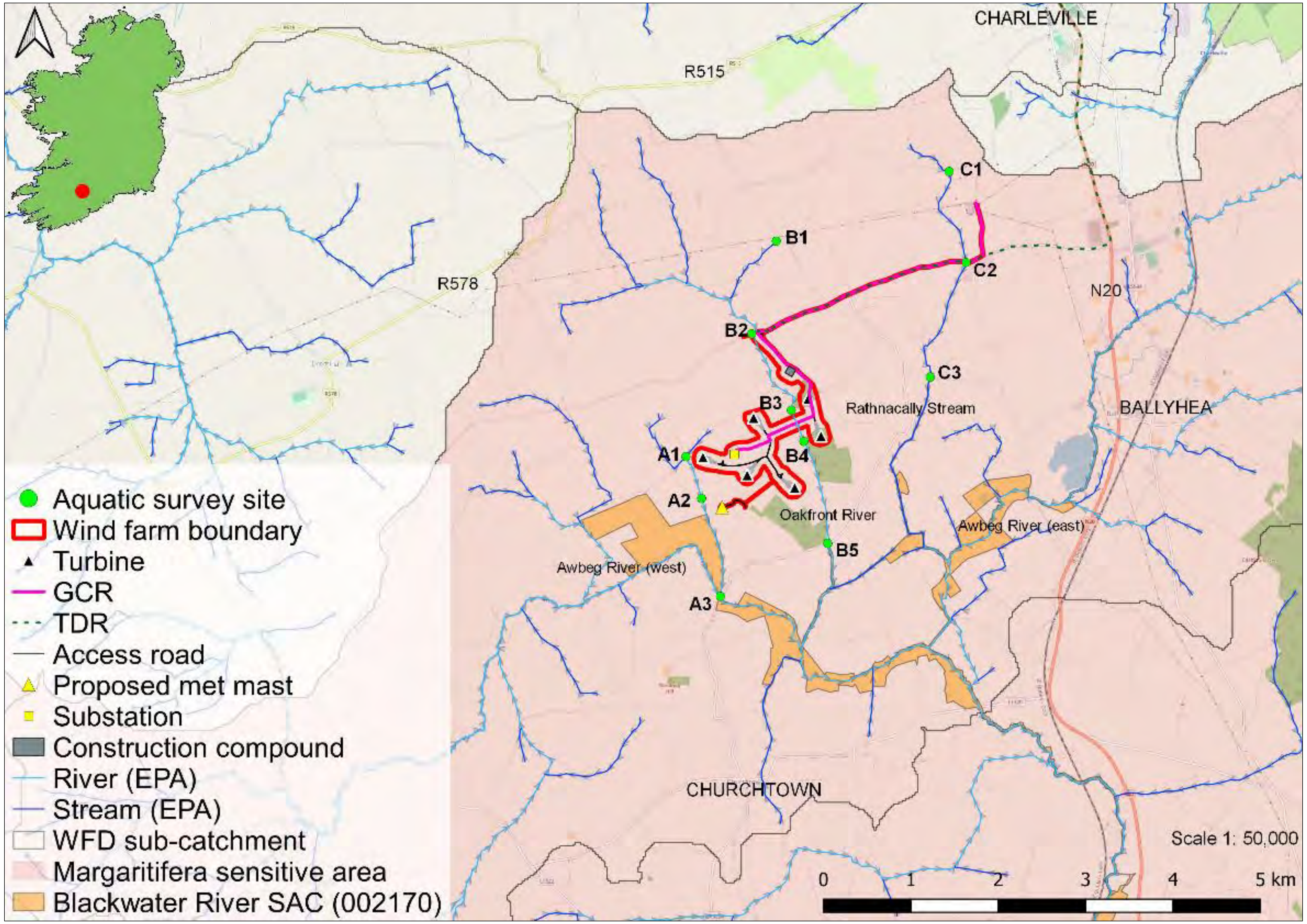


Figure 2.1 Overview of the aquatic survey locations for the proposed Annagh wind farm project, Co. Cork

2.3 Site surveys

Site surveys of the watercourses within the vicinity of the proposed wind farm project were conducted in September 2020. Survey effort focused on both instream and riparian habitats approx. 150m upstream and 150m downstream of each sampling point (see **Figure 2.1** above). The watercourses at each survey site were described in terms of the important aquatic habitats and species. This helped to evaluate species and habitats of ecological value in the vicinity of each site. The aquatic baseline prepared would inform mitigation for the wind farm project.

A broad aquatic habitat assessment was conducted utilising elements of the methodology given in the Environment Agency's 'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003' (EA, 2003) and the Irish Heritage Council's 'A Guide to Habitats in Ireland' (Fossitt, 2000). All sites were assessed in terms of:

- Physical watercourse/waterbody characteristics (i.e. width, depth etc.)
- Substrate type, listing substrate fractions in order of dominance (i.e. bedrock, boulder, cobble, gravel, sand, silt etc.)
- Flow type, listing percentage of riffle, glide and pool in the sampling area
- An appraisal of the macrophyte and aquatic bryophyte community at each site
- Riparian vegetation composition

2.4 Catchment-wide electro-fishing

A catchment-wide electro-fishing (CWEF) survey of the watercourses within the vicinity of the proposed wind farm (*n*=11 sites, **Figure 2.1**) was conducted on the 2nd and 3rd September 2020, under the conditions of a Department of Communications, Climate Action & Environment (DCCAE) licence. The survey was undertaken in accordance with best practice (CEN, 2003; CFB, 2008; Matson et al., 2018) and Section 14 licencing requirements.

Furthermore, a fisheries habitat appraisal of the survey watercourses (**Figure 2.1**) was undertaken to establish their importance for salmonid, lamprey, European eel and other fish species. The baseline assessment considered the quality of spawning, nursery and holding habitat within the vicinity of the survey sites using Life Cycle Unit (salmonids) and Lamprey Habitat Quality Index scores (lamprey).

For detailed survey methodology, please refer to accompanying fisheries assessment report in **Appendix A.**

2.5 White-clawed crayfish survey

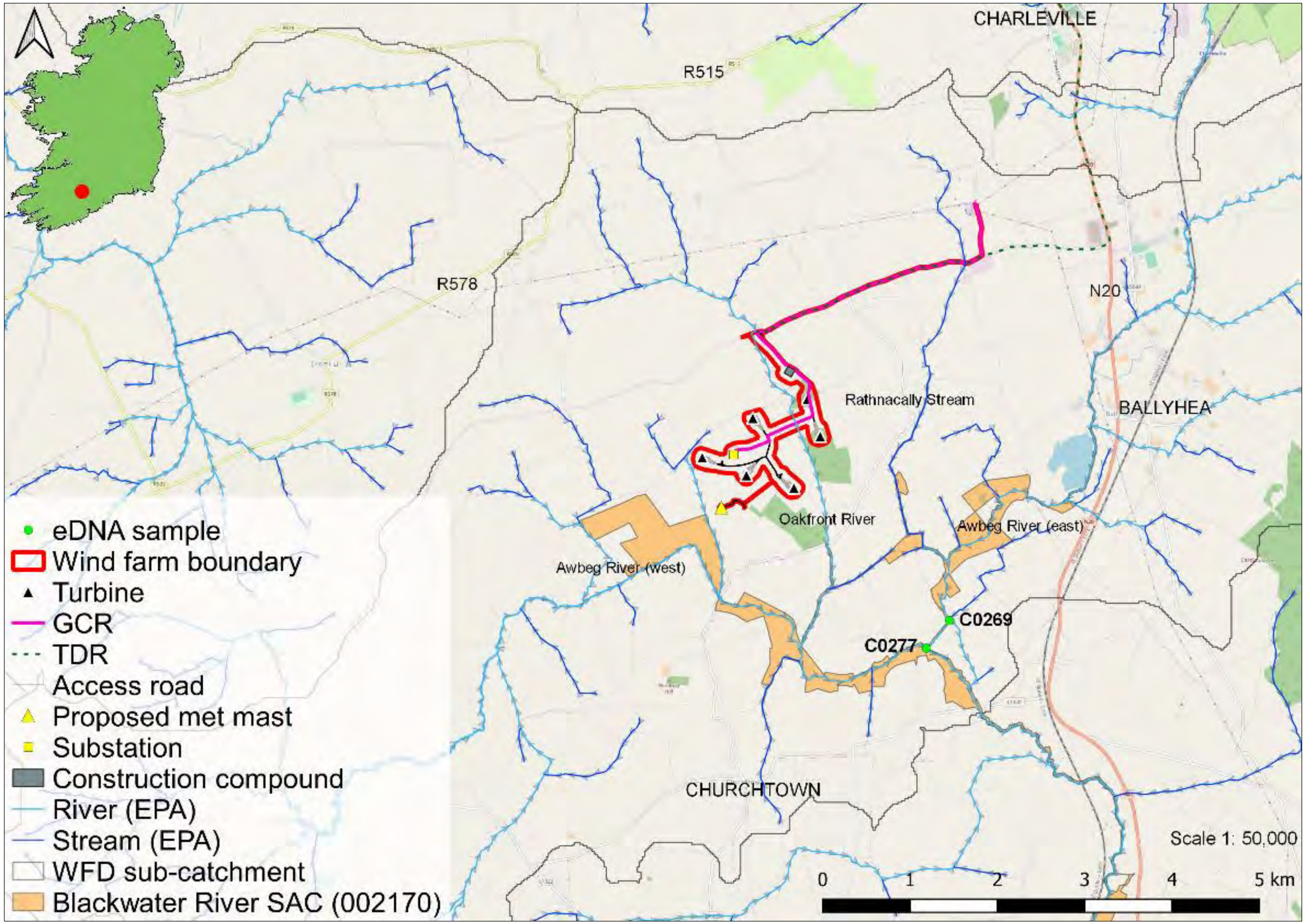
White-clawed crayfish (*Austropotamobius pallipes*) surveys were undertaken at the aquatic survey sites in September 2020 under a National Parks and Wildlife (NPWS) open licence (no. C79/2020), as prescribed by Sections 9, 23 and 34 of the Wildlife Act (1976-2021), to capture and release crayfish to their site of capture, under condition no. 5 of the licence. As per Inland Fisheries Ireland recommendations, the crayfish licence sampling started at the uppermost site(s) of the wind farm catchment/sub-catchments in the survey area to minimise the risk of transfer invasive propagules (including crayfish plague) in an upstream direction.

Hand-searching of instream refugia and sweep netting was undertaken according to Reynolds et al. (2010). Trapping of crayfish was not feasible given the small nature of most aquatic survey sites sampled. An appraisal of white-clawed crayfish habitat at each site was also carried out based on physical channel attributes, water chemistry and incidental records in mustelid spraint. Additionally, a desktop review of crayfish records within the wider Awbeg River and Awbeg_SC_010 sub-catchment was undertaken.

2.6 eDNA analysis

To validate traditional surveys (outlined above) and to detect potentially cryptically-low populations within the study area, a total of *n*=2 samples from the Awbeg River were analysed for white-clawed crayfish environmental DNA (eDNA) (**Figure 2.2**). Furthermore, samples were also analysed for crayfish plague (hitherto unrecorded from the wider Munster Blackwater catchment). Samples were collected on 2nd April 2021, with the sites strategically chosen to maximise longitudinal (instream) coverage within the catchment (i.e. facilitating a greater likelihood of detection).

In accordance with best practice, composite (500ml) water samples were collected from each sampling point, maximising the geographic spread within each site (20 x 25ml samples at each site), thus increasing the chance of detecting the target species' DNA. Each composite sample was filtered on site using a sterile proprietary eDNA sampling kit. Fixed samples were stored at room temperature and sent to the laboratory for analysis. A total of *n*=12 qPCR replicates were analysed for each site. Given the high sensitivity of eDNA analysis, a single positive qPCR replicate is considered as proof of the species' presence (termed qPCR No Threshold, or qPCR NT). Whilst an eDNA approach is not currently quantitative, the detection of the target species' DNA indicates the presence of the species at and or upstream of the sampling point. Please refer to **Appendix D** for full eDNA laboratory analysis methodology.


CHARLEVILLE
R515
R578
N20
BALLYHEA
Rathnacally Stream
Oakfront River
Awbeg River (east)
Awbeg River (west)
C0269
C0277
CHURCHTOWN
Scale 1: 50,000
0
1
2
3
4
5 km
eDNA sample
Wind farm boundary
Turbine
GCR
TDR
Access road
Proposed met mast
Substation
Construction compound
River (EPA)
Stream (EPA)
WFD sub-catchment
Blackwater River SAC (002170)

2.7 Freshwater pearl mussel survey

A freshwater pearl mussel (*Margaritifera margaritifera*) survey was undertaken in September 2020 at a total of *n*=14 sites on the Ardglass River, Oakfront River, Awbeg River (east and west branches) and Rathnacally Stream (under NPWS licence C201/2020). Methodology followed NPWS guidance (Anon, 2004) and included bathyscope and snorkel surveys, dependant on local water depths and flow regimes. Assessments were made of the habitat suitability for freshwater pearl mussels, based on the criteria of Hastie et al. (2000) and Skinner et al. (2003). Please refer to **Appendix B** for detailed methodology.

2.8 Biological water quality (Q-sampling)

Given the unsuitability of some sites (lack of flow, lack of water or too deep), biological water quality was assessed at a total of *n*=7 aquatic survey sites through Q-sampling during September 2020 (**Figure 2.3**). Macro-invertebrate samples were converted to Q-ratings as per Toner et al. (2005). All riverine samples were taken with a standard kick sampling hand net (250mm width, 500µm mesh size) from areas of riffle/glide utilising a three-minute sample. Large cobble was also washed at each site where present and samples were elutriated and fixed in 70% ethanol for subsequent laboratory identification. Any rare invertebrate species were identified from the NPWS Red List publications for beetles (Foster et al., 2009), mayflies (Kelly-Quinn & Regan, 2012), stoneflies (Feeley et al., 2020) and other relevant taxa (i.e. Byrne et al., 2009; Nelson et al., 2011).

Table 2.2 Reference categories for EPA Q-ratings (Q1 to Q5)

Q Value	WFD Status	Pollution status	Condition
Q5 or Q4-5	High status	Unpolluted	Satisfactory
Q4	Good status	Unpolluted	Satisfactory
Q3-4	Moderate status	Slightly polluted	Unsatisfactory
Q3 or Q2-3	Poor status	Moderately polluted	Unsatisfactory
Q2, Q1-2 or Q1	Bad status	Seriously polluted	Unsatisfactory

2.9 Otter signs

The presence of otter (*Lutra lutra*) at each aquatic survey site was determined through the recording of otter signs within 150m upstream and downstream of the site. These included holts, couches, spraints, latrines, slides and prints which are useful determinants of otter utilisation of watercourses. The location of signs was recorded via handheld GPS.

2.10 Aquatic ecological evaluation

The evaluation of aquatic ecological receptors contained within this report uses the geographic scale and criteria defined in the 'Guidelines for Assessment of Ecological Impacts of National Road Schemes' (NRA, 2009).

2.11 Biosecurity

A strict biosecurity protocol including the Check-Clean-Dry approach was adhered to during surveys for all equipment and PPE used. Disinfection of all equipment and PPE before and after use with Virkon™ was conducted to prevent the transfer of pathogens or invasive propagules between survey sites. Surveys were undertaken at sites in a downstream order to minimise the risk of upstream propagule mobilisation. Any aquatic invasive species or pathogens recorded within or adjoining the survey areas were geo-referenced.

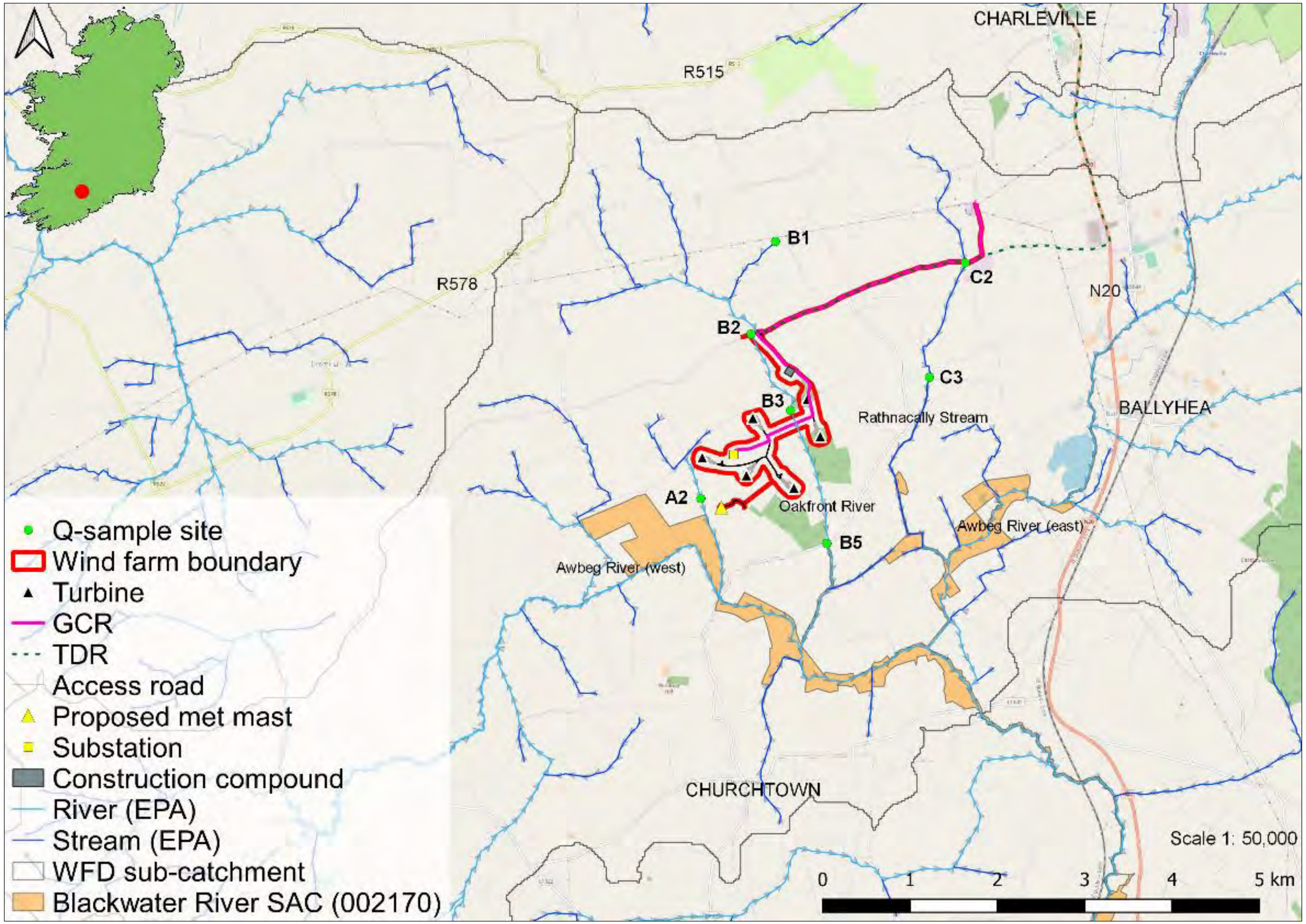


Figure 2.3 Overview of biological water quality (Q-sampling) locations for the proposed Annagh wind farm project, Co. Cork

3. Receiving environment

3.1 Sites designated for aquatic interests

There was a single European site with downstream hydrological connectivity to the proposed Annagh wind farm project, namely Blackwater River SAC (site code: 002170) (**Figure 1.1**).

3.1.1 Blackwater River SAC (002170)

The River Blackwater is one of the largest rivers in Ireland, draining a major part of Co. Cork and five ranges of mountains. The site consists of the freshwater stretches of the River Blackwater as far upstream as Ballydesmond, the tidal stretches as far as Youghal Harbour and many tributaries, the larger of which include the Awbeg, Licky, Bride, Flesk, Chimneyfield, Finisk, Araglin, Awbeg (Buttevant), Clyda, Glen, Allow, Dalua, Brogeen, Rathcool, Finnow, Owentaraglin and Awnaskirtaun.

The River Blackwater is of considerable conservation significance for the occurrence of good examples of habitats and populations of plant and animal species that are listed on Annexes I and II of the E.U. Habitats Directive, respectively. Furthermore, the site is of high conservation value for the populations of bird species that use it. Two Special Protection Areas, designated under the E.U. Birds Directive, are also located within the site - Blackwater Callows and Blackwater Estuary. Additionally, the importance of the site is enhanced by the presence of a suite of uncommon plant species (NPWS, 2016).

The proposed wind farm boundary was not located within the European site although the lower reaches of the Ardglass River formed a border with the SAC to the west of the site (**Figure 2.1**). Furthermore, potential downstream hydrological connectivity existed between the proposed wind farm site and associated infrastructure and Blackwater River SAC via the Oakfront River, Rathnacally Stream and Awbeg River (west branch). The shortest potential hydrological pathway between proposed site infrastructure and the Blackwater River SAC was approx. 700m from the turbine T4 hardstand via the Ardglass River (i.e. over-land and by water distance). The access road to turbine T2 crossed the Oakfront River approx. 1.7km instream distance from the Blackwater SAC site. The GCR did not cross over watercourses within or part of the Blackwater River SAC although hydrological connectivity was present via the Oakfront River and Rathnacally Stream (1.7km and 1.5km instream distance, respectively). The proposed TDR crossed the Rathnacally Stream approx. 1.5km upstream of the Blackwater River SAC boundary.

The Blackwater River SAC is designated for the following qualifying interests (NPWS, 2012), namely;

- Estuaries [1130]
- Mudflats and sandflats not covered by seawater at low tide [1140]
- Perennial vegetation of stony banks [1220]
- Salicornia and other annuals colonising mud and sand [1310]
- Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330]
- Mediterranean salt meadows (Juncetalia maritimi) [1410]

- Water courses of plain to montane levels with the *Ranunculion fluitantis* and Ca*llitricho-Batrachion* vegetation [3260]
- Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0]
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) [91E0]
- *Margaritifera margaritifera* (freshwater pearl mussel) [1029]
- *Austropotamobius pallipes* (white-clawed crayfish) [1092]
- *Petromyzon marinus* (sea lamprey) [1095]
- *Lampetra planeri* (brook lamprey) [1096]
- *Lampetra fluviatilis* (river lamprey) [1099]
- *Alosa fallax fallax* (twaite shad) [1103]
- *Salmo salar* (Atlantic salmon) [1106]
- *Lutra lutra* (otter) [1355]
- *Trichomanes speciosum* (Killarney fern) [1421]

3.2 Sensitive species data request

A sensitive species data request of aquatic interest was submitted (20th January 2021) to the National Parks and Wildlife Service for the 10km grid squares containing and adjoining the proposed wind farm project (i.e. R41, R50, R51, R52 & R60) and was received on the 26th January 2021. Records for a number of rare or protected species were available although most did not overlap directly with the survey area.

Numerous records for white-clawed crayfish (*Austropotamobius pallipes*) records were available from the Awbeg River (**Figure 3.1**). In the vicinity of the proposed wind farm (Awbeg [Buttevant]_SC_010 sub-catchment), the majority of crayfish records were for the Awbeg River (east branch), i.e. a watercourse with no downstream hydrological connectivity to the proposed project. However, a low number of records were available for Annagh Bridge and the L1320 road bridge (2003-2012 period), sites which had downstream hydrological connectivity to the proposed wind farm site. The nearest crayfish record to proposed wind farm infrastructure with potential hydrological connectivity was at Annagh Bridge on the Awbeg River, located approx. 1.7km from the turbine T4 hardstand via the Ardglass River (i.e. over-land and by water distance).

A single sea lamprey (*Petromyzon marinus*) record (spawning) was available for the Awbeg River (east branch) at Longford Bridge (grid square R51). However, this location did not share any downstream hydrological connectivity with the proposed wind farm project or associated infrastructure (see **Figure 3.1**).

Although located within the Munster Blackwater *Margaritifera* sensitive area, there were no freshwater pearl mussel (*Margaritifera margaritifera*) records available for the respective 10km grid squares in the vicinity of the proposed wind farm. The nearest downstream freshwater pearl mussel record was in the vicinity of Ballyhooly on the River Blackwater, >45km instream distance from the proposed wind farm. Please refer to **Appendix B** (freshwater pearl mussel report for further details)

Common frog (*Rana temporaria*) were widespread throughout 10km grid squares R41, R50, R51, R52 & R60 although no records overlapped directly with the proposed wind farm footprint. Several frog records were available for the Annagh Bogs area, located to the immediate northwest of the proposed site boundary.

Numerous records for kingfisher (*Alcedo atthis*) were available on the Awbeg River for grid squares R50 and R60 (downstream of Buttevant). No records were available in the vicinity of the proposed wind farm.

A low number of otter (*lutra lutra*) records were spread throughout the relevant grid squares, with records available for the Awbeg River at multiple locations. This included the L1320 road bridge (downstream of the proposed wind farm), as well as downstream of Buttevant.

3.3 Annagh wind farm catchment and survey area description

The proposed wind farm project is located in a lowland area in the townlands of Annagh North and Coolcaum, approx. 6km south-west of Charleville, Co. Cork. The Annagh wind farm site is within the South Western River Basin District and within hydrometric area 18 (Blackwater (Munster)). The aquatic survey sites were located on numerous watercourses within the Awbeg [Blackwater] SC_010 river sub-catchments near Charleville, Co. Cork. The survey area also overlapped with the Blackwater (Munster) *Margaritifera* sensitive area (**Figure 2.1**).

The following watercourses drained the proposed wind farm site:

- **Fiddane Stream** (EPA code: 18F19): the Fiddane Stream is a small, historically modified tributary of the Ardglass River located to the north-west of the site boundary
- **Ardglass River** (18A23): the Ardglass River is a small, historically modified tributary of the Awbeg River, to which it joins at Annagh Bridge. The short watercourses (2.6km length) river flows in a loosely north-south direction, to the west of the wind farm site. The lowermost c.1km of the river forms a boundary of the Blackwater River SAC (002170)
- **Awbeg River (west)** (18A09): the Awbeg River (west branch) is the major watercourse associated with the proposed Annagh project. The Awbeg flows in a loosely north-west-south-east direction and joins the River Blackwater south of Castletownroche, approx. 37.5km downstream of the proposed wind farm site. Much of the river's course is located within the Blackwater River SAC (002170)
- **Oakfront River** (18O02): the Oakfront River is a small, historically straightened tributary of the Awbeg, which it joins approx. 1.3km south of the bridge at Coolcaum (aquatic site A5). The Oakfront drains an area north of the proposed wind farm and flows through the centre of the site in a loosely north-south direction. The lowermost 1.3km of the river forms part of the Blackwater River SAC (002170)

In vicinity of the wind farm site, the TDR crosses the following watercourse:

- **Rathnacally Stream** (18R32): the Rathnacally Stream is a small, historically straightened tributary of the Awbeg River (east branch), which adjoins the main (western) branch of the

Awbeg at Scart Bridge. The TDR crosses this watercourse via a local road bridge at Rathnacally, near Ardnageehy Cross Roads (**TDR node 10.5**)

The GCR crosses the Rathnacally Stream at the L1322 local road crossing at Rathnacally (GCR-WCC1). The proposed crossing methodology for this location is via horizontal directional drilling (HDD).

The watercourses and aquatic surveys sites in the vicinity of Annagh wind farm are typically small, lowland depositing channels (FW2; Fossitt, 2000) which have been historically straightened and deepened as part of arterial drainage works (see **section 4** for more details). Land use practices in the wider survey area are dominated by agricultural pasture (CORINE 231) with localised pockets of broadleaved forests (311) and, less so, coniferous forests (312).

Predominantly, the watercourses flow over Visean limestone & calcareous shale, with Tournaisian limestone to the east and Namurian shale, sandstone, siltstone & coal to the north of the proposed site (Geological Survey of Ireland data).

3.4 EPA water quality data (existing data)

The following outlines the available water quality data for the watercourses in context of the proposed wind farm project. Only recent water quality (i.e. since 2018) is summarised below. There was no existing EPA biological monitoring data available for the Fiddane Stream (EPA code: 18F19), Ardglass River (18A23), Milltown Stream (18M57), Oakfront River (18O02) or Rathnacally Stream (18R32).

Please note that biological water quality analysis was undertaken as part of this study, with the results presented in the **section 4** and **Appendix C** of this report.

3.4.1 Awbeg River water quality

The Awbeg River (EPA code: 18A09) is the most significant watercourse draining the proposed wind farm site (downstream connectivity only, to the south of the site). Survey site A3 is located at the confluence of the Ardglass River and Awbeg River at Annagh Bridge.

In the vicinity of the survey area, there is a total of two EPA biological monitoring stations on the Awbeg which have been recently monitored (since 2018). The uppermost of these (station code: RS18A090400) is located at survey site A3 (Annagh Bridge). This site achieved Q2-3 (poor status) water quality in 2018 and thus failed to meet target good status (≥Q4) as set out under Water Framework Directive (2000/60/EC). However, station RS18A050550 (L1320 road crossing), located approx. 4km downstream of survey site A3 achieved Q4 (good status) water quality in 2018.

The WFD River Waterbodies Risk upstream of Annagh Bridge (Awbeg (Buttevant) (West)_020), the Awbeg (including the Ardglass River) was 'at risk' according to the EPA. Downstream of this point the River Waterbodies Risk for the Awbeg (Buttevant)_010 sub-catchment, which included the Awbeg River, Oakfront River, Milltown Stream and Rathnacally Stream, was 'under review' at the time of survey. The River Waterbody WFD Status for this sub-catchment in 2013-2018 period was ‘good’.

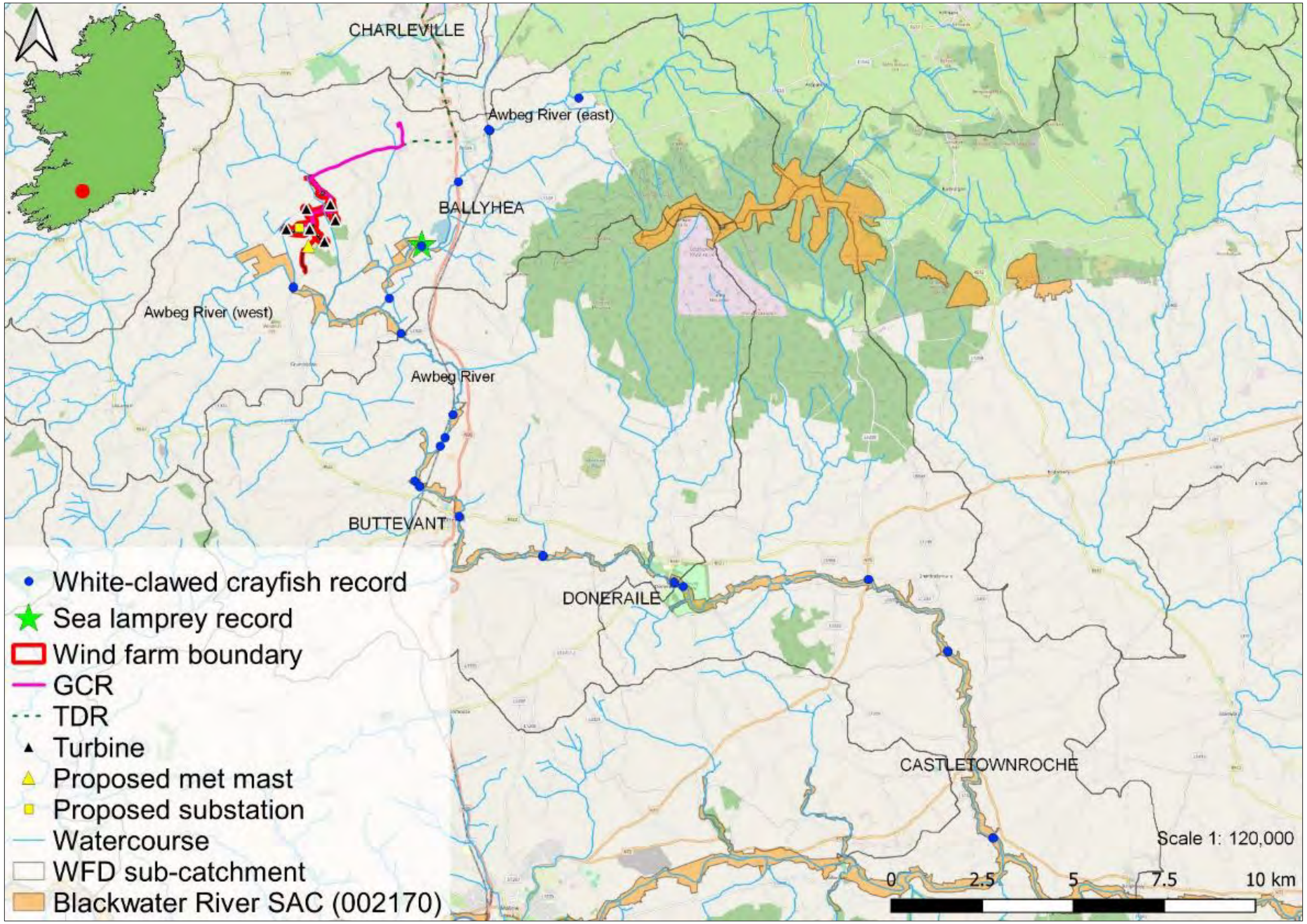


Figure 3.1 Distribution of white-clawed crayfish and sea lamprey records in the vicinity of the proposed wind farm (source: NPWS/NBDC data)

4. Results of aquatic surveys

The following section summarises each survey site in terms of aquatic habitats, physical characteristics and overall value for fish, white-clawed crayfish, freshwater pearl mussel and macrophyte communities. Biological water quality (Q-sample) results are also summarised for each site. Habitat codes are according to Fossitt (2000). Scientific names are provided at first mention only. Sites were surveyed in September 2020, with environmental DNA (eDNA) analysis carried out in April 2021. Please refer to **Appendix A** (fisheries assessment report), **Appendix B** (freshwater pearl mussel report), **Appendix C** (Q-sample results) and **Appendix D** (eDNA analysis) for more detailed results. An evaluation of the aquatic ecological importance of each survey site based on these aquatic surveys is provided and summarised in **Table 4.1**.

4.1 Aquatic survey site results

4.1.1 Site A1 – Fiddane Stream

Site A1 was located on the Fiddane Stream (18F19), immediately upstream of the Ardglass River confluence. The stream represented a small, narrow drainage channel (FW4) that averaged <1m wide and 0.1m deep. Flow was imperceptible at the time of survey (stagnant channel), with stagnant pool habitat to a maximum of 0.2m. The stream was considered a non-perennial watercourse at the survey location. The stream had been historically straightened and deepened, with varying bankfull heights of 1-2m. The substrata were composed of exclusively of deep silt, often >0.3m in depth. Livestock poaching was evident throughout the survey site. Riparian shading was high given a mature treeline dominated by ash (*Fraxinus excelsior*) and sycamore (*Acer psuedoplatanus*) with often dense bramble (*Rubus fruticosus* agg.), ivy (*Hedera helix*) and fern scrub. Tunnelling was frequent, with abundant woody debris instream, causing regular, significant blockages to flow. Consequently, macrophyte growth was limited to only occasional marginal fool's watercress (*Apium nodiflorum*).

Site A1 was not of fisheries value, with no fish recorded via electro-fishing (**Appendix A**). Whist localised ponding of water to 0.2m depth was present in several locations during the survey, the channel showed evidence of seasonal drying and was, therefore, not capable of supporting resident fish. The site had no suitability for white-clawed crayfish and none were recorded. The site had no suitability for freshwater pearl mussel given low flows, heavy siltation and its diminutive nature.

Site A1 was not suitable for Q-sampling during the survey period due to its shallow depth and lack of flow. Thus, it was not possible to assess biological water quality at this site.

The aquatic ecological evaluation of site A1 was of **Local importance (lower value)** (**Table 4.1**).

Plate 4.1 Representative image of site A1 on the Fiddane Stream, September 2020

4.1.2 Site A2 – Ardglass River, Annagh Bogs

Site A2 was located on the middle reaches of the Ardglass River (18A23) approx. 0.5km downstream from site A1. The river had been extensively straightened and over-deepened, historically, with a 1.5-2m wide channel with a deep U-shaped profile and 2-2.5m bankfull heights. The river represented a drainage channel (FW4), with an imperceptible flow at the time of survey. The channel averaged 0.7-0.8m deep with a bed composed exclusively of deep silt (often >0.5m in depth). The banks were heavily overgrown with dense bramble-dominated scrub (WS1). To the east was Annagh Bogs, an area of wet grassland (GS4), with coniferous plantation (WD4) adjoining to the west. Terrestrial encroachment of the channel was often high. Instream macrophyte coverage was very high, with abundant reed canary grass (*Phalaris arundinacea*) in addition to common duckweed (*Lemna minor*) and water mint (*Mentha aquatica*). As a result, open water areas were sparse. Common water starwort (*Callitriche stagnalis*) was occasional in more open areas of channel.

Three-spined stickleback (*Gasterosteus aculeatus*) was the only species recorded during electro-fishing at site A2 (**Appendix A**). The site was not of value for salmonids or lamprey given the heavily-silted, heavily-vegetated and low flow nature of the channel. Whilst some low suitability existed for European eel, none were recorded. The site had poor suitability for white-clawed crayfish and none were recorded. The site had no suitability for freshwater pearl mussel given low flows, heavy siltation and its diminutive nature (**Appendix B**).

Biological water quality, based on Q-sampling, was calculated (tentatively) as **Q2-3 (poor status)** (**Appendix C**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

The aquatic ecological evaluation of site A2 was of **Local importance (lower value)** (**Table 4.1**).

Plate 4.2 Representative image of site A2 on the Ardglass River, September 2020

4.1.3 Site A3 – Awbeg River, Annagh Bridge

Site A3 was located at the confluence of the Awbeg River (18A09) and Ardglass River, near Annagh Bridge. The Ardglass adjoined the Awbeg via a poorly accessible pipe culvert under the local road (leading to a large pool) and a deeply-cut, heavily-silted channel of 6-7m in width and 1.5-2m deep leading to the main river. The Ardglass had been extensively straightened and over-deepened throughout (both upstream and downstream of the confluence). Similarly, the Awbeg in the vicinity of Annagh Bridge had also been historically straightened and deepened. The river featured 100% deep glide which averaged 1.5->2m in depth and 8-10m in width, with steep margins. The substrata were dominated by deep silt throughout. The site was bordered by improved agricultural grassland (GA1) and an extensive area of wet grassland (historical floodplain) to the east, downstream of the bridge. Scrub comprising bramble, nettle, reed canary grass, great willowherb (*Epilobium hirsutum*) and rank grasses bordered the river. Given the typically low flows and heavily-silted nature of the site, macrophyte growth was high. Channel margins supported frequent stands of branched bur-reed (*Sparganium erectum*), abundant reed canary grass and occasional lesser water parsnip (*Berula erecta*). Common duckweed was frequent throughout.

Three fish species were recorded via electro-fishing from site A3 at the Awbeg-Ardglass confluence (**Appendix A**). Brown trout were the most frequently recorded, with a low density of adults recorded (*n*=10, the highest density of trout recorded at any survey site). European eel and three-spined stickleback were also present in low numbers. The site was not considered of value as a salmonid or lamprey spawning habitat given high siltation rates and its historically drained nature. However, holding habitat was good. The site was of some moderate value as a nursery although no juvenile salmonids were recorded (recruitment likely impacted by siltation). Despite abundant silt deposits, no lamprey ammocoetes were recorded. European eel habitat was good overall given frequent instream macrophyte refugia. The site had some good suitability for white-clawed crayfish although none were recorded via sweep netting or hand-searching. However, eDNA analysis of a water sample at Scart Bridge (3.2km downstream) indicated the presence of white-clawed crayfish in the Awbeg at and or upstream of Scart Bridge (see section 4.3). The site had no suitability for freshwater pearl mussel given heavy siltation (**Appendix B**).

Site A3 was not suitable for Q-sampling during the survey period due to its considerable depth and slow-flowing glide and pool habitat. Thus, it was not possible to assess biological water quality at this site (however, refer to section 3.4.1 for existing water quality data).

Given the location of the site (Awbeg and Ardglass channels) within the Blackwater River SAC (002170), the aquatic ecological evaluation of site A3 was of **international importance** (**Table 4.1**).

Plate 4.3 Representative image of site A3 at the Awbeg River (right)-Ardglass River (left) confluence at Annagh Bridge, September 2020 (facing downstream)

Plate 4.4 Representative image of the Ardglass River (right) upstream of site A3, September 2020

4.1.4 Site B1 – Milltown Stream, Milltown

Site B1 was located on the upper reaches of the Milltown Stream (18M57). The semi-natural lowland depositing watercourse (FW2) averaged 1-1.5m wide and 0.1-0.2m deep. Upstream of the road crossing (single arch bridge), the stream had been straightened but not deepened with low habitat heterogeneity remaining. However, downstream, the stream retained some good natural features (meanders, large woody debris and an overall greater depth). Overall, the site was characterised by shallow glide and riffle (both 40%) with only limited shallow pool present. Given the shallow depth, the site was considered likely to suffer from partial drying in the summer months. The substrata were dominated by small cobble (50%) which were highly compacted/bedded, although finer gravel fractions were also present locally. However, these were often heavily silted. The small (unnamed) stream adjoining the site immediately upstream of the bridge was evidently contributing to siltation pressures. Some limited small boulder habitat was present in the vicinity of the bridge. Silt accumulations were present (high clay fractions), usually in association with macrophyte beds. The riparian zone supported dense bramble scrub downstream of the bridge with a small block of wet woodland of willow and alder with Scot's pine (*Pinus sylvestris*), sitka spruce (*Picea sitchensis*), hawthorn, ivy, meadowsweet (*Filipendula ulmaria*), iris and nettle. Improved grassland (GA1) bordered the site on the south bank and upstream. In terms of macrophytes, the site featured heavy instream growth of fool's watercress (40%) with iris (*Iris pseudacorus*) encroachment also frequent downstream of the bridge.

Three-spined stickleback and European eel were the only species recorded via electro-fishing (**Appendix A**). Despite some suitability in terms of nursery and spawning habitat, the site did not support salmonids at the time of survey (possibly due to low flow pressures, seasonally). Although some localised soft sediment accumulations were present, no lamprey ammocoetes were recorded. European eel habitat was moderate overall, with some locally good habitat present in deeper pool areas. The site had some moderate suitability for white-clawed crayfish although none were recorded. The site had no suitability for freshwater pearl mussel given seasonal fluctuations and siltation pressures (**Appendix B**).

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix C**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of European eel, the aquatic ecological evaluation of site B1 was of **Local importance (higher value)** (**Table 4.1**).

Plate 4.5 Representative image of site B1 on the Milltown Stream, September 2020

4.1.5 Site B2 – Oakfront River, Cooliney Bridge

Site B2 was located on the upper reaches of the Oakfront River (18O02) approx. 0.6km downstream from its confluence with the Milltown Stream. At Cooliney Bridge, adjacent to the proposed grid cable route, the river had been extensively straightened and deepened historically for approx. 450m, with limited natural features remaining downstream of the bridge. Upstream, the river was more semi-natural although straightening was still evident. The river averaged a consistent 2.5m with little depth variation (0.2-0.3m). Shallow glide predominated (70%) with occasional riffles (20%) and very limited shallow pool (max. 0.4m). The substrata were dominated by cobble and small boulder (60%), which were largely bedded and compacted. Finer gravel fractions were present locally but these were limited in extent (more frequent upstream). Sand and silt accumulations were scattered. Overall, siltation was low but moderate locally (i.e. near bridge). The river was bordered on both banks by intensive agricultural grassland (GA1) with narrow riparian buffers (<2m). Shading was relatively high with intermittent immature treelines of willow, hawthorn and alder (evidently a mature treeline was cleared in the recent past). The riparian zone supported a low diversity and low cover of common species such as nettle, speedwell species (*Veronica* spp.), non-native montbretia (*Crocosmia x crocosmiiflora*) and rank grasses. Instream macrophytes were limited to occasional fool's watercress along channel margins. The bryophyte community was poorly developed with limited *Hygroamblystegium* sp. present on some instream boulder and cobble.

Low densities of brown trout, European eel, three-spined stickleback and *Lampetra* sp. ammocoetes were recorded via electro-fishing at site B2 (**Appendix A**). The site was of poor value for salmonids given poor hydromorphology, compaction of substrata and siltation pressures. Some moderate eel nursery habitat was present. Lamprey spawning habitat was present but limited in extent and silted. Some limited larval habitat was present immediately downstream of the bridge. The site had some low suitability for white-clawed crayfish although none were recorded. The site had no suitability for freshwater pearl mussel given historical straightening and siltation pressures (**Appendix B**).

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix C**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of brown trout, European eel and *Lampetra* sp. ammocoetes, the aquatic ecological evaluation of site B1 was of **Local importance (higher value)** (**Table 4.1**).

Plate 4.6 Representative image of site B2 on the Oakfront River, facing upstream to Cooliney Bridge, September 2020

4.1.6 Site B3 – Oakfront River, Milltown

Site B3 on the Oakfront River was located approx. 1km downstream from site B2 and approx. 150m upstream of the proposed internal road GCR crossing (WH-HF5). The river averaged 2-2.5m wide with depths ranging from 0.2-0.3m. Locally deeper pool/slacks were present, to a maximum of 0.5m. The stream had been extensively straightened historically although some limited natural features by way of meanders were present upstream and downstream. Bankfull heights were 1-2m, with natural scouring frequent (especially on meanders, **Plate 4.7**). The profile was dominated by shallow glide (80%) with limited pool and occasional riffle (10%). Unlike the channel upstream and downstream of the survey site (heavily silted), the substrata were dominated by fine and medium gravels (50%) with occasional cobble and small boulder in faster areas. Sand was frequent (20%). However, the substrata were moderately bedded and silted (moderate siltation). The site was bordered by improved agricultural grassland (GA1) to the east) and wet grassland (GS4) to the west, with bramble scrub and a mature alder/ash/hawthorn treeline along the west bank. The liverwort *Conocephalum conicum* was present on muddy banks. Given moderate shading, macrophytes were limited to marginal reed canary grass and occasional fool's watercress in open areas. Some branched bur reed (*Sparganium erectum*) was also present downstream of the proposed crossing. Filamentous algae was present but rare (<1% cover).

Low densities of brown trout, European eel and *Lampetra* sp. ammocoetes were recorded via electro-fishing at site B3, in addition to higher numbers of three-spined stickleback (**Appendix A**). The site was of moderate nursery value to salmonids with poorer quality spawning and holding habitat present (nevertheless, much improved over site B2 upstream). European eel habitat was moderate given the shallow depth and lack of instream refugia. Larval lamprey habitat was present locally although this was sub-optimal. Salmonid and lamprey spawning habitat as present but impacted by siltation. The site had some low suitability for white-clawed crayfish although none were recorded. The site had no suitability for freshwater pearl mussel given historical straightening and siltation pressures (**Appendix B**).

Biological water quality, based on Q-sampling, was calculated as **Q2-3 (poor status)** (**Appendix C**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of brown trout, European eel and *Lampetra* sp. ammocoetes, the aquatic ecological evaluation of site B3 was of **Local importance (higher value)** (**Table 4.1**).

Plate 4.7 Representative image of site B3 on the Oakfront River, September 2020 (facing downstream towards small meander)

4.1.7 Site B4 – Oakfront River, Springfort

Site B4 on the Oakfront River was located approx. 0.5km downstream from site B3 and 220m downstream of the proposed GCR crossing. The river averaged 2.5m wide with depths ranging from 0.2-0.3m. Locally deeper pool/slacks were present, to a maximum of 0.4m. As with upstream sites, the stream had been extensively straightened historically although some limited natural features by way of meanders were present (some good recovery of riparian areas also). Bankfull heights were 1-2m. The profile was dominated by swift, shallow glide (60%) with limited pool and occasional riffle (30%). The substrata were dominated by fine and medium gravels (50%) with occasional cobble (30%) and frequent sand (20%). Larger cobble and boulders were rare. However, the substrata were moderately bedded and silted (moderate siltation), although the faster flows had reduced siltation over upstream and downstream sites. Natural bank erosion was evident with some cattle poaching locally. The site was bordered by improved agricultural grassland (GA1) and adjoined a coniferous block (WD4) on the east bank (with alder buffer). The site was relatively highly shaded (not excessive) with a mature treeline and hedgerow mosaic of alder, ash and hawthorn, with an understory dominated by bramble scrub. The liverwort *Conocephalum conicum* was present on muddy banks. Given moderate shading, macrophytes were limited to occasional fool's watercress in open areas and some limited lesser water parsnip instream.

Low densities of brown trout, European eel and three-spined stickleback were recorded via electro-fishing at site B4 (**Appendix A**). The site was of moderate nursery value to salmonids with some good quality spawning habitat present (better than upstream site B3). Lamprey spawning habitat was available despite siltation pressures, though ammocoete habitat was sub-optimal (compacted sediment). European eel habitat was moderate given the presence of instream refugia such as scoured/undercut banks and large woody debris. Larval lamprey habitat was present locally although this was sub-optimal. Salmonid and lamprey spawning habitat as present but impacted by siltation. The site had some low suitability for white-clawed crayfish although none were recorded. The site had no suitability for freshwater pearl mussel given historical straightening and siltation pressures (**Appendix B**).

A kingfisher nest (that appeared recently used) was recorded under overhanging scrub in a steep muddy bank on the west bank of the river (ITM 550749, 617484) (Plate 4.9).

Biological water quality was not calculated at this site given the close proximity to site B3.

Given the presence of brown trout, European eel and a kingfisher nest, the aquatic ecological evaluation of site B4 was of **Local importance (higher value)** (**Table 4.1**).

Plate 4.8 Representative image of site B4 on the Oakfront River, September 2020

Plate 4.9 Steep muddy bank with kingfisher nest at site B4 (nest obscured underneath ivy scrub)

4.1.8 Site B5 – Oakfront River, bridge at Coolcaum

Site B5 was located on the lower reaches of the Oakfront River, at a local road crossing, approx. 1.2km downstream of site B4. Downstream of the bridge, the site was located within the Blackwater River SAC (002170) site. The lowland depositing watercourse (FW2) has been extensively straightened and over-deepened historically as part of flood relief works. A flood embankment was present on the west bank downstream of the bridge. The flood embankment was colonised by low-lying scrub comprising abundant nettle, reed canary grass, hogweed, creeping thistle, occasional bramble and rank grasses. The east bank was adjoined by intensive agricultural grassland (GA1) with no riparian buffer (farmed to edge). Coniferous afforestation (WD4) adjoined upstream (west bank). The river featured very little habitat heterogeneity with dredged deep glide >1.2m deep throughout and near vertical, low-lying banks. The site comprised 100% deep glide (shallower upstream of bridge). The site was heavily silted. The substrata was dominated by silt (70%) with some compacted, bedded cobble and medium to coarse gravels underneath. There was little exposed gravel. Some sand was present marginally upstream of the bridge (also high silt component). Sediment accumulations with some lamprey potential (see below) were present in association with limited instream macrophyte beds. Macrophyte growth was limited to occasional lesser water parsnip with occasional patches of common water starwort (*Callitriche stagnalis*). Reed canary grass and fool's watercress lined much of the channel margins.

Low densities of brown trout, European eel, three-spined stickleback and a single *Lampetra* sp. ammocoete were recorded via electro-fishing at site B5 (**Appendix A**). Site B5 provided poor salmonid habitat overall given heavy siltation, although predominant deep glide did offer some suitability for larger adults and European eel. Lamprey habitat was moderate overall, with an absence of suitable spawning substrata due to siltation. The site had some moderate suitability for white-clawed crayfish given instream refugia and soft banks for burrowing although none were recorded. The site had no suitability for freshwater pearl mussel given historical straightening and heavy siltation pressures (**Appendix B**).

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix C**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the location of the site downstream of the bridge within the Blackwater River SAC (002170), the aquatic ecological evaluation of site A3 was of **international importance** (**Table 4.1**). Upstream of the bridge, the site was considered of **local importance (higher value)** given the presence of brown trout and *Lampetra* sp.

Plate 4.9 Representative image of site B5 on the Oakfront River, September 2020 (facing downstream into Blackwater River SAC).

4.1.9 Site C1 – Rathnacally Stream, Clashganniv

Site C1 was located on the uppermost reaches of the Rathnacally Stream (18R32), at a local road crossing. The stream represented a small, heavily-modified drainage channel (historically straightened and deepened) with stagnant water at the time of the survey. The channel was evidently seasonal (dries out frequently) and downstream of the field boundary the channel merged into two dry ditches. The channel was heavily scrubbed over and buried in a dense hawthorn hedgerow. The bank heights were low at 0.6m. The bed comprised exclusively of deep silt. Some small pockets of standing water existed upstream of the road crossing, near a residential property entrance. These pools supported water 0.2m deep with high levels of terrestrial encroachment from wild angelica (*Angelica sylvestris*) and yellow iris (*Iris pseudacorus*). Macrophytes were limited to occasional fool's watercress.

The channel had no inherent value for fish, white-clawed crayfish or freshwater pearl mussel due to the absence of flows, heavy siltation and the site's evidently seasonal nature. No fish were recorded via electro-fishing.

Site C1 was not suitable for Q-sampling during the survey period due to its shallow depth and lack of flow. Thus, it was not possible to assess biological water quality at this site.

The aquatic ecological evaluation of site C1 was of **Local importance (lower value)** (**Table 4.1**).

Plate 4.10 Representative image of site C1 on the upper Rathnacally Stream, September 2020 (channel heavily overgrown).

4.1.10 Site C2 – Rathnacally Stream, bridge at Rathnacally

Site C2 on the Rathnacally Stream (18R32) was located at a local road (L1322) and proposed GCR and TDR crossing point (GCR-WCC1), approx. 1.2km downstream of site C1. The small lowland depositing stream (FW2) averaged 1.5m wide and 0.4m deep, although the channel was often shallower and narrower, particularly upstream. The bank heights were low at 0.75m and the stream exhibited historical straightening and deepening. The profile was dominated by deep glide (90%) and pool (10%), with frequent instream blockage (terrestrial plant encroachment, refuse, large woody debris etc.). The riparian zone comprised a mixture of dense scrub (e.g. bramble, hedge bindweed) and rank grasses. The treeline adjoining the stream comprised of mature ash, sycamore and sitka spruce with blackthorn (*Prunus spinosa*), hawthorn and ivy in the understory. The adjoining land uses were of heavily improved grassland (GA1). The substrata comprised small amounts of cobble, occasional coarse and medium gravels but was dominated by silt with a high clay fraction. The silt formed a bed c.0.3m deep over the majority of the coarse substrata. The very heavily-modified stream habitat did not contain any macrophytes apart from marginal fool's watercress with lesser amounts of watercress (*Nasturtium officinale*).

Three-spined stickleback was the only fish species recorded via electro-fishing from site C2 (**Appendix A**). The slow-flowing site was considered too heavily modified and silted to support a healthy fish population fish and the deep silt/clay bed was considered too compacted to support lamprey ammocoetes. The site had some very low suitability for white-clawed crayfish, albeit none were recorded. The site had no suitability for freshwater pearl mussel given historical straightening and heavy siltation pressures (**Appendix B**).

Biological water quality, based on Q-sampling, was calculated as **Q2 (bad status)** (**Appendix C**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

The aquatic ecological evaluation of site C2 was of **Local importance (lower value)** (**Table 4.1**).

Plate 4.11 Representative image of site C2 on the Rathnacally Stream, September 2020 (downstream of road crossing).

4.1.11 Site C3 – Rathnacally Stream, bridge at Ballynadrideen

Site C3 on the Rathnacally Stream (18R32) was located at a local road, approx. 1.5km downstream of site C2. The small lowland depositing stream (FW2) had been historically straightened upstream of the bridge but retained more semi-natural features downstream, where the stream was located within the Blackwater River SAC site. The small, lowland depositing watercourse (FW2) averaged 2.0m wide and 0.3m deep, with localised pool to 0.7m downstream of the bridge. The bank heights were low at 0.6m. The profile was dominated by deep glide (80%), riffle (10%) and pool (10%) by surface area over the survey reach, with deeper glide predominating downstream of the bridge and shallower glide and riffle upstream. The substrata were dominated by sand and silt covering 50% surface area of the bed. The remaining fractions comprised small boulder, coarse, medium and fine gravels (50%). Downstream of the bridge, the silt formed a bed

0.3m deep and covered large areas of the substrata. The riparian zone supported hedgerows and treelines adjoining domestic gardens upstream (GA2) and downstream of the road crossing. These were composed primarily of hawthorn, elder (*Sambucus nigra*), ash, sycamore and scattered sitka spruce (*Picea sitchensis*) with bramble in the understories. The adjoining land uses were of heavily improved grassland (GA1). The heavily-modified stream habitat did not contain any macrophytes apart from marginal fool's watercress.

Three-spined stickleback and European eel were the only fish species recorded via electro-fishing from site C3 (**Appendix A**). The slow-flowing site had been extensively straightened historically and was considered too heavily modified to support a healthy fish population. Salmonids were absent, despite some superficial suitability (riffle, glide and pool habitat). Evidently, siltation and water quality pressures had impacted the stream's ability to support salmonids (as per upstream). The deep silt/clay bed was considered too compacted to support lamprey ammocoetes, with none recorded. Suitability for European eel was moderate overall, although only a single juvenile was captured. The site had some moderate suitability for white-clawed crayfish given the presence of refugia and suitable burrowing habitat (clay banks). However, none were recorded. The site had no suitability for freshwater pearl mussel given historical straightening and heavy siltation pressures (**Appendix B**).

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix C**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the location of the site (downstream of the bridge) within the Blackwater River SAC (002170), the aquatic ecological evaluation of site C3 was of **international importance** (**Table 4.1**).

Plate 4.12 Representative image of site C3 on the Rathnacally Stream, September 2020 (facing downstream from bridge).

4.2 Biological water quality (macro-invertebrates)

No rare or protected macro-invertebrate species (according to national red lists) were recorded in the biological water quality samples taken from *n*=7 sites across the Fiddane Stream, Ardglass River, Milltown Stream, Oakfront River and Rathnacally Stream (**Figure 4.1, Appendix C**). All samples failed to meet the good status (≥Q4) requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC).

The majority of samples achieved Q2-3 or Q3 (poor status) given the absence of EPA group A (sensitive) species and paucity of group B (less sensitive) species. The Group B cased caddis *Limnephilus* sp. was only present in small numbers at sites B1 (Milltown Stream) and B5 (Oakfront River). The dominance of group C species such as *Baetis rhodani, Gammarus duebeni* and *Limnius volckmari* and or group D *Asellus aquaticus* and *Radix balthica,* along with the presence of group E species (e.g. *Tubificid* sp.) reduced the Q-rating to that of poor status in the majority of samples. Site C2 on the Rathnacally Stream (proposed GCR and TDR crossing, GCR-WCC1) achieved Q2 (bad status) given the dominance of group D *Asellus aquaticus* and E species such as *Chironomus* sp., in addition to very heavy siltation.

4.3 eDNA analysis

Composite water samples collected from both the Awbeg River (east branch) (sample C0269) and Awbeg River west branch, immediately upstream of east branch confluence; sample C0277) (**Figure 2.2**) returned a positive result for white-clawed crayfish eDNA (10 of 12 and 2 of 12 qPCR replicates, respectively) (**Appendix D**). These test results were considered as evidence of the species' presence within the vicinity of Annagh wind farm, i.e. present at and or upstream of the sampling locations in the east and west branches of the Awbeg River. These results suggest a higher frequency of crayfish in the eastern branch of the Awbeg River, which is in keeping with available data and personal observations of high densities upstream of Ballyhea Cross Roads.

Given the absence of crayfish recorded using traditional survey methodologies (i.e. hand-searching, sweep netting, examination of otter spraints) at the *n*=11 aquatic survey sites, these results may indicate cryptically low populations of white-clawed crayfish within the vicinity of Annagh wind farm. It is considered that the habitat quality for crayfish has been significantly reduced given historical arterial drainage (removed bed material, higher compaction etc.) and ongoing siltation pressures.

A negative result for crayfish plague was returned for the two sample sites i.e. crayfish plague eDNA was not detected or was present below the limit of detection in a series of 12 qPCR replicates (0 positive replicates out of 12) (**Appendix D**). To date, crayfish plague has not been recorded in the wider Munster Blackwater catchment (inclusive of the Awbeg River).

4.4 Aquatic ecological evaluation

An aquatic ecological evaluation of each survey site was based on the results of electro-fishing, white-clawed crayfish, freshwater pearl mussel and biological water quality surveys (**Table 4.1**). Brown trout, *Lampetra* sp., European eel and three-spined stickleback were the only fish species recorded via electro-fishing. No salmonids or lamprey were recorded in the Fiddane Stream, Ardglass River or Rathnacally Stream. There was no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded during the aquatic surveys using traditional methodologies. However, eDNA analysis revealed the species' presence in the Awbeg River (west branch) at or upstream of Scart Bridge and in the Awbeg River (east branch) at or upstream of the road crossing at Caherconnor.

Biological water quality was calculated as Q2-3 or Q3 across all *n*=7 sampling sites (**Appendix C**). Thus, all sites failed to achieve the (≥Q4) good status requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC).

During freshwater pearl mussel surveys (**Appendix B**), otter signs (spraint) were recorded on the Awbeg River at Scart Bridge and the L1320 road bridge, as well as the Awbeg River (east branch) bridge at Caherconnor. An active otter holt was recorded near the Awbeg-Oakfront confluence (ITM 550754, 615085).

No examples of Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] ('floating river vegetation') were recorded at the aquatic survey sites.

Sites A3 (Awbeg River), B5 (Oakfront River) and C3 (Rathnacally Stream) were considered of **international importance** given their location within the Blackwater River SAC (002170).

Sites B2, B3 and B4 on the Oakfront River, as well as site B1 on the connected Milltown Stream, were evaluated as **local Importance (higher value)** given the presence of salmonid, European eel and or *Lampetra* sp. populations and the presence of a kingfisher nest (site B4).

Sites A1 (Fiddane Stream), A2 (Ardglass River) and the remaining sites on the Rathnacally Stream (C1 & C2) were evaluated as l**ocal importance (lower value)** given their poor or absent fisheries value due to extensive historical modifications, heavy siltation, poor water quality (≤Q3) and or evident seasonality.

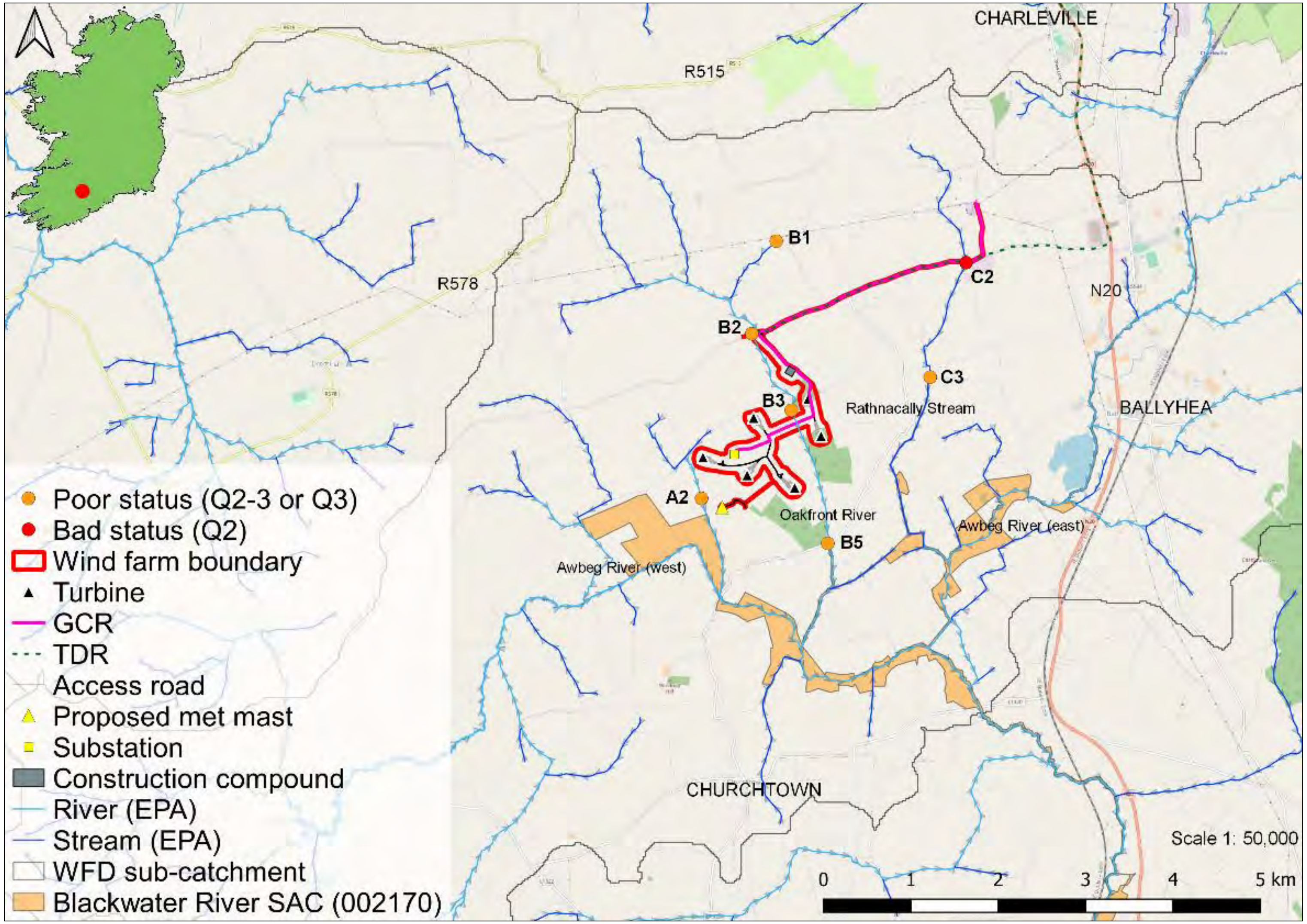


Figure 4.1 Biological water quality at n=7 sites in the vicinity of the proposed Annagh wind farm project, September 2020

Table 4.1 Aquatic ecological evaluation summary of the survey sites according to NRA (2009) criteria

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
A1	Fiddane Stream	18F19	Local importance (lower value)	No fisheries value (no fish recorded); biological water quality not assessed due to unsuitability; no other aquatic species or habitats of high conservation value
A2	Ardglass River	18A23	Local importance (lower value)	Poor fisheries value, three-spined stickleback recorded via electro-fishing; Q2-3 (poor status) water quality; no other aquatic species or habitats of high conservation value
A3	Awbeg River, Annagh Bridge	18A09	**International importance**	Located within Blackwater River SAC (002170); moderate quality salmonid and European eel value; brown trout, European eel & three-spined stickleback recorded via electro-fishing; biological water quality not assessed due to unsuitability; white-clawed crayfish eDNA present at and or upstream of Scart Bridge; no other aquatic species or habitats of high conservation value
B1	Milltown Stream	18M57	**Local importance (higher value)**	Moderate quality salmonid habitat but none present; European eel & three-spined stickleback recorded via electro-fishing; Q3 (poor status) water quality; no other aquatic species or habitats of high conservation value
B2	Oakfront River, Cooliney Bridge	18O02	**Local importance (higher value)**	Poor quality salmonid habitat, moderate lamprey habitat; brown trout, *Lampetra* sp., European eel & three-spined stickleback recorded via electro-fishing; Q3 (poor status) water quality; no other aquatic species or habitats of high conservation value
B3	Oakfront River	18O02	**Local importance (higher value)**	Moderate quality salmonid habitat, moderate quality lamprey habitat; brown trout, *Lampetra* sp., European eel & three-spined stickleback recorded via electro-fishing; Q2-3 (poor status) water quality; no other aquatic species or habitats of high conservation value
B4	Oakfront River	18O02	**Local importance (higher value)**	Moderate quality salmonid nursery & spawning habitat, moderate quality lamprey habitat; brown trout, European eel & three-spined stickleback recorded via electro-fishing; biological water quality not assessed; kingfisher nest recorded; no other aquatic species or habitats of high conservation value European eel present

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
B5	Oakfront River, bridge at Coolcaum	18O02	**International importance**	Located within Blackwater River SAC (002170) downstream of the bridge; poor quality salmonid habitat, moderate quality lamprey habitat; brown trout, *Lampetra* sp., European eel & three-spined stickleback recorded via electro-fishing; Q3 (poor status) water quality; no other aquatic species or habitats of high conservation value
C1	Rathnacally Stream	18R32	Local importance (lower value)	No fisheries value (seasonal drainage channel); no fish recorded via electro-fishing; biological water quality not assessed due to unsuitability; no other aquatic species or habitats of high conservation value
C2	Rathnacally Stream	18R32	Local importance (lower value)	Low fisheries value; three-spined stickleback recorded via electro-fishing; Q2 (bad status) water quality; no other aquatic species or habitats of high conservation value
C3	Rathnacally Stream	18R32	**International importance**	Located within Blackwater River SAC (002170); moderate quality salmonid and lamprey habitat; European eel & three-spined stickleback recorded via electro-fishing; Q3 (poor status) water quality; no other aquatic species or habitats of high conservation value

[1] Kingfisher are protected under Annex I of the EU Birds Directive (79/409/EEC, as amended 2009/147/EC) and are Amber-listed (medium conservation concern) in Ireland according to the Birds of Conservation Concern of Ireland (BoCCI; Gilbert et al., 2021)

*** Conservation value:** Atlantic salmon (*Salmo salar*), sea lamprey (*Petromyzon marinus*), brook lamprey (La*mpetra planeri*), river lamprey (*Lampetra fluviatilis*), white-clawed crayfish (*Austropotamobius pallipes*) and otter (*Lutra lutra*) are listed under Annex II of the Habitats Directive [92/42/EEC]. Atlantic salmon, river lamprey, white-clawed crayfish and otter are also listed under Annex V of the Habitats Directive [92/42/EEC]. Otters, along with their breeding and resting places, are also protected under provisions of the Irish Wildlife Acts 1976 to 2021. European eel are 'critically endangered' according to most recent ICUN red list (Pike et al., 2020) and listed as 'critically engendered' in Ireland (King et al., 2011). With the exception of the Fisheries Acts 1959 to 2019, brown trout have no legal protection in Ireland.

5. Potential impacts

As with any construction project, wind farm developments and associated infrastructure have the potential to cause significant negative impacts on water dependant species and habitats that fall within the footprint of the project or maintain downstream hydrological connectivity. The proposed Annagh Wind Farm drains the Awbeg [Buttevant]_SC_010 river sub-catchment and shares downstream hydrological connectivity with the Blackwater River SAC (site code: 002170). To elucidate potential impacts resulting from the proposed wind farm project, detailed surveys of physical and riparian habitats, and assessments of fish stocks (electro-fishing), fisheries habitat, white-clawed crayfish (including eDNA, freshwater pearl mussel, otter and biological water quality (Q-sampling) were undertaken in September 2020 and April 2021 (eDNA only).

The principle impacts from the proposed project on the aquatic environment are expected to occur during the construction phase where access track construction, concrete pouring for turbine bases and watercourse crossings are required. Ongoing operational activities including the maintenance of the turbines and infrastructure are considered unlikely to result in significant impacts on the receiving aquatic environment due to more localised footprints and the absence of direct disturbance to habitats.

The conventional source-pathway-target model was applied to assess potential impacts to downstream aquatic receptors as a result of the proposed project. This was evaluated by establishing the closest downstream watercourses and likely pathways for direct or indirect effects. The nearest hydrological distances from the aforementioned infrastructure to receiving watercourses are summarised in **Table 5.1.**

The proposed turbine delivery route (TDR) and grid connection route (GCR) travels predominantly along the existing road and utilises existing bridge and culvert structures over various watercourses. The crossing of the Rathnacally Stream on the L1322 (GCR-WCC1) will be via horizontal directional drilling (HDD), located approx. 1.5km upstream of the Blackwater River SAC (002170). The Oakfront Stream will be crossed at a single location (WF-HF5) via a single span, pre-cast concrete bridge. These proposed watercourse crossings are summarised in Chapter 3 and Chapter 10 (section 10.6.4). Within the proposed site boundary, new access tracks will be required and these will also convey the GCR.

The potential impacts of the proposed project are outlined below for the ‘do-nothing’ scenario and construction, operation and decommissioning phases (as applicable) of the Annagh wind farm project. These are the potential impacts that could potentially occur in the absence of mitigation measures. The summary of potential impacts, magnitude, duration, likelihood and whether it is of a direct or indirect nature is provided in **Table 5.1**.

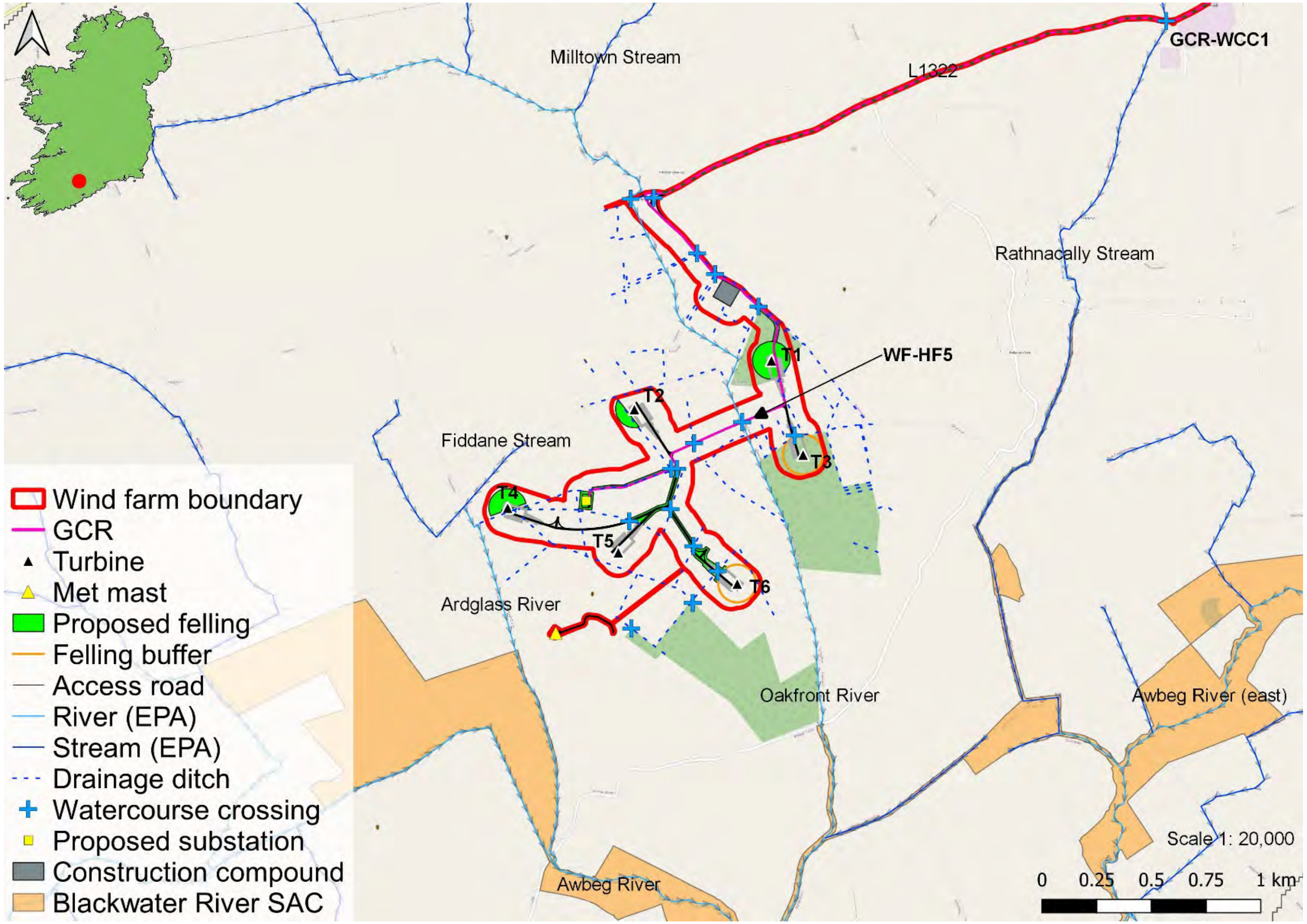


Figure 5.1 Location of the proposed Annagh wind farm project, Co. Cork showing proposed infrastructure

5.1 'Do nothing' scenario

If the proposed wind farm project does not go ahead then the land in the vicinity of the site will continue to be used for agricultural pasture and commercial forestry activities. The 'do-nothing' approach would result in water quality, hydrological regimes and the aquatic ecology of the receiving watercourses remaining consistent with the emergent baseline (i.e. pre-development). The majority of the aquatic survey sites achieved poor status (i.e. Q2-3 or Q3), with no sites meeting target good status (≥Q4) (**Appendix C**). Significant pressures such as eutrophication and siltation would continue to pose a threat to water quality within the wider catchment.

5.2 Potential construction phase impacts

The principle impacts from the proposed project on the aquatic environment are expected to occur during the construction phase. Primarily, these risks relate to water pollution and or contamination via siltation (suspended solids), hydrocarbons, concrete etc. The Construction Environmental Management Plan (CEMP), which details the construction methodology, has been developed to minimise the requirement for in-stream works and to reduce the risk of potential contamination and water pollution. Potential impacts relating specifically to hydrology are dealt with in Chapter 10 (Hydrology and Water Quality). The potential impacts relating to specific construction-phase activities on the aquatic environment are discussed in detail below.

5.2.1 Potential impacts during tree felling

Localised tree felling will be required in the vicinity of turbines T1, T2, T3, T4, and T6 hardstand areas, the substation (and associated access track) and along the access tracks to T1, T4 and T6; see **Figure 5.1**). It is estimated that 12.6ha of existing broadleaf forestry will be felled to facilitate development of the proposed wind farm infrastructure (e.g., turbine hardstands, substation compound, associated access tracks and bat felling buffers). There are potential source-receptor pathways from felling areas to both the Ardglass River and Oakfront River.

In light of the location of these felling areas in relation to surface water features (i.e. drainage ditches) and watercourses (**Figure 5.1**), there is potential for felling to contribute to the increase in site run-off, as outlined in section 10.4.2 of chapter 10. This may impact sensitive aquatic ecological receptors through mobilisation of sediment and or nutrients (especially phosphorus), resulting in impacts to both water quality and aquatic habitat (e.g., smothering fish spawning substrata). The release of nutrients to watercourses can also come from brash if material is left within close proximity to receiving watercourses (riparian zone) or if it is incorrectly managed (e.g. not replaced as required when used for off-road plant). However, it is noted that nutrient leaching would be less severe in a lowland setting with broadleaf-dominated forestry where little or no fertilisation has occurred than, for example, an upland conifer plantation which was heavily fertilised. The overall felling area proposed is small (12.6ha) when compared to commercial conifer clear-felling operations taking place within the catchment nearby (primarily the Ballyhoura Mountains). Considering these factors together, the potential for impacts associated with nutrient run-off or leaching is relatively low.

Tree felling operations require trafficking of heavy machinery which can lead to pollution of watercourses due to spillage of fuels and hydrocarbons. Exposure of soil and subsoil following vehicle tracking, skidding and extraction methods also has the potential to release nutrients to surface waters, posing a risk to aquatic ecosystems and species, including aquatic qualifying interests of the downstream-connecting Blackwater River SAC (002170). There is also a risk that machinery associated with tree felling could act as a vector for introducing or dispersing non-native invasive species, which may spread along nearby watercourses.

Whilst tree felling in the vicinity of all turbines poses a potential risk to water quality and aquatic receptors given the existing site drainage network, the greatest risk of impact to aquatic sensitivities from felling was identified at turbine T4, whose felling area is located <15m from a drainage channel with connectivity to the Ardglass River (felling area located c.65m direct distance from Ardglass River). This drainage channel also adjoins (to the south) an area of wet grasslands/marsh (GS4/GM1), which may increase the potential hydrological connectivity to the receiving watercourse. The felling area for the proposed site substation is located <20m from the existing drainage channel network which shares downstream hydrological connectivity with the Ardglass River (approx. 500m instream distance from substation). Similarly, the proposed felling along the existing access track to the substation area is located directly adjacent to the drainage channel network, which provides potential (indirect) hydrological connectivity to the Ardglass River (approx. 530m instream distance). The Ardglass River is a heavily-modified watercourse (straightened, deepened, heavily silted with poor flows) and supported three-spined stickleback, with no other species or habitats of conservation value greater than local importance (lower value) present. However, the Ardglass River shares hydrological connectivity with the Blackwater River SAC (002170), located approx. 0.6km downstream of the aforementioned drainage channel network confluence west of turbine T4. Thus, there is potential for tree felling to impact qualifying interests such as otter, lamprey species and white-clawed crayfish.

The proposed 2.1ha felling area in the vicinity of turbine T1 is located c.70m (shortest over-land distance) from the Oakfront River. Whilst potential hydrological connectivity (via existing drainage network) is poor, and although an existing forestry plantation buffer exists between the turbine location and the river, the close proximity of felling to the Oakfront River presents a risk to sensitive aquatic receptors and the Blackwater River SAC located approx. 1.8km downstream.

Although hydrological connectivity is relatively poor, the proposed felling area (2.6ha) associated with turbine T3 is located <160m from the Oakfront River via the drainage channel network. This may serve as a more significant source-receptor pathway during periods of heavy rainfall/higher water levels. The Oakfront River supported brown trout, *Lampetra* sp. and otter. Therefore, there is potential for tree felling activities to impact these sensitive aquatic receptors and their habitats via water quality impacts (eutrophication, sedimentation), in addition to the Blackwater River SAC (002170), located approx. 1.4km downstream from the potential drainage channel confluence. The remaining felling areas in the vicinity of turbines T2, and T6 are located >200m from riverine watercourses and share poor/limited hydrologically connectivity to these watercourses via the existing drainage channel network.

Potential hydrological and water quality impacts as a result of tree felling and felling activities are further considered in section 10.4.2 of chapter 10.

Given the close proximity of and potential hydrological connectivity of the Ardglass River and Oakfront River to tree felling areas, potential impacts to aquatic ecology, in the absence of mitigation, are assessed as being **likely moderate negative, short-term and at the local scale[1].**

With regards the downstream-connecting Blackwater River SAC (002170), potential impacts to aquatic qualifying interests are considered as **likely significant negative, short-term and at the scale of the European site**.

5.2.2 Potential impacts during access track construction

It is proposed to construct approximately 4.5km of new internal access tracks and 0.1km length of turning heads, and carry out upgrades to c.0.4km of existing agricultural tracks to facilitate site access and construction activities. New access tracks and upgrade of existing tracks have the potential to contribute to the increase in surface water run-off and cause more localised water quality impacts through sediment- and nutrient-laden run-off, including from tree felling areas associated with new tracks. Works leading to erosion of the river banks/bed could result in the release of suspended solids. This may impact sensitive aquatic ecological receptors in receiving watercourses through mobilisation of sediment and or contaminants, as well as additional erosion, resulting in impacts to both water quality and aquatic habitat. Details on the projected increase are provided in section 10.4.2 of chapter 10.

Access track construction will also require localised tree felling, primarily in the vicinity of turbines T1and T6. Potential impacts on aquatic ecological receptors from tree felling required for access track construction are the same as those outlined above in section 5.2.1.

As outlined in section 10.6 of chapter 10, the drainage system for the existing tracks and roads will largely be retained. It is proposed to upgrade approximately 0.4km of existing agricultural roads. All track widening will be undertaken using clean uncrushable stone with a minimum of fines.

Road drainage will be over the edge, where the surface runoff will be collected in swales and dispersed via diffuse outfalls. Swales will be connected to settlement ponds at the end of the swale.

These activities have the potential to convey suspended solids and contaminants (e.g., nutrients, hydrocarbons) to receiving watercourses.

There will be one new access track crossing over the Oakfront River and 13 no. crossings over the field and forestry drains identified during the site visits. These access track crossings are detailed in section 10.6.4 and Table 10.9 of chapter 10, and shown in **Figure 5.1** above. The proposed crossing structure over the Oakfront River (WF-HF5) is a single span, pre-cast concrete bridge, approx. 1.6km instream distance from the Blackwater River SAC (002170). Foundations are to be

[1] i.e. at the river sub-catchment scale

set back 2.5m from the river bank. The Oakfront River was found to support brown trout, European eel, *Lampetra* sp., three-spined stickleback, kingfisher and otter. Water quality was of poor status (Q2-3 or Q3) in September 2020.

For small crossings over the field and forestry drains, pre-cast box culverts are proposed. Manmade agricultural and forest drains will be crossed using 450mm diameter pipes. Where cross drains are to be provided to convey the drainage across the track, the minimum sizes of these cross drains are 300 mm diameter pipes.

Given the close proximity of and potential hydrological connectivity of access track construction to the Oakfront River and (less so) the Ardglass River, potential impacts to aquatic ecology, in the absence of mitigation, are assessed as being **likely moderate negative, short-term and at the local scale.**

With regards the downstream-connecting Blackwater River SAC (002170), potential impacts to qualifying interests are considered as **likely significant negative, short-term and at the scale of the European site**.

5.2.3 Potential impacts during turbine base and met mast construction

The construction of 6 no. wind turbines (with a transformer at each turbine and associated hardstand areas) and 1 no. met mast will include construction activity, large-scale earthworks, drainage and pouring of concrete. The 6 no. turbines have been positioned at a minimum distance of c.120m (measured along flow paths) from the riverine watercourses draining the site (i.e. Ardglass River and Oakfront River). The proposed met mast is located approx. 200m north-west (over-land) from the nearest potential hydrological pathway (i.e. Ardglass River).

The greatest threat to aquatic ecology from turbine base construction (based on site topography and the layout of surface water features) was impacts to water quality identified at turbines T3 and T4 which are located approx. 130m and 170m from the Ardglass River and Oakfront River, respectively (indirect connectivity via drainage ditches). Although the aquatic ecological evaluation of the heavily-modified Ardglass River was considered of local importance (lower value) only, the Oakfront River supported brown trout, European eel, *Lampetra* sp., three-spined stickleback, kingfisher and Blackwater River SAC qualifying interest otter. Both the Ardglass and Oakfront Rivers share downstream hydrological connectivity with the Awbeg River and Blackwater River SAC (002170), with the shortest hydrological distances from proposed turbine infrastructure to the European site being 0.7km and 1.4km, respectively (via surface water drains and the rivers). The Awbeg is known to support a range of aquatic qualifying interest species and habitats, including otter, Atlantic salmon, lamprey species and white-clawed crayfish. No crayfish were recorded via traditional surveys in the vicinity of the proposed wind farm. However, eDNA sampling detected cryptically low levels of white-clawed crayfish at and or upstream of Scart Bridge, located downstream of the wind farm site (3.2km hydrological distance to turbine hardstand T3). The earthworks required to facilitate turbine base construction may liberate nutrients and increase the sediment load of surface water run-off, potentially impacting water quality and aquatic sensitivities (e.g. fish, macro-invertebrates, otter, white-clawed crayfish) in adjacent and downstream watercourses, including the Oakfront River, Ardglass River, Awbeg

River and Blackwater River SAC (002170). Thus, given the proximity and hydrological connectivity of turbines T3 and T4 to these receiving watercourses (see **Table 5.1** for distances), there exists a risk of water quality impacts to aquatic receptors via siltation, nutrient run-off and pollution associated with turbine base construction.

Wet concrete poured for turbine bases, met mast construction or rinsing of truck chutes on-site could lead to contamination of receiving waters via surface water run-off. Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality and aquatic biota, including Atlantic salmon, lamprey, otter and white-clawed crayfish.

Heavy machinery required for turbine base and met mast construction may also lead to pollution of nearby receiving watercourses due to spillage of fuels and hydrocarbons. Haul tracks crossing the Oakfront River or passing close to sites drainage channel network could allow the migration of silt-laden run-off into adjacent watercourses via surface water pathways (e.g. wheel rutting). Accidental spillage during refuelling of construction plant with petroleum hydrocarbons can cause significant pollution risk to surface waters and aquatic ecology. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in surface waters, resulting in death of aquatic organisms.

There is also a risk that machinery required for construction could act as a vector for introducing or dispersing non-native invasive species, which may spread along nearby watercourses. However, no invasive species were identified in the vicinity of the proposed turbines or site access tracks and the geographical separation of same from adjacent watercourses would reduce this risk considerably.

It is noted that there is little direct connectivity between the turbine locations or met mast site and the receiving watercourses draining the site (i.e. considerable geographic separation), so the risk of silt-laden surface water run-off to watercourses is greatly reduced. However, given the close proximity of turbines T3 and T4 from receiving riverine watercourses and the proximity of the proposed met mast from surface water drains (see **Table 5.1** for details), potential impacts to aquatic ecology resulting from turbine and met mast construction do exist and are considered **likely moderate negative, short-term and in the local context,** in the absence of mitigation.

At its shortest distance, the Blackwater River SAC (002170) is located approx. 0.7km and 1.4km downstream of wind farm site infrastructure respectively (via surface water drains and the Ardglass and Oakfront Rivers). Potential impacts to local populations of qualifying interest Atlantic salmon, lamprey species, white-clawed crayfish and otter and Annex I habitats are considered **likely significant negative, short-term and in context of the European site**, in the absence of mitigation.

5.2.4 Potential impacts resulting from site drainage

The construction phase may result in significant changes or alterations to the existing drainage network within the wind farm boundary, which may increase sediment and nutrient loads to receiving watercourses within, adjoining or draining the site. No alterations to existing drainage are proposed or expected outside of the wind farm boundary (e.g. along the TDR or grid connection route). As outlined in Chapter 10 (section 10.4.6), there are several watercourse (drain) crossings to be installed for the wind farm access tracks. Track widening will involve slight relocation of existing roadside drains. For small crossings over the field and forestry drains, pre-cast box culverts are proposed. Manmade agricultural and forest drains will be crossed using 450mm diameter pipes. Where cross drains are to be provided to convey the drainage across the track, the minimum sizes of these cross drains are 300mm diameter pipes. Culverting may increase surface water run-off (flow) to the receiving Ardglass River and Oakfront River, mobilising and increasing siltation rates and exacerbating the risk of other water quality impacts (e.g., eutrophication).

Site drainage, including silt traps and stilling ponds, will be put in place in parallel with construction, such that excavation for new infrastructure will have functional drainage system in place. Inappropriate management of the carrying out of these modifications could result in blockages of existing roadside drainage and drainage swales, which may both increase the risk of water contamination to adjacent watercourses via siltation, fuel spillages etc., as well as cause alterations in the existing hydrology of the wider site. Inappropriate management of the excavated material associated with construction (e.g. inadequate silt fences on drainage channels or ponds alongside access/haul tracks) could also lead to loss of suspended solids to surface waters.

Whilst the on-site drainage network was not of value to sensitive aquatic receptors (e.g. salmonids, lamprey, white-clawed crayfish), inappropriate sizing of pipework or blockages could impede flows, particularly during heavy rainfall events. Local flooding or surface water ponding could result, potentially resulting in the release of suspended solids to receiving watercourses or altering local hydrology. The significance of the effect of the increase in site run-off as a result of the proposed project has been assessed as "not significant" on receiving waters because estimated increases in the peak run-off is low compared to the flows of receiving waters (chapter 10). Further consideration to site drainage and the potential for hydrological impacts are considered in section 10.6 of chapter 10.

The temporary construction compound, located in agricultural pasture to the north-east extent of the site, poses a risk to water quality of the Oakfront River given the potential drainage channel source-receptor pathways present in close proximity (c.185m). Whilst set-back from the drainage network, inappropriate management of surface water run-off to the interceptor drain and stilling pond could lead to aquatic ecological impacts. Potential impacts to hydrology resulting from site drainage of the temporary construction compound are outlined in section 10.6.6 of chapter 10.

Given the likely small-scale of site drainage-related events due to geographic separation and limited surface water pathways to receiving watercourses, potential impacts to aquatic ecology resulting from alterations to/inadequate site drainage management are considered **likely moderate negative, short-term and in the local context**, in the absence of mitigation.

Potential impacts to Blackwater River SAC (002170) qualifying interest species and habitats are considered **likely significant negative, short-term and in context of the European site**, in the absence of mitigation.

5.2.5 Potential impacts during GCR installation (HDD and excavations)

The proposed underground grid connection cable route (GCR), which is approx. 6km in length, follows to-be-constructed access tracks and local public roads to connect to the existing Charleville 110Kv substation in the townland of Rathnacally, 2.8km north-east of the wind farm site entrance. The cable ducts will be placed in the carriageway of the public road network, whilst along internal site tracks, the cable ducts will be installed above proposed pre-cast concrete pipe culverts at drainage crossing points (see section 10.6.4 of chapter 10). The proposed grid connection trench will be up to 600mm wide (1040mm wide in flat formation) and up to 1200mm deep. Where the proposed grid connection cable route encounters minor culverts, the ducts will be installed above or below the culvert depending on its depth in accordance with construction methodologies outlined in the CEMP. Excavation of the GCR trenching presents a potential risk to water quality from silt and hydrocarbons during construction. There is a potential impact, in the absence of mitigation measures, of sediment-laden run-off in surface water from the ground surface surrounding the cable trench. Wheel rutting from machinery could allow the migration of silt-laden run-off into adjacent watercourses via surface water pathways. Along the on-site access tracks, concrete (lean-mix) will be used as backfill around the ducting with excavated material used on top. Concrete has a high pH and presents a potential significant risk to the aquatic environment. Underground cabling can potentially provide a preferential flow path for surface water.

In addition to crossing 6 no. drainage channels, there will be a requirement for 2 no. riverine watercourse crossings along the GCR in total. These are on the Rathnacally Stream (GCR-WCC1) and Oakfront River (WF-HF5). The crossing of the Rathnacally Stream on the L1322 will be via horizontal directional drilling (HDD), located approx. 1.5km upstream of the Blackwater River SAC (002170). There is a risk of surface water quality impacts on the Oakfront River and the downstream Awbeg River and Blackwater River SAC (002170) during HDD and groundworks associated with potential directional drilling. Watercourses crossed by directional drilling are at risk of suspended solid releases, hydrocarbon pollution and escapement of drilling lubricants (e.g. bentonite). The release of suspended solids would negatively affect fish populations, invertebrates and other water-dependant species, such as otter and kingfisher. Suspended solids can damage fish spawning substrata through the blocking of interstitial spaces, preventing oxygen diffusion and effecting egg/larval development, or directly smothering attaching and burrowing invertebrates, causing mortalities and changes to fish and invertebrate community composition at the local scale. An increase in suspended solids can also have negative effects on instream flora through a reduction in light penetration and habitat heterogeneity, thus altering overall aquatic ecology. It is proposed that directional drilling under the existing L1322 road bridge will be undertaken to prevent direct impacts on the Rathnacally Stream. However, there is a risk of indirect impacts from sediment-laden run-off during the launch pit and reception pit excavation works. It should be noted that the Rathnacally Stream and downstream-connecting Awbeg River, already suffer from significant siltation and water quality pressures.

The water quality of the riverine watercourses within the vicinity of the proposed wind farm project are already compromised (bad to poor status, Q2 to Q3; **Appendix C**), with significant siltation and eutrophication pressures. These pressures would appear to have precluded salmonids and lamprey species from the Rathnacally Stream and Ardglass River (none recorded during electro-fishing surveys), and inhibited populations in the Oakfront River. Additional release of suspended solids and or nutrients as a result of the construction, operational and or decommissioning phases could cause further impacts to aquatic qualifying interest species and habitats of the Blackwater River SAC (002170).

To avoid instream works, the Oakfront River will be crossed by a single span, pre-cast concrete bridge (cable ducts to be incorporated into proposed pre-cast concrete structure), located approx. 1.6km upstream of the Blackwater River SAC (002170). However, there remains potential for the release of silt or contaminants (e.g. hydrocarbons) to the Oakfront River and downstream-connecting Blackwater River SAC (002170) due to vegetation/bank clearance/excavation works and construction/plant activity. As above, it should be noted that the Oakfront River and downstream-connecting Awbeg River, already suffer from significant siltation and water quality pressures.

Potential impacts to aquatic ecology of the receiving riverine watercourses, in the absence of mitigation, are assessed as being **likely moderate negative, short-term and at the local scale**.

With regards the downstream-connecting Blackwater River SAC (002170), potential impacts to aquatic qualifying interests are considered as **likely significant negative, short-term and at the scale of the European site**.

5.2.6 Potential impacts during turbine delivery (TDR)

In addition to turbine construction, the delivery of turbines and associated materials has the potential to impact water quality of watercourses crossed during transport. The turbine delivery route (TDR) will follow the existing road network and will run for 80km from the port of Foynes, Co. Limerick via the N69, M20, N20 and L1322 to the north-eastern extent of the site, near Cooliney Bridge.

Modifications along the TDR will involve the temporary removal of street furniture and removal of some vegetation in addition to the temporary local widening at bends using hardcore material. Within the vicinity of the wind farm site, the TDR will cross a single watercourse, namely the Rathnacally Stream at a local road crossing on the L1322 (GCR-WCC1). This crossing is located approx. 1.5km upstream (by water) of the Blackwater River SAC (002170). Although no instream works are proposed to this existing watercourse crossing, hedgerow trimming and wall lowering will be required to facilitate oversail. Given the close proximity of works to the watercourse, there is a low but potential risk of water quality impacts from sediment-laden run-off and or nutrient escapement resulting from vegetation removal. There is also a low risk of water quality impacts resulting from fuel spillage (hydrocarbons) from associated plant machinery in vicinity of the road crossing.

Potential impacts to aquatic ecology resulting from turbine delivery are considered **likely moderate negative, short-term and in the local context**, in the absence of mitigation.

Impacts to the downstream-connecting Blackwater River SAC (002170) are considered as **likely not significant, short-term and at the scale of the European site**.

Table 5.1 Summary of construction phase impacts to aquatic ecological receptors (pre-mitigation)

Activity	Nearest downstream connecting watercourse(s) (direct down-slope distance from activity)	Sensitive aquatic receptor(s)	Aquatic ecological impacts	Potential impact significance
Tree felling	**Ardglass River** (c.120m from T4 via a drainage channel) **Oakfront River** (c.160m from T3 via a drainage channel)	Salmonids (Atlantic salmon & brown trout), European eel, *Lampetra* sp., common frog, otter, kingfisher, white-clawed crayfish; Blackwater River SAC aquatic qualifying interests (≤1.4km downstream)	Release of suspended solids, contaminants and or nutrients (water quality impacts); mortality of aquatic invertebrates & fish eggs; eutrophication and impacts to downstream fish, otter, kingfisher, invertebrates & water quality; spread of invasive species along watercourses	*All downstream aquatic habitats & species:* **Likely moderate negative, short-term and in the local context** *All downstream aquatic qualifying interests of Blackwater River SAC (002170):* **Likely significant negative, short-term and in context of the European site**
Access track construction	**Oakfront River** (crossed by single span bridge (WF-HF5), c.1.4km instream distance from Blackwater River SAC) **13 no. drainage channels** (crossed by access tracks – see section 10.6.4 of chapter 10)	Salmonids (Atlantic salmon & brown trout), European eel, *Lampetra* sp., common frog, otter, kingfisher, white-clawed crayfish; Blackwater River SAC aquatic qualifying interests	Release of suspended solids, contaminants and or nutrients (water quality impacts); mortality of aquatic invertebrates & fish eggs; eutrophication and impacts to downstream fish, otter, kingfisher, invertebrates & water quality; spread of invasive species along watercourses	*All downstream aquatic habitats & species:* **Likely moderate negative, short-term and in the local context** *All downstream aquatic qualifying interests of Blackwater River SAC (002170):* **Likely significant negative, short-term and in context of the European site**
Turbine base and met mast construction	<u>**Turbine bases:**</u>	Salmonids (Atlantic salmon & brown trout),	Release of suspended solids, contaminants and or nutrients (water quality impacts); mortality of	*All downstream aquatic habitats & species:*

Activity	Nearest downstream connecting watercourse(s) (direct down-slope distance from activity)	Sensitive aquatic receptor(s)	Aquatic ecological impacts	Potential impact significance
	Ardglass River (c.130m from T4 via a drainage channel, 0.7km from Blackwater River SAC) **Oakfront River** (c.170m from T3 via a drainage channel, 1.4km from Blackwater River SAC) **Drainage channels** (numerous small drains in footprint of hardstands) **<u>Met mast:</u>** **Ardglass River** (c.200m from met mast)	European eel, *Lampetra* sp., common frog, otter, kingfisher, white-clawed crayfish; Blackwater River SAC aquatic qualifying interests	aquatic invertebrates & fish eggs; eutrophication and impacts to downstream fish, otter, kingfisher, invertebrates & water quality; spread of invasive species along watercourses	**Likely moderate negative, short-term and in the local context** *All downstream aquatic qualifying interests of Blackwater River SAC (002170):* **Likely significant negative, short-term and in context of the European site**
Site drainage (incl. crossing/culverting of drainage channels)	**Ardglass River** (various source-receptor pathways via drainage channels) **Oakfront River** (various source-receptor pathways via drainage channels)	Salmonids (Atlantic salmon & brown trout), European eel, *Lampetra* sp., common frog, otter, kingfisher, white-clawed crayfish; Blackwater River SAC aquatic qualifying interests	Increase in flow rates (surface water run-off); changes to rates of erosion & deposition in receiving watercourses; impacts to aquatic habitats and water quality	*All downstream aquatic habitats & species:* **Likely moderate negative, short-term and in the local context** *All downstream aquatic qualifying interests of Blackwater River SAC (002170):* **Likely significant negative, short-term and in context of the European site**

Activity	Nearest downstream connecting watercourse(s) (direct down-slope distance from activity)	Sensitive aquatic receptor(s)	Aquatic ecological impacts	Potential impact significance
Grid connection route (GCR)	**Rathnacally Stream** (crossed at GCR-WCCC1 via HDD on L1322 road) **Oakfront River** (crossed at WF-HF5 via single span pre-cast concrete bridge) **6 no. drainage channels** (crossed by GCR via box culvert– see section 10.6.4 and Table 10.9 of chapter 10)	Salmonids (Atlantic salmon & brown trout), European eel, *Lampetra* sp., common frog, otter, kingfisher, white-clawed crayfish; Blackwater River SAC aquatic qualifying interests	Release of suspended solids, contaminants and or nutrients (water quality impacts); mortality of aquatic invertebrates & fish eggs; eutrophication and impacts to downstream fish, otter, kingfisher, invertebrates & water quality; spread of invasive species along watercourses	*All downstream aquatic habitats & species:* **Likely moderate negative, short-term and in the local context** *All downstream aquatic qualifying interests of Blackwater River SAC (002170):* **Likely significant negative, short-term and in context of the European site**
Turbine delivery route (TDR)	**Rathnacally Stream** (crossed at GCR-WCCC1 on L1322 road, 1.5km upstream of Blackwater River SAC)	European eel; downstream Blackwater River SAC aquatic qualifying interests	Release of contaminants (water quality impacts); spread of invasive species along watercourses	*All downstream aquatic habitats & species:* **Likely moderate negative, short-term and in the local context** *All downstream aquatic qualifying interests of Blackwater River SAC (002170):* **Likely not significant negative, short-term and in context of the European site**

5.3 Potential operational phase impacts

Operational wind farms are not normally considered to have the potential to significantly impact on the aquatic environment. The main risk to watercourses is via water quality impacts, when oils and lubricants are used on the site (e.g. infrastructure maintenance). If such substances leaked from the turbines or maintenance areas or were disposed of inappropriately, there is a risk of water contamination and subsequent impacts to aquatic ecology. However, the likelihood of this occurring is very low, and the potential significance of this impact can be mitigated through effective mitigation and appropriate management.

Increases in the surface water run-off volume as a result of less-permeable surfaces of the wind farm (e.g. hardstands, access tracks etc.) are predicted to be <1% of the average daily/monthly volume in comparison to the baseline pre-development conditions (section 10.6 of chapter 10). Thus, no significant operational phase impacts are predicted as a result of increases in surface water run-off.

The overall estimated increase in the unmitigated peak runoff due to the wind farm is 0.174 m^3/s (or 0.20 %) for a 1 in 100 years storm event (Chapter 10, section 10.4.2). Therefore, the slight predicted increase in surface water run-off during the lifetime of the wind farm project is not anticipated to impact slow-swimming fish species, such as European eel or *Lampetra* sp., in receiving watercourses and is considered negligible.

Due to the natural 'grassing-over' the drainage swales and revegetation of other exposed surfaces, and the non-intrusive nature of site operations, there is a negligible risk of sediment release to the watercourses during the operational stage.

Spills of any oil or fuels (hydrocarbons) from site vehicles onto access tracks may leach to adjacent watercourses. However, this is unlikely to be a significant impact considering the low volumes of vehicular traffic involved in typical wind farm operations. During the operation stage, small quantities of oil will be used in cooling the transformers associated with the facility. A back-up generator at the sub-station may be used (and refuelled). There is, therefore, a potential for small oil spills which may enter surface waters and cause impacts to aquatic ecology. Upgrading of the site track/road network within the wind farm boundary could present the risk of silt-laden run-off resulting from excavations required for underground cable maintenance.

Potential operational phase impacts on aquatic ecology are considered **likely slight negative, short-term and in the local context**, in the absence of mitigation.

Given the downstream-connectivity from the wind farm site and associated infrastructure (GCR, sub-stations, access tracks etc.), potential impacts to aquatic qualifying interest species and habitats of the Blackwater River SAC (002170) are considered **likely not significant negative, short-term and in context of the European site**, in the absence of mitigation.

5.4 Potential decommissioning phase impacts

Decommissioning activities of the Annagh Wind Farm project will take place in a similar fashion to the construction phase. Potential impacts will be similar to the construction phase but on a reduced scale. The decommissioning phase poses similar risks of potential effects vis-á-vis the construction phase. However, with suitable planning and provision of adequate mitigation, potential negative impacts on the receiving aquatic environment during decommissioning can be minimised. The decommissioning phase is described in Chapter 3 and these works will be subject to a decommissioning plan, to be agreed with Cork County Council. A decommissioning plan can be found in the CEMP.

There would be increased trafficking and an increased risk of disturbance to underlying soils at the wind farm, during the decommissioning phase, in this instance, leading to the potential for silt laden run-off entering receiving watercourses from the wheels of vehicles (i.e. wheel-rutting).

Any such potential impacts would be likely to be less than during the construction stage as the drainage swales would be fully mature and would provide additional filtration of run-off. Any diesel or fuel oils stored on main wind farm site will be bunded.

For access tracks and turbine foundations it is proposed that they are left in place and covered with local topsoil and re-vegetated. Removal of this infrastructure would result in considerable disruption to the local environment in terms of an increased possibility of sedimentation. It is considered that leaving the turbine foundations hardstanding areas in-situ will cause less environmental damage than removing them.

Grid connection cables will be left in the ground, therefore no potential impacts to aquatic ecology during the decommissioning stage are likely to occur.

Potential decommissioning phase impacts on aquatic ecology are considered **likely slight negative, short-term and in the local context**, in the absence of mitigation.

Potential impacts to aquatic qualifying interest species and habitats of the Blackwater River SAC (002170) are considered **likely not significant negative, short-term and in context of the European site**, in the absence of mitigation.

5.5 Potential cumulative impacts

There is the potential for cumulative impacts to occur to aquatic ecological receptors during the construction and operational phases of the proposed Annagh wind farm.

Cumulative impact from an aquatic ecology point of view can only occur if assessed developments are hydrologically linked. The major developments which are in the same sub-basin and within 10km from the proposed wind farm are listed and evaluated in section 8.5.5 of Chapter 8 and section 10.9 of chapter 10. Of these, Boolard wind farm, Rathnacally wind farm and two separate solar farm developments are located within the Awbeg (Buttevant)_010 and Oakfront_010 sub-basins and therefore share hydrological linkage with the proposed Annagh wind farm project.

The potential for impacts to aquatic ecology from wind farms is primarily during the construction phase, and relate principally to water quality impacts. Both the Boolard and Rathnacally wind farm developments are operational and have themselves been assessed as 'not significant' in terms of potential impacts to water quality. Therefore, there is not considered any potential for the operation of these developments to contribute towards significant in-combination impacts with the current project.

Solar farm (2) is located approximately 1km south-east of the proposed wind farm site, in the Awbeg (Buttevant)_010 sub-basin, and is hydrologically linked to it. The potential impacts to water quality and hydrology of this solar farm development has been assessed as 'not significant'. Given the absence of overlapping infrastructure between this and the current project, there is there is not considered any potential for significant in-combination impacts on aquatic ecology.

Solar farm (1) is located approximately 0.1km north of the proposed Annagh wind farm site and is hydrologically linked to it. The environmental impact assessment screening report of the solar farm concluded that there will be no significant environmental impact as a result of the development. The grid connection for this solar farm overlaps with that proposed for Annagh Wind Farm and will also cross the Rathnacally Stream at watercourse crossing GCR-WCC1 (unnamed bridge on L1322). However, the solar farm grid connection is scheduled to be constructed first, with the cable ducts to be installed in the bridge deck. The GCR for Annagh wind farm is to cross the Rathnacally Stream via HDD (as outlined in section 5.2.5). Whilst the potential for in-combination impacts to water quality will be reduced through scheduling divergence and differing crossing methodologies, a risk of cumulative impacts nevertheless exists, in the absence of mitigation.

While it is difficult to quantify the level of impact with certainty, in-combination effects are considered likely, in the absence of mitigation. These would include the increased release of sediment and, in particular, nutrients to receiving watercourses. The risk of such impacts would, for example, greatly increase if such works were taking place during the winter months or times of very high rainfall. Due to the already compromised water quality of the majority of watercourses draining the proposed project site (e.g. predominantly poor status; **section 4.2, Appendix C**), further significant impacts to these could be likely. This would be of particular concern to the downstream-connecting Awbeg River and Blackwater River SAC (002170). In the absence of mitigation, a **significant negative, short-term cumulative impact** on the European site is considered likely. Potential cumulative impacts on aquatic ecology are considered **likely slight negative, short-term and in the local context**, in the absence of mitigation.

6. Mitigation measures

6.1 Construction phase mitigation

Construction phase mitigation for hydrology should follow that outlined in section 10.7 of Chapter 10, and the mitigation measures outlined should be adhered to in conjunction with those outlined in this section. Construction phase mitigation measures for aquatic ecology predominantly involve the preservation of water quality.

All measures for the protection of water quality within the proposed project site, as detailed in the CEMP, will also protect the aquatic ecology and fisheries value of downstream watercourses. The measures adopted within the CEMP (including recommendations from Inland Fisheries Ireland) will ensure effective protection of aquatic ecological interests downstream of the proposed project, particularly the habitats supporting sensitive aquatic species and with connectivity to the Blackwater River SAC (002170).

6.1.1 Mitigation measures for tree felling

Localised tree felling will be required in the vicinity of turbine T1, T2, T3, T4 and T6 hardstand areas, the substation (and associated access track) and along the access tracks to T1and T6 (see **Figure 5.1**). It is estimated that 12.6ha of existing broadleaf forestry will be felled to facilitate development of the proposed wind farm infrastructure (e.g., turbine hardstands, substation compound and associated access tracks). There are potential source-receptor pathways from felling areas to both the Ardglass River and Oakfront River.

Whilst no specific mitigation exists for the felling of broadleaf forestry, the installation of buffer zones adjacent to the aquatic zone are particularly important adjacent to the Ardglass River and adjoining drainage channel located near turbine T4 (c.130m shortest instream distance) and the Oakfront River and associated drainage channel near turbine T3 (c.160m shortest instream distance). Given the close proximity of felling areas to receiving watercourses and potential source-receptor pathways (i.e. drainage channels), a minimum buffer zone for felling areas of 15m will be applied. Check dams/silt fences will be required within the drainage channels adjoining the Ardglass and Oakfront Rivers (i.e. those providing hydrological connectivity from felling areas to receiving watercourses). Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Broadleaf brash mats will be used to support vehicles on soft ground and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall.

To ensure tree clearance methodology that reduces the potential for sediment and nutrient run-off, the construction methodology will follow the specifications set out in the following best guidance documents:

- DAFM (2019). Standards for Felling and Reforestation;

- Forestry Service (2000a). Forest Service Forestry and Water Quality Guidelines;
- Forestry Service (2000b). Forest Harvesting and Environmental Guidelines;

Additional mitigation measures for the protection of aquatic ecology and receptors during felling activities will follow those outlined in section 10.7.1.2 and 10.7.1.6 of Chapter 10 (e.g. minimum buffer zone widths along watercourses).

Given the sensitivity of aquatic ecological receptors in the Ardglass River, Oakfront River and downstream-connecting Blackwater River SAC (002170) (e.g. salmonids, lamprey species, kingfisher, otter, white-clawed crayfish), it is recommended to undertake felling in the spring period to facilitate the sowing of grass seeds post-harvest to aid sediment filtration and nutrient absorption, using native grass species *Holcus lanatus* and *Agrostris capilaris* (DAFM, 2018). Machine operations must not take place in the 48-hour period before predicated heavy rainfall, during heavy rainfall or in the 48-hour period following heavy rainfall (DAFM, 2018). Removal of branch lop-and-top and other debris (brash) from felling areas within 20m of drainage channels will reduce nutrient seepage immediately post-felling and in the proceeding years after felling has occurred (DAFM, 2019).

In the presence of mitigation measures, potential impacts to aquatic ecology resulting from tree felling are considered **likely slight negative, short-term and in the local context**.

Potential impacts to qualifying interest species and habitats of the downstream-connecting Blackwater River SAC (002170) are considered **likely not significant and short-term in in context of the European site,** in the presence of mitigation.

6.1.2 Mitigation measures for access track construction

It is proposed to construct approximately 4.5km of new internal access tracks and 0.1km of turning heads, and carry out upgrades to c.0.4km of existing agricultural tracks (including bend widening) to facilitate site access and construction activities. All track widening will be undertaken using clean uncrushable stone with a minimum of fines to reduce the risk of suspended solid releases to receiving watercourses.

Still traps will be placed in the new roadside swales. Proposed new tracks will be drained as via roadside swales with stilling ponds at the end of the swale. These grassed swales will serve to detain flow and reduce the velocities of surface water flows. The swales will be 0.3 m deep with a bottom width of 0.5 m and side slope of 1 in 3. The swales will be constructed in accordance with CIRIA C698 Site Handbook for the Construction of SuDS which can be used in conjunction with CIRIA C753 The SuDS Manual. Where roadside drains are laid at slopes greater than 2%, check dams will be provided.

Mitigation measures to protect site hydrology and water quality are provided in section 10.6 and 10.7.1 of chapter 10. These include measures to reduce or prevent surface water run-off, suspended solids, hydrocarbons, site wastewater, cement and nutrients escaping to receiving surface waters. The mitigation measures proposed will reduce potential direct and indirect impacts from the construction of access tracks. The risk of water quality impacts to receiving watercourses via siltation or nutrient release will be further reduced through siltation management as detailed in the CEMP.

The 13 no. surface water drains within the site boundary to be crossed by access tracks during the construction phase will be via precast box culverts (refer to section 10.6.4 of chapter 10). Silt Protection Controls (SPCs) are proposed at the location of the drain crossings. It is recommended that the SPCs will consist of a minimum of silt traps containing filter stone and filter material staked across the width of the swales and upstream of the outfall to any watercourse.

In the presence of mitigation measures, potential impacts to aquatic ecology resulting from access track construction are considered **likely slight negative, short-term and in the local context**.

Potential impacts to qualifying interest species and habitats of the downstream-connecting Blackwater River SAC (002170) are considered **likely not significant and short-term in in context of the European site,** in the presence of mitigation.

6.1.3 Mitigation measures for turbine base and met mast construction

The greatest threat to aquatic ecology from turbine base construction (based on site topography and the layout of surface water features) are impacts to water quality identified at turbines T3 and T4 which are located approx. 130m and 170m from the Ardglass River and Oakfront River, respectively (indirect connectivity via drainage ditches). Both the Ardglass and Oakfront Rivers share downstream hydrological connectivity with the Awbeg River and Blackwater River SAC (002170), with the shortest hydrological distances to the European site being 0.7km and 1.4km, respectively (via surface water drains and the rivers).

Please refer to section 10.6 of Chapter 10 for detailed mitigation measures for site drainage and silt attenuation to prevent impacts to the water quality of downstream watercourses during the construction phase. These include measures to prevent run-off erosion from vulnerable areas and consequent sediment release into nearby watercourses to which the proposed development site discharges. The mitigation measures proposed will reduce potential direct and indirect impacts from the construction of the turbine foundations/hardstands. The risk of water quality impacts to receiving watercourses via siltation or nutrient release will be further reduced through siltation management as detailed in the CEMP.

In the presence of mitigation measures, potential impacts to aquatic ecology resulting from turbine base and met mast construction are considered **likely slight negative, short-term and in the local context**.

Potential impacts to qualifying interest species and habitats of the downstream-connecting Blackwater River SAC (002170) are considered **likely not significant and short-term in in context of the European site,** in the presence of mitigation.

6.1.4 Mitigation measures for site drainage

Permanent roadside drainage will be installed as part of the construction stage. This will include the use of interceptor drains, swales, check dams and stilling ponds. These measures will buffer site run-off during periods of high rainfall by retaining the water until the storm hydrograph has receded. The proposed locations of the stilling ponds are provided in the Surface Water Management Plan (SWMP) contained in Appendix 10.3 and in the Planning Drawings. Silt fencing will be provided at strategic locations (See section 10.7 in Chapter 10 Hydrology and water Quality) to further protect watercourses during the construction phase.

Site drainage, including silt traps and stilling ponds, will be put in place in parallel with construction, such that excavation for new infrastructure will have functional drainage system in place. The stilling ponds will remain in place during construction phase. The stilling ponds will drain diffusely overland, over existing vegetated areas, within the site boundary. The stilling ponds will be back-filled and the swales that were connected to them will be re-connected to the outfall once construction is completed. Silt Protection Controls (SPCs) are proposed at the location of all drain crossings. SPCs will consist of a minimum of silt traps containing filter stone and filter material staked across the width of the swales and upstream of the outfall to any watercourse.

As outlined in section 5.2.4, It is noted that there is little direct connectivity between the development area and the riverine watercourses draining the site (i.e. heavily vegetated drainage channels connecting to the Ardglass River and Oakfront River), so the risk of silt-laden surface water run-off to receiving watercourses is greatly reduced, even in the absence of mitigation. However, detailed mitigation measures to protect water quality (which include but are not limited to sediment run-off control and management of concrete and aquatic buffer zones) in respect of site drainage are outlined in Chapter 10 and the CEMP.

Please refer to section 10.6 of Chapter 10 for detailed mitigation measures for site drainage and silt attenuation to prevent impacts to the water quality of downstream watercourses during the construction phase.

In the presence of mitigation to protect water quality, potential impacts to aquatic ecology resulting from alterations to/inadequate site drainage management are considered **likely slight negative, short-term and in the local context**.

Potential impacts to qualifying interest species and habitats of the downstream-connecting Blackwater River SAC (002170) are considered **likely not significant and short-term in in context of the European site,** in the presence of mitigation.

6.1.5 Mitigation measures for GCR installation

In addition to the crossing on 6 no. drainage channels, there will be a requirement for 2 no. riverine watercourse crossings along the GCR in total. These are on the Rathnacally Stream (GCR-WCC1) and Oakfront River (WF-HF5).

The crossing of the Rathnacally Stream on the L1322 will be via horizontal directional drilling (HDD), located approx. 1.5km upstream of the Blackwater River SAC (002170). Mitigation measures relating to water quality preservation are outlined in detail in section 10.7 of chapter 10. These measures will also serve to protect sensitive aquatic ecological receptors and Blackwater River SAC (002170) qualifying interest species and habitats. Although no-instream works are proposed, the drilling works will only be completed during a dry period between July and September (as required by Inland Fisheries Ireland for in-stream works) to avoid the salmonid spawning season and sensitive life stage period. A pre-construction otter survey will be undertaken in the vicinity of GCR-WCC1 and WF-HF5 to ensure than no breeding or resting areas are located within 150m (no holts recorded in these locations to date during otter surveys but pre-construction surveys will be undertaken to reconfirm the findings of the EIAR). Should an otter breeding (holt) or resting area (couch) be detected, a derogation licence would need to be obtained from the NPWS to facilitate drilling works.

Excavation of the grid route trench will require excavation of soils/subsoils which has the potential to impact the water quality and aquatic habitat of receiving watercourses. Excavated spoil emanating from the cut trenches, where appropriate (i.e. when trenching within private tracks or the public road verge) will be used to back-fill the trenches. Any excess will be disposed of off-site, at an appropriate licenced facility. All excavated material emanating from trenches within the public road network will be disposed at an appropriate licenced facility. Mitigation measures to prevent the escapement of suspended solids to receiving watercourses (e.g. silt fences, interceptor drains, stilling ponds, drain blocking etc.) are outlined in section 10.7 of chapter 10 and the CEMP. On the Rathnacally Stream, silt fences will also be constructed in the vicinity of the excavated areas on the stream banks to prevent siltation of the adjacent watercourse. An Ecological Clerk of Works (ECoW) will monitor both turbidity and observe the riverbed during the drilling process to detect any leakage (frac-out) of drilling fluid. Should this leakage be observed, works will cease immediately. If drilling fluids are required, a biodegradable fluid that is non-toxic to aquatic life, such as CLEARBORE, shall be used rather than bentonite.

The GCR crossing of the Oakfront River (WF-HF5) will be via a single span, pre-cast concrete bridge. This will avoid the requirement for instream works. Nevertheless, installation will only be completed during a dry period between July and September (as required by Inland Fisheries Ireland for in-stream works) to avoid the salmonid spawning season and sensitive life stage period. Potential releases of sediment-laden surface run-off as a result of bank clearance works to facilitate bridge installation/access will be mitigated against through the water quality mitigation measures applicable throughout the site (see section 10.7 of chapter 10 and the CEMP).

Further mitigation measures in relation to the grid connection cable route (including the spread of invasive species) are outlined in the CEMP and will be fully implemented.

In the presence of mitigation measures, potential impacts to aquatic ecology resulting from GCR installation are considered **likely slight negative, short-term and in the local context**.

Potential impacts to qualifying interest species and habitats of the downstream-connecting Blackwater River SAC (002170) are considered **likely not significant and short-term in in context of the European site,** in the presence of mitigation.

6.1.6 Mitigation measures for turbine delivery route

The TDR will cross the Rathnacally Stream at a local road crossing on the L1322 (GCR-WCC1). This crossing is located approx. 1.5km upstream (by water) of the Blackwater River SAC (002170). There are no instream works required at the bridge structure to facilitate turbine delivery, although hedgerow trimming and wall lowering will be required to facilitate oversail. These minor, localised works could in the absence of mitigation cause impacts to the water quality of the receiving Rathnacally Stream and downstream Blackwater River SAC (002170).

Mitigation measures relating to water quality preservation are outlined in detail in section 10.7 of Chapter 10 and in the CEMP. These measures, which include but are not limited to silt fences, roadside drain blocking, refuelling protocols and spoil disposal, will also serve to protect sensitive aquatic ecological receptors and Blackwater River SAC (002137) qualifying interests such as Atlantic salmon, lamprey species, otter and white-clawed crayfish.

In terms of hydrology and water quality, the significance of the effect of the works associated with TDR onto the receiving waters has been assessed as “not significant” (section 10.7.3 of chapter 10).

In the presence of mitigation measures, potential impacts to aquatic ecology resulting from turbine delivery are considered **likely not significant, short-term and in the local context**.

Potential impacts to qualifying interest species and habitats of the downstream-connecting Blackwater River SAC (002170) are considered **likely not significant and short-term in in context of the European site,** in the presence of mitigation.

6.2 Operational phase mitigation

The primary impact to aquatic ecology resulting from the operational phase of the proposed wind farm is an increase in surface water run-off from hardstand areas, access tracks and other reduced-permeability surfaces, thus potentially impacting water quality and site drainage/hydrology. However, the overall estimated increase in the unmitigated peak runoff due to the wind farm is 0.174 m^3/s (or 0.20 %) for a 1 in 100 years storm event (Chapter 10, section 10.4.2). Therefore, the slight predicted increase in surface water run-off during the lifetime of the wind farm project (compared with baseline conditions, pre-development) is not anticipated to impact slow-swimming fish species, such as European eel or *Lampetra* sp., in receiving watercourses and is considered negligible.

In light of this slight increase, potential impacts to receiving watercourses are considered unlikely, even pre-mitigation. Nonetheless, mitigation measures (including interceptor drains, check dams, settlement ponds) will be implemented to reduce this risk even further. Mitigation for the maintenance regime respective of hydrology and water quality is outlined in section 10.7.4 of chapter 7. These measures will also serve to protect sensitive aquatic receptors.

Due to the natural 'grassing-over' the drainage swales and revegetation of other exposed surfaces, and the non-intrusive nature of site operations, there will be a further reduction in the risk of sediment release to the watercourses during the operational stage.

In the presence of mitigation, potential operational phase impacts on aquatic ecology are considered **likely imperceptible negative, short-term and in the local context**.

Given the downstream-connectivity from the wind farm site and associated infrastructure (GCR, sub-stations, access tracks etc.), potential impacts to aquatic qualifying interest species and habitats of the Blackwater River SAC (002170) are considered **likely not significant negative, short-term and in context of the European site**, in the presence of mitigation.

6.3 Decommissioning phase mitigation

In relation to aquatic ecology, the same mitigation measures will apply for the decommissioning phase as for the construction phase. In the event of decommissioning of the Annagh wind farm, the access tracks may be used in the decommissioning process. Mitigation measures applied during decommissioning activities will be similar to those applied during construction but will be of reduced magnitude.

It is proposed that turbine foundations and hardstand areas should be left in place and covered with local soil/topsoil to revegetate at the decommissioning stage. It is considered that leaving the turbine foundations, access tracks and hardstand areas in-situ will cause less environmental damage than removing them. The grid connection ducting and substation will be left in situ as part of the national grid, therefore no potential impacts during decommissioning stage are likely to occur. Hence no mitigation measures are required.

Moreover, due to the relatively long life of wind farm infrastructure, it is likely that a revised/updated environmental assessment will be required at the time of decommissioning to account for any changes in baseline conditions at the wind farm site, and potential changes is assessment guidelines and legislation.

In the presence of mitigation, potential decommissioning phase impacts on aquatic ecology are considered **likely slight negative, short-term and in the local context**, in the absence of mitigation.

Potential impacts to aquatic qualifying interest species and habitats of the Blackwater River SAC (002170) are considered **likely not significant negative, short-term and in context of the European site**, in the presence of mitigation.

7. Residual impacts

The residual impacts on aquatic ecology resulting from Annagh wind farm project are summarised in **Table 7.1** below, using the impact assessment criteria outlined in Section 2.1.

The layout and design of the proposed Annagh wind farm has taken the aquatic ecology of the existing environment into consideration. The limitation of indirect impacts arising from water quality pollution events such as siltation and run-off of suspended solids will significantly reduce the potential for impacts affecting aquatic ecological interests within the vicinity of the proposed project. Provided all mitigation measures are implemented in full, no significant residual impacts on the local aquatic ecology or integrity of the Blackwater River SAC (002170) are expected from the project.

Overall, the proposed Annagh wind farm project will have a **likely moderate to significant negative, short-term impact** on sensitive aquatic receptors in the **local scale context** during the construction phase, in the absence of mitigation (see Table 5.1). Potential impacts to the aquatic qualifying interest species and habitats of the Blackwater River SAC (002170) in the absence of mitigation, are considered **likely significant negative, short-term and in context of the European site**, with the exception of impacts from the TDR which was assessed as being **likely not significant negative, short-term and in context of the European site.**

However, through the implementation of the mitigation measures outlined in **Section 6 above,** section 10.6 and 10.7 of Chapter 10 and the CEMP, residual impacts to aquatic species and habitats are considered to be **likely slight negative to not significant, short-term and in the local context.**

For the Blackwater River SAC (002170), the impacts to aquatic qualifying interest species and habitats are considered **likely not significant, short-term and in the context of the European site**.

Table 7.1 Summary of residual impacts to aquatic ecological receptors (post-mitigation)

Activity	Nearest downstream connecting watercourse(s) (direct down-slope distance from activity)	Sensitive aquatic receptor(s)	Aquatic ecological impacts	Potential impact significance
Tree felling	**Ardglass River** (c.120m from T4 via a drainage channel) **Oakfront River** (c.160m from T3 via a drainage channel)	Salmonids (Atlantic salmon & brown trout), European eel, *Lampetra* sp., common frog, otter, kingfisher, white-clawed crayfish; Blackwater River SAC aquatic qualifying interests (≤1.4km downstream)	Release of suspended solids, contaminants and or nutrients (water quality impacts); mortality of aquatic invertebrates & fish eggs; eutrophication and impacts to downstream fish, otter, kingfisher, invertebrates & water quality; spread of invasive species along watercourses	*All downstream aquatic habitats & species:* **Likely slight negative, short-term and in the local context** *All downstream aquatic qualifying interests of Blackwater River SAC (002170):* **Likely not significant, short-term and in context of the European site**
Access track construction	**Oakfront River** (crossed by single span bridge (WF-HF5), c.1.4km instream distance from Blackwater River SAC) **13 no. drainage channels** (crossed by access tracks – see section 10.6.4 of chapter 10)	Salmonids (Atlantic salmon & brown trout), European eel, *Lampetra* sp., common frog, otter, kingfisher, white-clawed crayfish; Blackwater River SAC aquatic qualifying interests	Release of suspended solids, contaminants and or nutrients (water quality impacts); mortality of aquatic invertebrates & fish eggs; eutrophication and impacts to downstream fish, otter, kingfisher, invertebrates & water quality; spread of invasive species along watercourses	*All downstream aquatic habitats & species:* **Likely slight negative, short-term and in the local context** *All downstream aquatic qualifying interests of Blackwater River SAC (002170):* **Likely not significant, short-term and in context of the European site**
Turbine base and met mast construction	<u>**Turbine bases:**</u> **Ardglass River**	Salmonids (Atlantic salmon & brown trout), European eel, *Lampetra* sp., common frog, otter, kingfisher, white-clawed	Release of suspended solids, contaminants and or nutrients (water quality impacts); mortality of aquatic invertebrates & fish eggs; eutrophication and impacts to downstream fish, otter, kingfisher,	*All downstream aquatic habitats & species:* **Likely slight negative, short-term and in the local context**

Activity	Nearest downstream connecting watercourse(s) (direct down-slope distance from activity)	Sensitive aquatic receptor(s)	Aquatic ecological impacts	Potential impact significance
	(c.130m from T4 via a drainage channel, 0.7km from Blackwater River SAC) **Oakfront River** (c.170m from T3 via a drainage channel, 1.4km from Blackwater River SAC) **Drainage channels** (numerous small drains in footprint of hardstands) **<u>Met mast:</u>** **Ardglass River** (c.200m from met mast)	crayfish; Blackwater River SAC aquatic qualifying interests	invertebrates & water quality; spread of invasive species along watercourses	*All downstream aquatic qualifying interests of Blackwater River SAC (002170):* **Likely not significant, short-term and in context of the European site**
Site drainage (incl. crossing/culverting of drainage channels)	**Ardglass River** (various source-receptor pathways via drainage channels) **Oakfront River** (various source-receptor pathways via drainage channels)	Salmonids (Atlantic salmon & brown trout), European eel, *Lampetra* sp., common frog, otter, kingfisher, white-clawed crayfish; Blackwater River SAC aquatic qualifying interests	Increase in flow rates (surface water run-off); changes to rates of erosion & deposition in receiving watercourses; impacts to aquatic habitats and water quality	*All downstream aquatic habitats & species:* **Likely slight negative, short-term and in the local context** *All downstream aquatic qualifying interests of Blackwater River SAC (002170):* **Likely not significant, short-term and in context of the European site**

Activity	Nearest downstream connecting watercourse(s) (direct down-slope distance from activity)	Sensitive aquatic receptor(s)	Aquatic ecological impacts	Potential impact significance
Grid connection route (GCR)	**Rathnacally Stream** (crossed at GCR-WCCC1 via HDD on L1322 road) **Oakfront River** (crossed at WF-HF5 via single span pre-cast concrete bridge) **6 no. drainage channels** (crossed by GCR via box culvert – see section 10.6.4 and Table 10.9 of chapter 10)	Salmonids (Atlantic salmon & brown trout), European eel, *Lampetra* sp., common frog, otter, kingfisher, white-clawed crayfish; Blackwater River SAC aquatic qualifying interests	Release of suspended solids, contaminants and or nutrients (water quality impacts); mortality of aquatic invertebrates & fish eggs; eutrophication and impacts to downstream fish, otter, kingfisher, invertebrates & water quality; spread of invasive species along watercourses	*All downstream aquatic habitats & species:* **Likely slight negative, short-term and in the local context** *All downstream aquatic qualifying interests of Blackwater River SAC (002170):* **Likely not significant, short-term and in context of the European site**
Turbine delivery route (TDR)	**Rathnacally Stream** (crossed at GCR-WCCC1 on L1322 road, 1.5km upstream of Blackwater River SAC)	European eel; Blackwater River SAC aquatic qualifying interests	Release of contaminants (water quality impacts); spread of invasive species along watercourses	*All downstream aquatic habitats & species:* **Likely not significant , short-term and in the local context** *All downstream aquatic qualifying interests of Blackwater River SAC (002170):* **Likely not significant, short-term and in context of the European site**

8. References

Byrne, A. W., Moorkens, E. A., Anderson, R., Killeen, I. J., & Regan, E. (2009). Ireland Red List no. 2: Non-marine molluscs. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government.

CEN (2003). Water Quality - Sampling of Fish with Electricity. Document CEN EN 14011:2000.

CFB (2008). Methods for the Water Framework Directive. Electric Fishing in Wadeable Reaches. Central Fisheries Board, Dublin. Unpublished report.

CIEEM (2019). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. September 2018. Version 1.1 - Updated September 2019.

DAFM (2018). Draft Plan for Forestry and Freshwater Pearl Mussel in Ireland. Department of Food, Agriculture, Food and Marine.

DAFM (2019). Standards for Felling and Reforestation. October 2019. Department of Food, Agriculture, Food and Marine.

DHPLG (2019). Draft Revised Wind Energy Development Guidelines. December 2019. Prepared by the Department of Housing, Planning and Local Government.

EA (2003). River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003. Environment Agency, UK.

EC (2013). Interpretation Manual of European Union Habitats, version EUR 28. European Commission. Available at: http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf

EPA (2015). Advice Notes for Preparing Environmental Impact Statements. Environmental Protection Agency

EPA (2017). Guidelines on the Information to Be Contained in Environmental Impact Assessment Reports. Environmental Protection Agency.

Feeley, H. B., Baars, J. R., Kelly-Quinn, M., & Nelson, B. (2020). Ireland Red List No. 13: Stoneflies (Plecoptera). National Parks and Wildlife Service.

Finn, R. N. (2007). The physiology and toxicology of salmonid eggs and larvae in relation to water quality criteria. Aquatic Toxicology, 81(4), 337-354.

Forestry Service (2000a). Forest Service Forestry and Water Quality Guidelines.

Forestry Service (2000b). Forest Harvesting and Environmental Guidelines.

Fossitt, J. (2000) A Guide to Habitats in Ireland. The Heritage Council, Ireland.

Foster, G. N., Nelson, B. H. & O Connor, Á. (2009) Ireland Red List No. 1 – Water beetles. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Gilbert, G., Stanbury, A., & Lewis, L. (2021). Birds of Conservation Concern in Ireland 4: 2020–2026. Irish Birds, 43, 1-22.

Giller, P.S. & O'Halloran, J. (2004). Forestry and the aquatic environment: studies in an Irish context. Hydrology and Earth System Sciences Discussions, European Geosciences Union, 2004, 8 (3),

Graham, C.T., Drinan, T.J., Harrison, S.S.C., & O'Halloran, J. (2014). Relationship between plantation forest and brown trout growth, energetics and population structure in peatland lakes in western Ireland. Forest Ecology and Management, 321, 71–80.

Harrison, S. S., Hutton, S., Baars, J. R., Cruikshanks, R., Johnson, J., Juhel, G., ... & Kelly-Quinn, M. (2014). Contrasting impacts of conifer forests on brown trout and Atlantic salmon in headwater streams in Ireland. In *Biology and Environment: Proceedings of the Royal Irish Academy* (Vol. 114, No. 3, pp. 219-231). Royal Irish Academy.

IFI (2016). Guidelines on protection of fisheries during construction works in and adjacent to waters. Inland Fisheries Ireland.

Irish Wind Energy Association (2012). Best Practice Guidelines for the Irish Wind Energy Industry. Irish Wind Energy Association.

Kelly-Quinn, M. & Regan, E.C. (2012). Ireland Red List No. 7: Mayflies (Ephemeroptera). National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Kelly-Quinn, M., Bruen, M., Harrison, S., Healy, M., Clarke, J., Drinan, T., Feeley, H., Finnegan, J., Graham, C., Regan, J. & Blacklocke, S., (2016). Assessment of the impacts of forest operations on the ecological quality of water (HYDROFOR), Synthesis Report. Environmental Protection Agency, Wexford, Ireland.

Lehane, B.M., Giller, P.S., O'Halloran, J., & Walsh, P.M. (2004). Relative influences of catchment geology, land use and in-stream habitat on brown trout populations in south-western Ireland. In Biology and Environment: Proceedings of the Royal Irish Academy (pp. 43-54). Royal Irish Academy.

Matson, R., Delanty, K., Shephard, S., Coghlan, B., & Kelly, F. (2018). Moving from multiple pass depletion to single pass timed electrofishing for fish community assessment in wadeable streams. Fisheries Research, 198, 99-108.

Nelson, B., Ronayne, C. & Thompson, R. (2011). Ireland Red List No.6: Damselflies & Dragonflies (Odonata). National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

NPWS (2012). Conservation Objectives: Blackwater River (Cork/Waterford) SAC 002170. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2016). Site synopsis: Blackwater River (Cork/Waterford) SAC 002170, rev 16. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NRA (2008). Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes. National Roads Authority.

NRA (2009). Guidelines for Assessment of Ecological Impacts of National Road Schemes. Revision 2, 1st June 2009. National Roads Authority, Dublin.

9. Appendix A – fisheries assessment report

Fisheries assessment of Annagh wind farm, Co. Cork

Prepared by Triturus Environmental Ltd. for Fehily Timoney & Company

October 2021

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Table of contents

1. Introduction

1.1 Background

Triturus Environmental Ltd. were contracted by Fehily Timoney & Company to undertake a baseline fisheries assessment of numerous watercourses in the vicinity of the proposed Annagh wind farm, located near Charleville, Co. Cork (**Figure 1.1**).

The survey was undertaken to establish baseline fisheries data used in the preparation of the EIAR for the proposed project, which includes a proposed wind turbine layout, turbine delivery route (TDR) and associated grid connection route (GCR) alignment (**Figure 2.1**). In order to gain an accurate overview of the existing and potential fisheries value of the riverine watercourses within the vicinity of the proposed project, a catchment-wide electro-fishing survey across n=11 sites was undertaken (**Table 2.1; Figure 2.1**). Electro-fishing helped to identify the importance of the watercourses as nurseries and habitats for salmonids, lamprey and European eel (*Anguilla anguilla*), as well as other species, and helped to further inform impact assessment and any subsequent mitigation for the project.

Triturus Environmental Ltd. made an application under Section 14 of the Fisheries (Consolidation) Act, 1959 as substituted by Section 4 of the Fisheries (Amendment) Act, 1962, to undertake a catchment-wide electro-fishing survey in the vicinity of the proposed Annagh wind farm. Permission was granted on Friday 24th July 2020 and the survey was undertaken on Wednesday 2nd and Thursday 3rd September 2020.

1.2 Fisheries asset of the survey area

The proposed survey sites were located on numerous watercourses within the Awbeg [Buttevant]_SC_010 river sub-catchment near Charleville, Co. Cork. The survey area also overlapped with the (Munster) Blackwater *Margaritifera* sensitive area (**Figure 1.1**). The survey watercourses shared downstream hydrological connectivity with the Blackwater River SAC (site code: 002170), to the south of the survey area. Fisheries survey sites were present on the Fiddane Stream (EPA code: 18F19), Ardglass River (18A23), Milltown Stream (18M57), Oakfront River (18O02) and Rathnacally Stream (18R32) (**Table 2.1**).

The Awbeg River is a major tributary of the (Munster) River Blackwater, flowing for some 50km south-westerly from its source in the Ballyhoura Mountains through Buttevant and Doneraile before joining the River Blackwater near Castletownroche. Recreational brown trout fishing is popular along this river, although their growth rates have been noted as slow due to relatively low average water temperatures (O'Reilly, 2009; Kelly et al. 2013). The river is known to support Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), European eel (*Anguilla anguilla*), lamprey (*Lampetra* sp.), stone loach (*Barbatula barbatula*) and, in the lower reaches, the non-native dace (*Leuciscus leuciscus*) (Kelly et al., 2009, 2013). The Awbeg is also one of few sites in county Cork to support a significant population of white-clawed crayfish (*Austropotamobius pallipes*). Historically, the Awbeg was arterially drained and currently achieves poor (Q3) to moderate status (Q3-4) water quality throughout much of its length (EPA data).

Fisheries data for the other watercourses within the survey area was not available at the time of survey.

2. Methodology

2.1 Fish stock assessment (electro-fishing)

A single anode Smith-Root LR24 backpack (12V DC input; 300V, 100W DC output) was used to electro-fish sites on watercourses in the vicinity of the proposed Annagh wind farm on Wednesday 2nd and Thursday 3rd September, following notification to Inland Fisheries Ireland (Macroom) and under the conditions of a Department of Communications, Climate Action & Environment (DCCAE) license. Both river and holding tank water temperature was monitored continually throughout the survey to ensure temperatures of 20°C were not exceeded, thus minimising stress to the captured fish due to low dissolved oxygen levels. A portable battery-powered aerator was also used to further reduce stress to any captured fish contained in the holding tank.

Salmonids, European eel and other captured fish species were transferred to a holding container with oxygenated fresh river water following capture. To reduce fish stress levels, anaesthesia was not applied to captured fish. All fish were measured to the nearest millimetre and released in-situ following a suitable recovery period.

As three primary species groups were targeted during the survey, i.e. salmonids, lamprey, and eel, the electro-fishing settings were tailored for each species. By undertaking electro-fishing using the rapid electro-fishing technique (see methodology below), the broad characterisation of the fish community at each sampling reach could be determined as a longer representative length of channel can be surveyed. Electro-fishing methodology followed accepted European standards (CEN, 2003) and adhered to best practice (e.g. CFB, 2008).

The catchment-wide electro-fishing (CWEF) survey was undertaken across *n*=11 sites (see **Table 2.1, Figure 2.1**).

Table 2.1 *n*=11 electro-fishing survey site locations in the vicinity of the proposed Annagh wind farm project, Co. Cork.

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
A1	Fiddane Stream	18F19	Annagh Bogs	549427	617248
A2	Ardglass River	18A23	Annagh Bogs	549606	616770
A3	Awbeg River	18A09	Annagh Bridge	549823	615649
B1	Milltown Stream	18M57	Milltown	550461	619714
B2	Oakfront River	18O02	Cooliney Bridge	550181	618654
B3	Oakfront River	18O02	Milltown	550651	617869
B4	Oakfront River	18O02	Springfort	550775	617421
B5	Oakfront River	18O02	Bridge at Coolcaum	551050	616256
C1	Rathnacally Stream	18R32	Clashganniv	552439	620511
C2	Rathnacally Stream	18R32	Bridge at Rathnacally	552633	619468
C3	Rathnacally Stream	18R32	Bridge at Ballynadrideen	552222	618157

2.1.1 Salmonids and European eel

For salmonid species and European eel, as well as other incidental species, electro-fishing was carried out in an upstream direction for a 10-minute CPUE, an increasingly common standard approach for wadable streams (Matson et al., 2018). A total of approx. ≥75-100m channel length was surveyed at each site, where feasible, in order to gain a better representation of fish stock assemblages. At certain, more minor watercourse sites or sites with limited access, it was more feasible to undertake electro-fishing for a 5-minute CPUE. Discrepancies in fishing effort (CPUE) between sites are accounted for in the subsequent results section (**Table 3.1**).

Relative conductivity of the water at each site was checked in-situ with a conductivity meter and the electro-fishing backpack was energised with the appropriate voltage and frequency to provide enough draw to attract salmonids and European eel to the anode without harm. For the high conductivity waters of the sites (most draining calcareous geologies) a voltage of 210-230v, frequency of 40-45Hz and pulse duration of 3.5ms was utilised to draw fish to the anode without causing physical damage.

2.1.2 Lamprey

Electro-fishing for lamprey ammocoetes was conducted using targeted box quadrat-based electro-fishing (as per Harvey & Cowx, 2003) in objectively suitable areas of sand/silt, where encountered. As lamprey take longer to emerge from silts and require a more persistent approach, they were targeted at a lower frequency (30Hz) burst DC pulse setting which also allowed detection of European eel in sediment, if present. Settings for lamprey followed those recommended and used by Harvey & Cowx (2003), APEM (2004) and Niven & McAuley (2013). Using this approach, the anode was placed under the water's surface, approx. 10–15 cm above the sediment, to prevent immobilising lamprey ammocoetes within the sediment. The anode was energised with 100V of pulsed DC for 15-20 seconds and then turned off for approximately five seconds to allow ammocoetes to emerge from their burrows. The anode was switched on and off in this way for approximately two minutes. Immobilised ammocoetes were collected by a second operator using a fine-mesh hand net as they emerged.

Lamprey species were identified to species level, where possible, with the assistance of a hand lens, through external pigmentation patterns and trunk myomere counts as described by Potter & Osborne (1975) and Gardiner (2003).

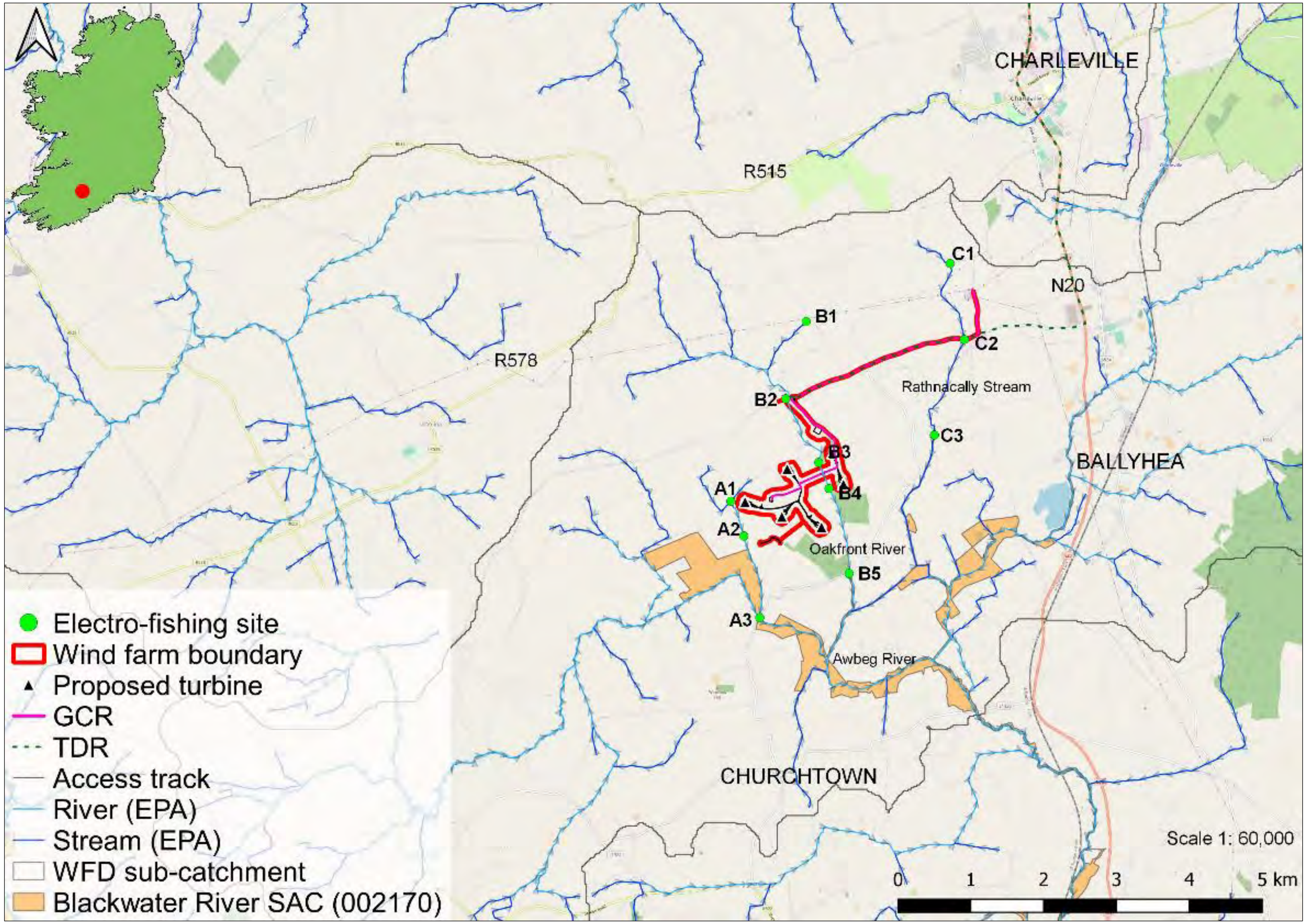

Figure 2.1 Location overview of the *n*=11 electro-fishing sites in vicinity of the proposed Annagh wind farm, Co. Cork

2.2 Fisheries habitat

2.2.1 Salmonid habitat

Fisheries habitat quality for salmonids was assessed using the Life Cycle Unit method (Kennedy, 1984; O'Connor & Kennedy, 2002) to map the *n*=11 riverine sites as nursery, spawning and holding habitat, by assigning quality scores to each type of habitat. Those habitats with poor quality substrata, shallow depth and a poorly defined river profile receive a higher score. Higher scores in the Life Cycle Unit method of fisheries quantification are representative of poorer value, with lower scores being more optimal despite this appearing counter-intuitive.

Table 2.1 Life Cycle Unit scoring system for salmonid nursery, spawning and holding habitat value (as per Kennedy, 1984 & O'Connor & Kennedy, 2002)

Habitat quality	Habitat score	Total score (three components)
Poor	4	12
Moderate	3	9-11
Good	2	6-8
Excellent	1	3-5

2.2.2 Lamprey habitat

Lamprey habitat evaluation for each survey site was undertaken using the Lamprey Habitat Quality Index (LHQI) scoring system, as devised by Macklin et al. (2018). The LHQI broadly follows a similar rationale as the Life Cycle Unit score for salmonids. Those habitats with a lack of soft, largely organic sediment areas for ammocoete burrowing, shallow sediment depth (<10cm) or compacted sediment nature receive a higher score. Higher scores in this index are thus of poorer value (in a similar fashion to the salmonid Life Cycle Unit Index), with lower scores being more optimal. Overall scores are calculated as a simple function of the sum of individual habitat scores.

Larval lamprey habitat quality as well as the suitability of adult spawning habitat is assessed based on the information provided in Maitland (2003) and other relevant literature (e.g. Gardiner, 2003). Unlike the salmonid Life Cycle Unit index, holding habitat for adult lamprey is not assessed owing to their different migratory and life history strategies, and that electro-fishing surveys routinely only sample larval lamprey.

The LHQI scoring system provides additional information compared to the habitat classification based on the observations of Applegate (1950) and Slade et al. (2003), which deals specifically with larval (sea) lamprey settlement habitat. Under this scheme, habitat is classified into three different types: preferred (Type 1), acceptable (Type 2), and not acceptable for larvae (Type 3) (Slade et al. 2003). Type 1 habitat is characterized by soft substrate materials usually consisting of a mixture of sand and fine organic matter, often with some cover over the top such as detritus or twigs in areas of deposition. Type 2 habitat is characterized by substrates consisting of shifting sand with little if any organic matter and may also contain some gravel and cobble (lamprey may be present but at much lower densities than Type 1). Type 3 habitat consists of materials too hard for larvae to burrow including bedrock and highly compacted sediment. This classification can also be broadly applied to other lamprey species ammocoetes, including *Lampetra* species.

Table 2.2 Lamprey Habitat Quality Index (LHQI) scoring system for lamprey spawning and nursery habitat value (Macklin et al., 2018).

Habitat quality	Habitat score	Total score (two components)
Poor	4	8
Moderate	3	6-7
Good	2	3-5
Excellent	1	2

2.2.3 General fisheries habitat

A broad appraisal / overview of the upstream and downstream habitat at each site was also undertaken to evaluate the wider contribution to salmonid and lamprey spawning and general fisheries habitat. River habitat surveys and fisheries assessments were also carried out utilising elements of the approaches in the River Habitat Survey Methodology (Environment Agency, 2003) and Fishery Assessment Methodology (O'Grady, 2006) to broadly characterise the river sites (i.e. channel profiles, substrata etc.).

2.3 Biosecurity

A strict biosecurity protocol following the Check-Clean-Dry approach was employed during the survey. Equipment and PPE used was disinfected with Virkon® between survey sites to prevent the transfer of pathogens and/or invasive species between survey areas. Particular cognisance was given to preventing the introduction or spread of crayfish plague (*Aphanomyces astaci*) given the known presence of a healthy white-clawed crayfish population throughout the Awbeg catchment. As per best practice, surveys were undertaken at sites in a downstream order (i.e. uppermost site surveyed first etc.) to prevent the upstream mobilisation of invasive propagules and pathogens. Any invasive species recorded within or adjoining the survey area were geo-referenced.

3. Results

A catchment-wide electro-fishing survey of *n*=11 sites in the vicinity of the proposed Annagh wind farm was conducted on Wednesday 2nd and Thursday 3rd September 2020 following notification to Inland Fisheries Ireland (Macroom). The results of the survey are discussed below in terms of fish population structure, population size and the suitability and value of the surveyed areas as nursery and spawning habitat for salmonids, European eel and lamprey species. Scientific names are provided at first mention only.

3.1 Fish stock assessment (electro-fishing)

3.1.1 Site A1 – Fiddane Stream

No fish were recorded during electro-fishing at site A1 on the Fiddane Stream, located along the wind farm site boundary, immediately upstream of the Ardglass River confluence. The historically straightened site represented a heavily-silted, stagnant drainage ditch (FW4) and was not of fisheries value. Whist localised ponding of water to 0.2m was present in several locations during the survey, the channel showed evidence of seasonal drying and was, therefore, not capable of supporting resident fish. Fisheries potential improved further down the catchment (i.e. Ardglass River).

Plate 3.1 Representative image of site A1 on the Fiddane Stream (no fish recorded via electro-fishing).

3.1.2 Site A2 – Ardglass River, Annagh Bogs

Three-spined stickleback (*Gasterosteus aculeatus*) was the only species recorded during electro-fishing at site A2 on the Ardglass River. The river had been extensively straightened and deepened, historically and resembled a drainage ditch habitat (FW4) with an imperceptible flow at the time of survey. The river at this location (and for much of its length) was heavily-vegetated and supported a low density of both juveniles and adult stickleback.

The site was of no value for salmonids or lamprey given the heavily-silted, heavily-vegetated and low flow nature of the channel. Whilst some low suitability existed for European eel, none were recorded.

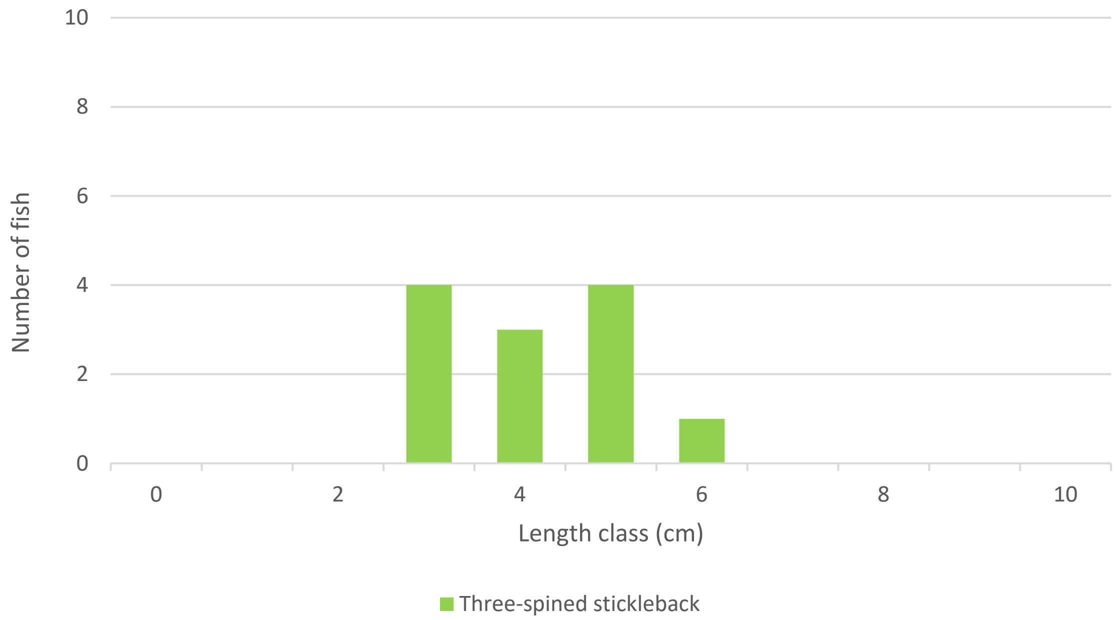

Figure 3.1 Fish stock length distribution recorded via electro-fishing at site A2 on the Ardglass River, September 2020.

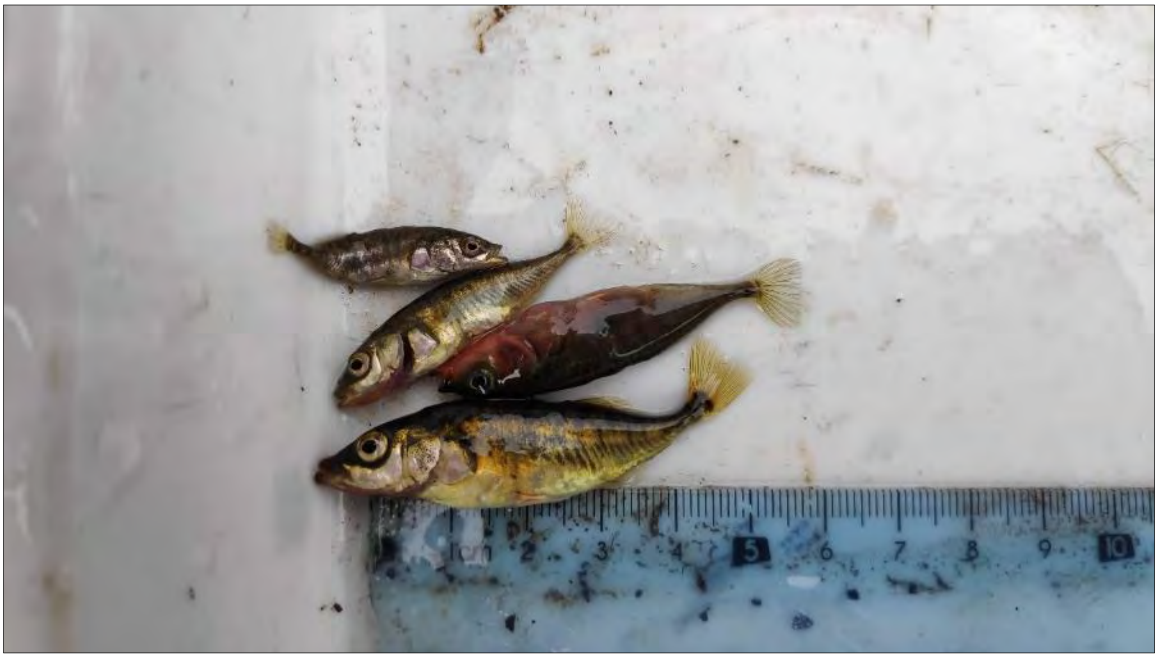

Plate 3.2 Three-spined stickleback recorded from site A2 on the Ardglass River, September 2020.

3.1.3 Site A3 – Awbeg River, Annagh Bridge

Three fish species were recorded via electro-fishing from site A3 at the Awbeg-Ardglass confluence (**Figure 3.2**). Brown trout were the most frequently recorded, with a low density of adults recorded (*n*=10). This was the highest density of trout recorded at any survey site. No juvenile trout were captured. European eel and three-spined stickleback were also present in low numbers.

The slow-flowing site was not considered of value as a salmonid spawning area given high siltation rates and its historically drained nature (i.e. deepened, straightened channel with heavy siltation). However, holding habitat was good given the predominance of deep glide and pool, often >1.5m in depth. The site was of some moderate value as a nursery although no juvenile salmonids were recorded (recruitment likely impacted by siltation). Despite abundant silt deposits, no lamprey ammocoetes were recorded, possibly reflecting typically low flows at this site. Lamprey spawning habitat was absent. European eel habitat was good overall given frequent instream macrophyte refugia.

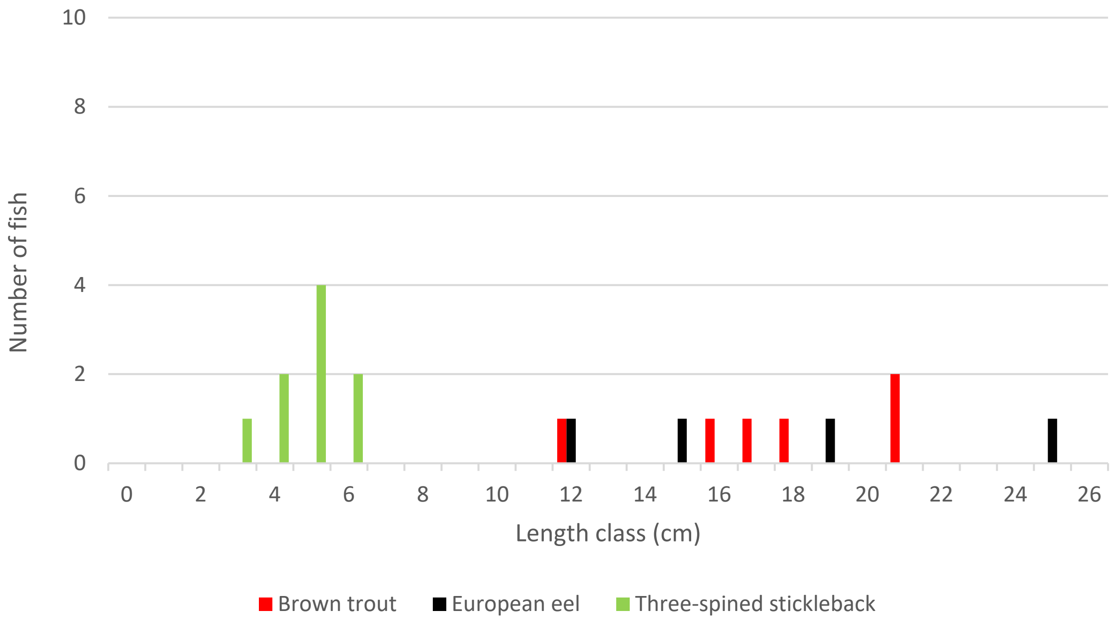

Figure 3.2 Fish stock length distribution recorded via electro-fishing at site A3 on the Awbeg River, September 2020.

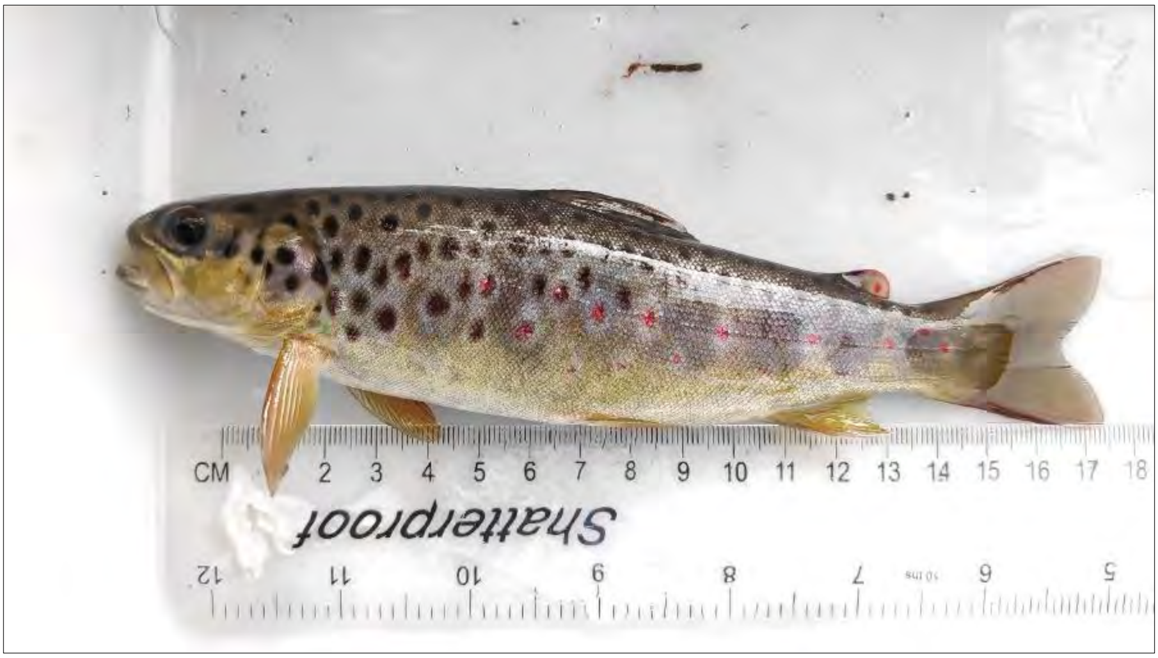

Plate 3.3 Small adult brown trout recorded from site A3 on the Awbeg River, September 2020.

3.1.4 Site B1 – Milltown Stream, Milltown

Two fish species were recorded from site B1 on the uppermost reaches of the Milltown Stream (**Figure 3.3**). Low numbers of three-spined stickleback were captured along with a single juvenile European eel.

Despite some physical suitability, the site did not support salmonids at the time of survey. Overall salmonid habitat was impacted by siltation pressures, upstream historically straightening and the shallow nature of the small stream, which resulted in moderate salmonid nursery and spawning habitat. Instream macrophyte growth and riparian tunnelling were both high. There was some evidence that the stream was exposed to seasonal low flows or partial-drying which further impacted the site's fisheries value. Despite the presence of some localised soft sediment accumulations (in association with instream macrophytes), no lamprey ammocoetes were recorded. European eel habitat was moderate overall, with some locally good habitat present underneath the bridge structure (i.e. boulder refugia in deeper pool area).

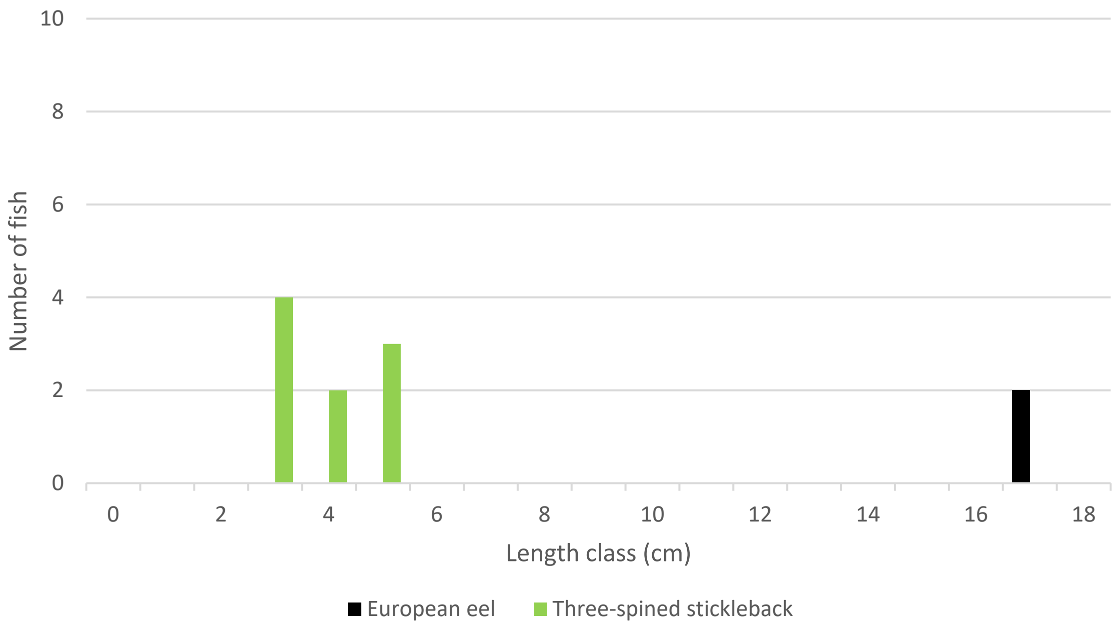

Figure 3.3 Fish stock length distribution recorded via electro-fishing at site B1 on the Milltown Stream, September 2020.

Plate 3.4 Representative image of site B1 on the Milltown Stream

3.1.5 Site B2 – Oakfront River, Cooliney Bridge

A total of four fish species were recorded from site B2 on the Oakfront River (**Figure 3.4**). Three-spined stickleback dominated the site (n=33), the highest density of any survey site (0.147 fish per m^2). A low number of European eel were recorded along with a single juvenile brown trout. A low density of *Lampetra* sp. ammocoetes (likely brook lamprey, *Lampetra planeri*) were present in shallow, superficial soft sediment near the bridge (ford crossing).

Downstream of the road bridge, the site had been extensively straightened and deepened historically and was evidently a poor nursery for salmonids despite some superficial suitability. However, compaction and or siltation of the bed in addition to poor profile heterogeneity reduced the overall value of the site. Some moderate eel habitat was present (nursery), with the better refugia in vicinity and underneath the bridge structure. Lamprey spawning habitat was present but limited in extent and silted. Some limited larval habitat was present immediately downstream of the bridge, in a marginal slack associated with a farm access crossing/cattle drink. Whilst the silt accumulations here were shallow (mostly <5cm and with high clay fractions), the area on the east bank supported a low number of ammocoetes ($2m^2$ fished, 3 ammocoetes recorded.). Stickleback were abundant in marginal macrophytes in this same area.

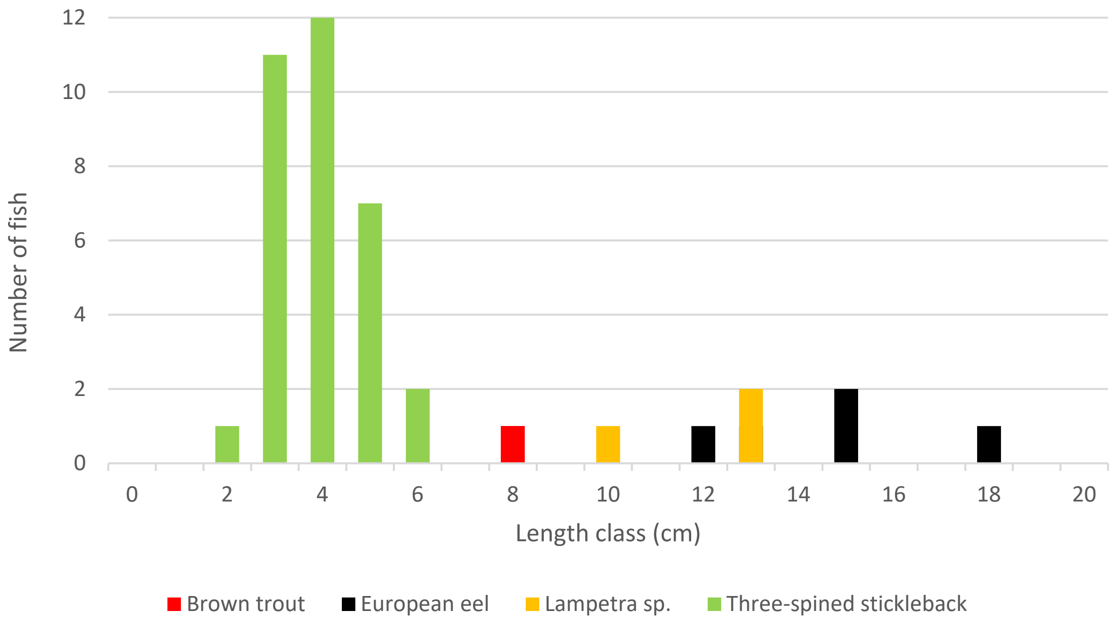

Figure 3.4 Fish stock length distribution recorded via electro-fishing at site B2 on the Oakfront River, September 2020.

Plate 3.5 Lamprey (*Lampetra* sp.) ammocoetes recorded from site B2 on the Oakfront River at Cooliney Bridge, September 2020.

3.1.6 Site B3 – Oakfront River, Milltown

A total of four fish species were recorded from site B3 on the Oakfront River (**Figure 3.5**). Three-spined stickleback dominated the site (*n*=21). A low number of brown trout were recorded, with both juveniles and small adults present. A low density of *Lampetra* sp. ammocoetes (likely brook lamprey) and European eel were also recorded.

The site was of moderate value to salmonids overall, supporting a small brown trout population. Whilst some good nursery habitat features were present (swift glide etc.), the spawning and holding value of the site was moderate, at best, due to bedding/compaction of the gravel and cobble substrata and an overall shallow depth with few pools. Nevertheless, salmonid habitat was much improved over site B2 upstream. Eel habitat was moderate given shallow depth and lack of instream refugia although juveniles were present at low densities. Larval lamprey habitat was present locally although sub-optimal (compacted, lots of sand, shallow depth).

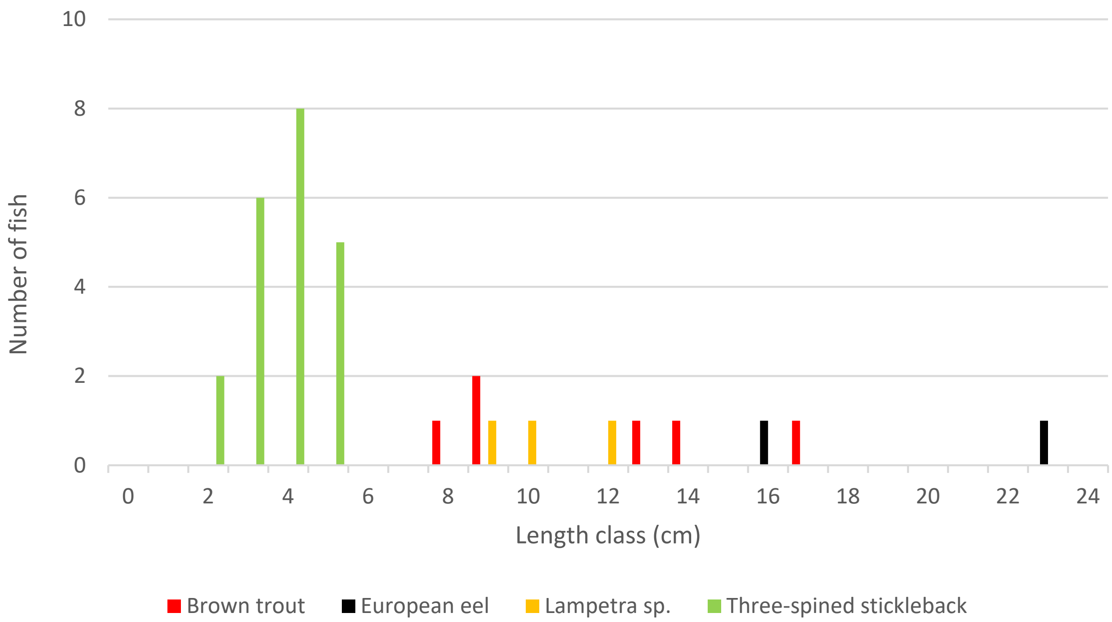

Figure 3.5 Fish stock length distribution recorded via electro-fishing at site B3 on the Oakfront River, September 2020.

3.1.7 Site B4 – Oakfront River, Springfort

A total of three fish species were recorded from site B4 on the Oakfront River, located approx. 475m downstream from site B3 (**Figure 3.6**). The overall density of fish was low - a small number of three-spined stickleback (*n*=8) and brown trout (*n*=3) were present alongside two European eel. Unlike upstream sites, no *Lampetra* sp. ammocoetes were recorded.

The site was a moderate value salmonid nursery although the number of brown trout recorded were less than expected for the river type (likely due to siltation pressures, substrata compaction etc.). Spawning habitat was good, locally although deeper holding habitat for adults was sparse. Larval lamprey habitat was present locally although sub-optimal (compacted, sand-dominated, shallow depth) – no ammocoetes were recorded. Lamprey spawning was good physically despite siltation pressures. Eel habitat was moderate given the presence of instream refugia such as scoured/undercut banks and large woody debris. Juvenile eels were present at low densities.

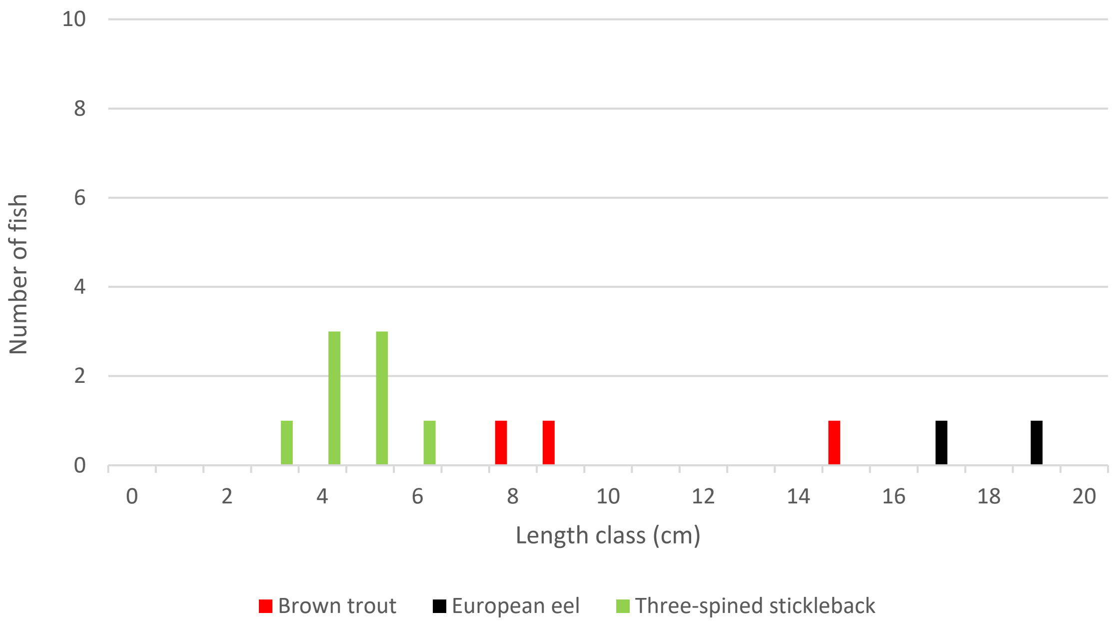

Figure 3.6 Fish stock length distribution recorded via electro-fishing at site B4 on the Oakfront River, September 2020.

Plate 3.6 Representative image of site B4 on the Oakfront River, September 2020.

3.1.8 Site B5 – Oakfront River, bridge at Coolcaum

A total of four fish species were recorded from site B5 on the Oakfront River (**Figure 3.7**). As with site B4 (1.2km) upstream, the overall density of fish at the historically straightened and deepened site was low. A low number of three-spined stickleback and European eel were recorded with a single small adult brown trout. A single, particularly large *Lampetra* sp. ammocoete (15.2cm TL) was also recorded near the bridge crossing (Plate 3.7).

The fisheries value of the site was much reduced given historical drainage (straightening and deepening), although the site provided some moderate quality eel and larval lamprey habitat. Overall salmonid habitat was poor, apart from some good deep glide holding habitat. Lamprey habitat was moderate overall, with an absence of suitable spawning substrata. However, some heavily silted gravels were present upstream of the road bridge. The silt-dominated river bed was considered sub-optimal for larval lamprey although a single ammocoete was recorded. European eel habitat was good overall given deep glide and pool with scoured/undercut banks and macrophyte refugia.

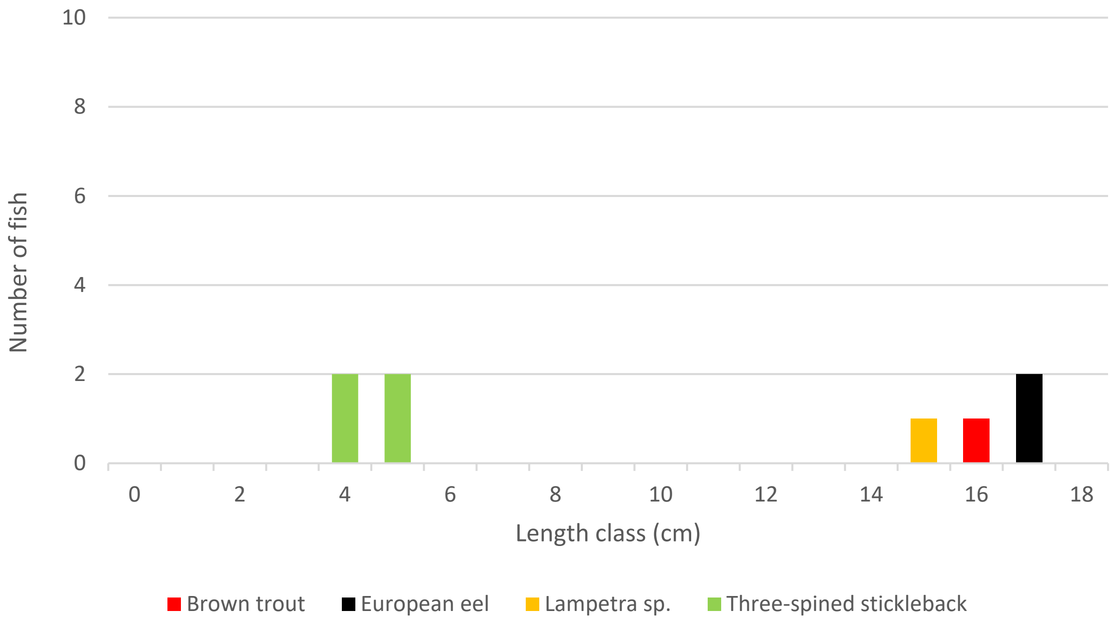

Figure 3.7 Fish stock length distribution recorded via electro-fishing at site B5 on the Oakfront River, September 2020.

Plate 3.7 A single, particularly large *Lampetra* sp. ammocoete (likely brook lamprey due to size) recorded from site B5 on the Oakfront River, September 2020.

3.1.9 Site C1 – Rathnacally Stream, Clashganniv

No fish were recorded via electro-fishing at site C1 on the upper reaches of the Rathnacally River. The small drainage channel site (FW4) had been historically straightened and deepened. The site featured pools of stagnant water (0.2m deep max.) at the time of survey (no observable flow) and was not considered to be of fisheries value. Whist localised ponding of water was present the channel showed evidence of seasonal drying and was, therefore, not capable of supporting resident fish. Fisheries potential improved further downstream.

Plate 3.8 Representative image of site C1 on the Rathnacally Stream (stagnant water, no fish recorded via electro-fishing).

3.1.10 Site C2 – Rathnacally Stream, bridge at Rathnacally

Three spined stickleback were the only fish species recorded via electro-fishing at site C2 on the Rathnacally Stream, located approx. 1.2km downstream of site C1. The heavily-silted and modified site supported low numbers of both juveniles and adults (total *n*=11).

The slow-flowing site was considered too heavily modified to support a healthy fish population fish and the deep silt/clay bed was considered too compacted to support lamprey ammocoetes. Adjoining diffuse sources of pollution were evidently contributing to enrichment and very heavy siltation. These pressures also removed the potential for the stream to support salmonids, which were absent during the survey at this location. Furthermore, no European eel were recorded. Small numbers of stickleback were recorded from marginal macrophyte beds.

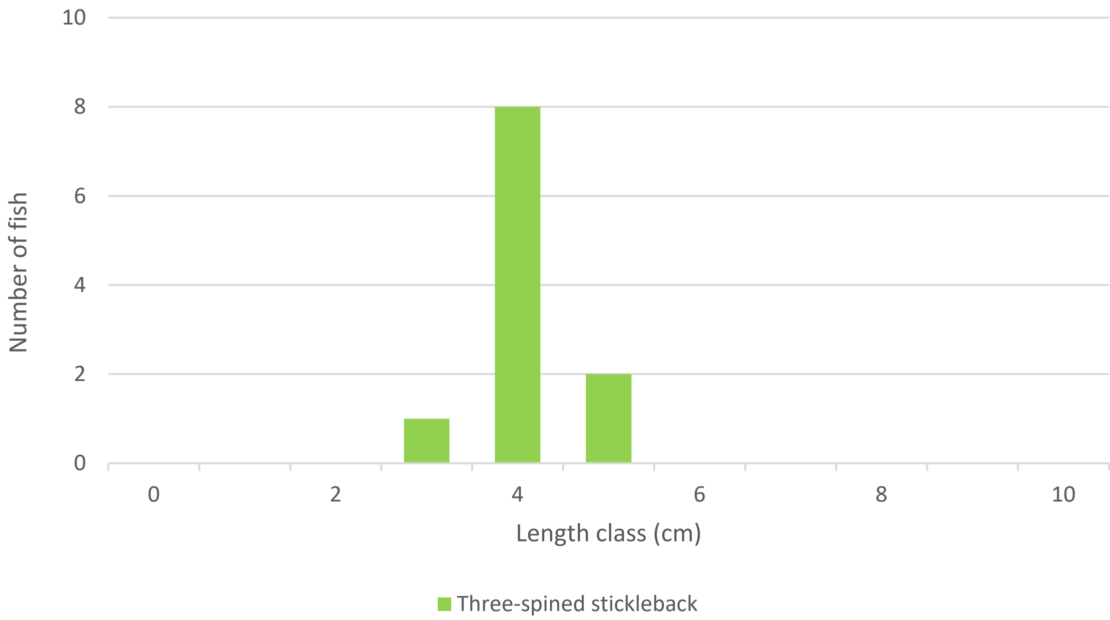

Figure 3.8 Fish stock length distribution recorded via electro-fishing at site C2 on the Rathncacally Stream, September 2020.

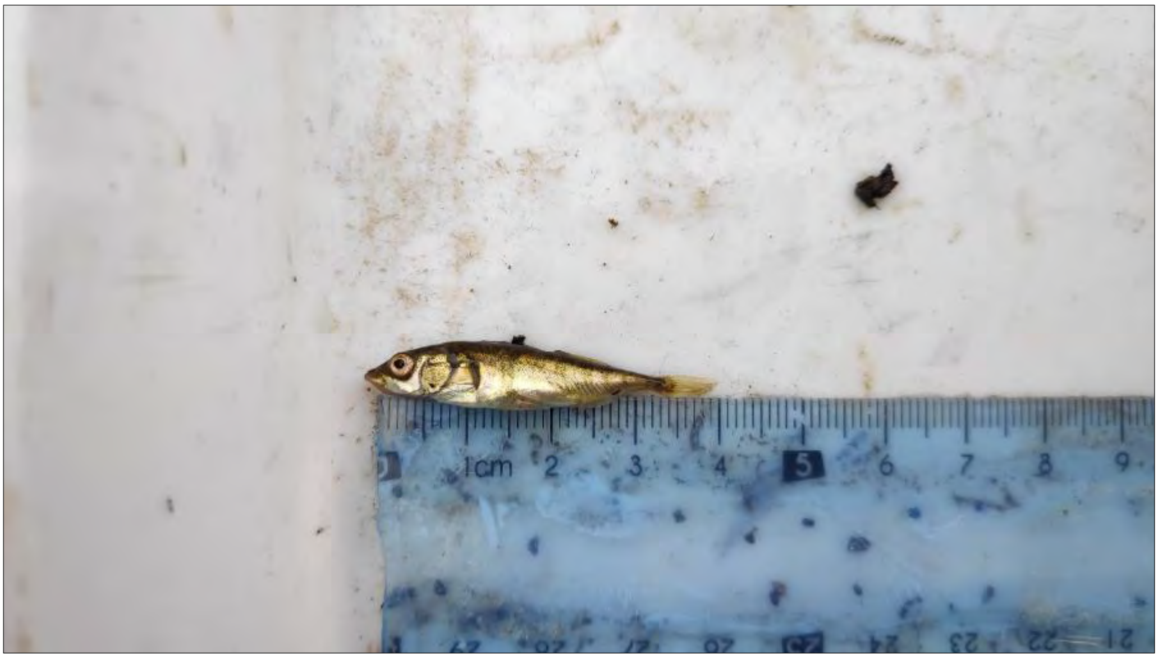

Plate 3.9 Representative image of three-spined stickleback recorded from site C2 on the Rathnacally Stream, September 2020.

3.1.11 Site C3 – Rathnacally Stream, bridge at Ballynadrideen

A total of two fish species were recorded from site C3 on the Rathnacally Stream, located at the boundary of the Blackwater River SAC site, approx. 1.5km downstream from site C2 (**Figure 3.9**). The overall density of fish was low, with three-spined stickleback dominating (*n*=20). A single European eel was also captured. Despite some habitat suitability, no *Lampetra* sp. ammocoetes were recorded.

The slow-flowing site had been extensively straightened historically and was considered too heavily modified to support a healthy fish population fish. Salmonids were absent, despite some superficial suitability (riffle, glide and pool habitat). Evidently, siltation and water quality pressures had impacted the stream’s ability to support salmonids (as per upstream). The deep silt/clay bed was considered too compacted to support lamprey ammocoetes, with none recorded. Suitability for European eel was moderate overall (deep glide and instream refugia present), although only a single juvenile was captured.

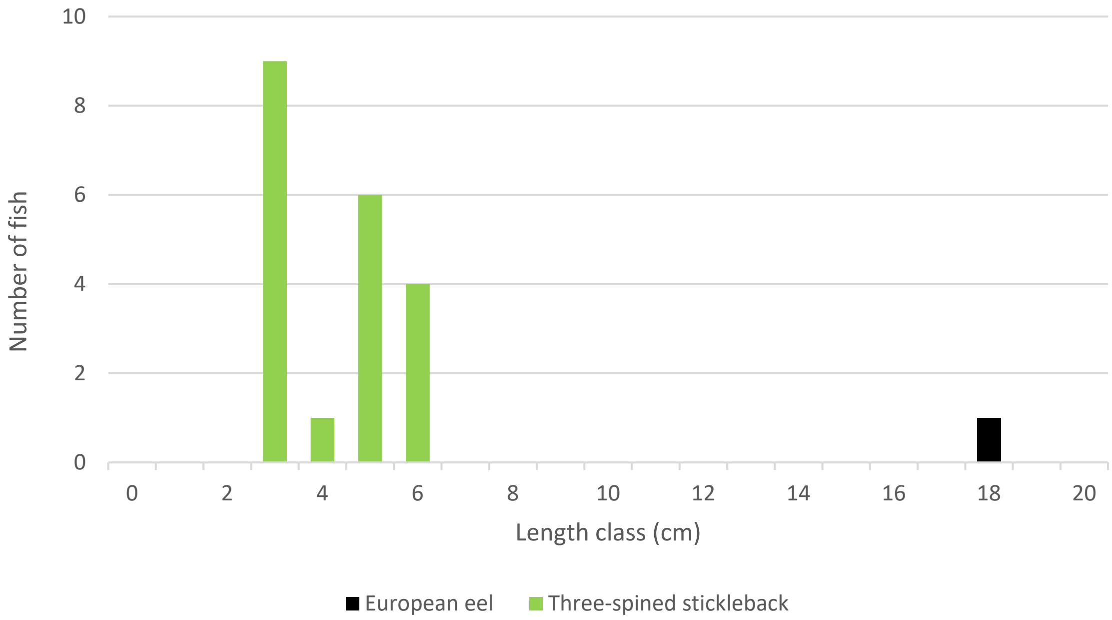

Figure 3.9 Fish stock length distribution recorded via electro-fishing at site C3 on the Rathncacally Stream, September 2020.

Plate 3.10 Juvenile European eel recorded from site C3 on the Rathnacally Stream, September 2020.

Table 3.1 Fish species densities per m^2 recorded at sites in the vicinity of Annagh wind farm via electro-fishing in September 2020. Values in **bold** represent the highest densities recorded for each species, respectively. * = no. *Lampetra* sp. per m^2 of targeted habitat

Site	Watercourse	CPUE (minutes)	Approx. area fished (m^2)	Fish density (number fish per m^2)			
				Brown trout	European eel	*Lampetra* sp.	Three-spined stickleback
A1	Fiddane Stream	5	22.5	0.000	0.000	0.000	0.000
A2	Ardglass River	10	130	0.000	0.000	0.000	0.092
A3	Awbeg River	10	112.5	**0.089**	**0.036**	0.000	0.053
B1	Milltown Stream	10	127.5	0.000	0.016	0.000	0.071
B2	Oakfront River	10	225	0.004	0.022	**0.67***	**0.147**
B3	Oakfront River	10	175	0.034	0.011	**0.67***	0.120
B4	Oakfront River	10	200	0.015	0.010	0.000	0.040
B5	Oakfront River	5	82.5	0.012	0.024	0.012	0.048
C1	Rathnacally Stream	5	20	0.000	0.000	0.000	0.000
C2	Rathnacally Stream	5	45	0.000	0.000	0.000	0.244
C3	Rathnacally Stream	10	140	0.000	0.007	0.000	0.143

3.2 Fisheries habitat

3.2.1 Salmonid habitat

The quality of salmonid habitat ranged from poor to good across the survey sites (**Table 3.2**) but was significantly impacted by siltation pressures in the vicinity of the proposed wind farm. Brown trout were recorded from a total of four sites, with no Atlantic salmon recorded.

Of the *n*=11 sites, only two offered good quality salmonid habitat according to Life Cycle Unit scores. These were sites B3 and B4 on the middle reaches of the Oakfront River, where small brown trout populations were present. Sites A3, B1, B2, B5 and C3 all offered moderate quality salmonid habitat only, given high siltation rates. Sites A1, A2, C1 and C2 scored as poor according to Life Cycle Unit scores but, in reality, offered no potential for salmonids given imperceptible or low flows, heavy siltation and or evident channel seasonality.

Table 3.2 Life Cycle Unit scores for salmonid habitat at the sites surveyed in the vicinity of the proposed Annagh wind farm, September 2020 (lower scores = superior habitat).

Site no.	Salmonid habitat value	Spawning	Nursery	Holding	Total score	Salmonids recorded
A1	Poor	4	4	4	**12**	No
A2	Poor	4	4	4	**12**	No
A3	Moderate	4	3	2	**9**	Yes
B1	Moderate	3	3	4	**10**	No
B2	Moderate	3	3	3	**9**	Yes
B3	Good	3	2	3	**8**	Yes
B4	Good	2	2	3	**7**	Yes
B5	Moderate	4	4	2	**10**	No
C1	Poor	4	4	4	**12**	No
C2	Poor	4	4	4	**12**	No
C3	Moderate	4	3	3	**10**	No

3.2.2 Lamprey habitat

The quality of lamprey habitat ranged from poor to good across the survey sites (**Table 3.3**) but, as with salmonid habitat, was significantly impacted by siltation pressures in the vicinity of the proposed wind farm. *Lampetra* sp. ammocoetes were recorded from a total of three sites (B2, B3 and B5), all on the Oakfront River.

Of the *n*=11 sites, only three offered good quality lamprey habitat according to Lamprey Habitat Quality Index scores. These were sites B2 and B3 on the middle reaches of the Oakfront River, where very low densities of ammocoetes were present (both 0.67 ammocoetes per m^2 of ammocoete habitat fished). Sites A3, B1, B5, C2 and C3 all offered moderate quality lamprey habitat only, primarily due to poor spawning habitat (high siltation rates) – however none of these sites were found to support lamprey. Sites A1, A2 and C1 scored as poor according to LHQI scores but, in reality, offered no potential for lamprey given imperceptible or low flows and or evident channel seasonality.

Table 3.3 Lamprey Habitat Quality Index (LHQI) scores for lamprey habitat at the sites surveyed in the vicinity of the proposed Annagh wind farm, September 2020 (lower scores = superior habitat).

Site no.	Lamprey habitat value	Spawning	Nursery	Total score	Lamprey recorded
A1	Poor	4	4	**8**	No
A2	Poor	4	4	**8**	No
A3	Moderate	4	2	**6**	No
B1	Moderate	3	3	**6**	No
B2	Good	3	2	**5**	**Yes**
B3	Good	3	2	**5**	**Yes**
B4	Good	2	3	**5**	No
B5	Moderate	4	3	**7**	**Yes**
C1	Poor	4	4	**8**	No
C2	Moderate	4	3	**7**	No
C3	Moderate	3	3	**6**	No

3.2.3 European eel habitat

European eel were recorded from a total of *n*=7 sites; A3 (Awbeg River), B1, B2, B3, B4 and B5 (Oakfront River) and C3 (Rathnacally Stream). All four survey sites on the Oakfront River supported eel, albeit in very low densities. In general, eel habitat was poor to moderate at best across the majority of survey sites, primarily due to siltation pressures, intermittent flows and sub-optimal habitat (e.g. lack of deep pool refugia, macrophyte beds etc.).

4. Discussion

4.1 Most valuable sites

4.1.1 Salmonids

In general, salmonid habitat in the vicinity of the proposed Annagh wind farm was poor due to historical drainage pressures, low or intermittent/seasonal flows and often excessive siltation. Whilst some better-quality salmonid habitat was present at sites B3 and B4 on the middle reaches of the Oakfront River, this was highly localised in areas of faster flow and the small brown trout populations recorded present were evidently at risk from significant siltation and water quality pressures in the catchment. The downstream-connecting Awbeg River is known to support a healthy population of both brown trout and Atlantic salmon, at least in the middle and lower reaches of the river.

Diffuse siltation is one of the greatest threats to salmonid populations, particularly in agricultural catchments such as that of the proposed Annagh wind farm. Sediment not only blocks interstitial spaces in substrata and limits oxygen supply to salmonid eggs (required for healthy embryonic project and successful hatching) but can also smother substrata, thus reducing available spawning habitat and impact macro-invertebrate communities on which salmonids feed (Soulsby et al., 2001; Walling et al., 2003; Louhi et al., 2008, 2011; Cocchiglia et al., 2012; Conroy et al., 2016; Davis et al., 2018; Kelly-Quinn et al., 2020). Sedimentation of salmonid habitat is a particular problem in Irish rivers flowing through agricultural catchments (Evans et al., 2006).

4.1.2 Lamprey

As with salmonid habitat, the quality of lamprey habitat was significantly impacted by siltation pressures in the vicinity of the proposed wind farm. *Lampetra* sp. ammocoetes were recorded from a total of three sites (B2, B3 and B5), all on the Oakfront River. However, these were present in very low densities (both 0.67 ammocoetes per m^2 of ammocoete habitat fished). Lamprey ammocoetes require the deposition of fine, organic rich sediment ≥5cm in depth in which to burrow and mature (Gardiner, 2003; Goodwin et al., 2008; Aronsuu & Virkkala, 2014). Whilst such habitat was widespread in the watercourses within the vicinity of the proposed wind farm, spawning habitat for adult lamprey was appreciably sparse and invariably of poor quality due to significant siltation pressures.

Owing to their relatively small morphologies, *Lampetra* species such as brook lamprey require clean, fine gravels in which to dig their redds (Lasne et al., 2010; Rooney et al., 2013; Dawson et al., 2015) although areas may also include fractions of sand, larger gravels, and cobble (Nika & Virbickas, 2010). Furthermore, at the beginning of dispersal, young *Lampetra* spp. larvae appear to favour and burrow in fine gravel substrata soon after hatching, until they are better able to burrow in soft sediment (Aronsu & Virkkala, 2014).

Larval lamprey distribution and settlement is passive and entirely regulated by local, dynamic hydrographical (flow) regimes (Hardisty & Potter 1971; Potter, 1980; King & Kelly, 2001). Thus, a paucity of suitable spawning sites (i.e. sources of larvae) can often counteract the presence of even widespread ammocoete burial habitat (i.e. soft sediment) and limit the success of local populations. This was exemplified at surveys sites on the Awbeg River (A3), Milltown Stream (B1), Rathnacally Stream (C2 and C3) and Oakfront River (B5), where, despite a presence of suitable ammocoete habitat none were recorded, presumably due to spawning habitat pressures within these watercourses.

4.1.3 European eel

On both a global and Irish scale, the European eel is listed as 'critically endangered' (Pike et al., 2020; King et al., 2011). European eel were recorded from a total of *n*=7 sites; A3 (Awbeg River), B1, B2, B3, B4 and B5 (Oakfront River) and C3 (Rathnacally Stream). All four survey sites on the Oakfront River supported eel, albeit in very low densities. In keeping with impacts to general fisheries habitat across the survey area, the quality of European eel habitat was also compromised primarily due to siltation pressures but also intermittent flows and sub-optimal habitat (e.g. lack of deep pool refugia, macrophyte beds etc. required as diurnal refugia; Laffaile et al., 2003). Nonetheless, even smaller channels with poor or little fisheries value overall can offer potential as European eel migratory pathways provided they maintain downstream connectivity to larger channels. (e.g. adult migration seawards, usually from September/October onwards).

5. References

APEM (2004). Assessment of sea lamprey distribution and abundance in the River Spey: Phase II. Scottish Natural Heritage Commissioned Report No. 027 (ROAME No. F01AC608).

Applegate, V.C. (1950). Natural history of the sea lamprey, *Petromyzon marinus* in Michigan. Special Scientific Report of the US Fish and Wildlife Service, 55, 1-237.

Aronsuu, K. & Virkkala, P. (2014). Substrate selection by subyearling European river lampreys (*Lampetra fluviatilis*) and older larvae (*Lampetra* spp.). Ecology of Freshwater Fish, 23: 644–655.

CEN (2003). Water Quality - Sampling of Fish with Electricity. Document CEN EN 14011:2000.

CFB (2008). Methods for the Water Framework Directive. Electric Fishing in Wadeable Reaches. Central Fisheries Board, Dublin. Unpublished report.

Cocchiglia, L., Curran, S., Hannigan, E., Purcell, P. J., & Kelly-Quinn, M. (2012). Evaluation of the effects of fine sediment inputs from stream culverts on brown trout egg survival through field and laboratory assessments. Inland Waters, 2(1), 47-58.

Conroy, E., Turner, J. N., Rymszewicz, A., O'sullivan, J. J., Bruen, M., Lawler, D., ... & Kelly-Quinn, M. (2016). The impact of cattle access on ecological water quality in streams: Examples from agricultural catchments within Ireland. Science of the Total Environment, 547, 17-29.

Davis, S. J., Mellander, P. E., Kelly, A. M., Matthaei, C. D., Piggott, J. J., & Kelly-Quinn, M. (2018). Multiple-stressor effects of sediment, phosphorus and nitrogen on stream macroinvertebrate communities. Science of the Total Environment, 637, 577-587.

EA (2003). River Habitat Survey in Britain and Ireland: Field Survey Guidance Manual: 2003 Version. Forest Research. Environment Agency, UK.

Evans, D. J., Gibson, C. E., & Rossell, R. S. (2006). Sediment loads and sources in heavily modified Irish catchments: A move towards informed management strategies. Geomorphology, 79(1-2), 93-113

Gardiner, R. (2003). Identifying lamprey. A field key for sea, river and brook lamprey. Conserving Natura 2000 Rivers, Conservation techniques No. 4. Peterborough. English Nature.

Goodwin, C.E., Dick, J.T.A. & Elwood, R.W. (2008). A preliminary assessment of the distribution of the sea lamprey (*Petromyzon marinus* L), river lamprey (*Lampetra fluviatilis* (L.)) and brook lamprey (*Lampetra planeri* (Bloch)) in Northern Ireland. Biology and Environment: Proceedings of the Royal Irish Academy 109B, 47-52.

Hardisty, M.W. and Potter, I.C. (1971). The behaviour, ecology and growth of larval lampreys. In M.W. Hardisty and I.C. Potter (eds), The Biology of Lampreys, vol. 1. London. Academic Press.

Harvey, J. & Cowx, I. (2003). Monitoring the River, Sea and Brook Lamprey, *Lampetra fluviatilis, L. planer*i and *Petromyzon marinus*. Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough.

Kelly, F. L., & King, J. J. (2001) A review of the ecology and distribution of three lamprey species, *Lampetra fluviatilis* (L.), *Lampetra planeri* (Bloch) and *Petromyzon marinus* (L.): a context for conservation and biodiversity considerations in Ireland. In Biology and Environment: Proceedings of the Royal Irish Academy (pp. 165-185). Royal Irish Academy.

Kelly, F.L., Harrison, A., Connor, L., Wightman, G., Matson, R., Hanna, G., Feeney, R., Morrissey, E., O'Callaghan, R., Wogerbauer, C., Rocks, K., Hayden, B., & Stafford, T. (2010). Water Framework Directive Fish Stock Survey of Rivers in the South Western River Basin District. Inland Fisheries Ireland, Swords Business Campus, Swords, Co. Dublin, Ireland.

Kelly, F.L., Matson, R., Connor, L., Feeney, R., Morrissey, E., Wogerbauer, C. and Rocks, K. (2013). Water Framework Directive Fish Stock Survey of Rivers in the South Western River Basin District. Inland Fisheries Ireland, Swords Business Campus, Swords, Co. Dublin, Ireland.

Kelly-Quinn, M., Feeley, H., & Bradley, C. (2020). Status of freshwater invertebrate biodiversity in Ireland's rivers–time to take stock. In Biology and Environment: Proceedings of the Royal Irish Academy (Vol. 120, No. 2, pp. 65-82). Royal Irish Academy.

Kennedy, G.J.A. (1984). Evaluation of techniques for classifying habitats for juvenile salmon (*Salmo salar* L.) Proceedings of the Atlantic Salmon trust workshop on stock enhancement. 23 pp.

King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., FitzPatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. & Cassidy, D. (2011). Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Laffaille P., Feunteun E., Baisez A., Robinet T., Acou A., Legault A. & Lek S. (2003). Spatial organisation of European eel (*Anguilla anguilla* L.) in a small catchment. Ecology of Freshwater Fish 12, 254–264.

Lasne. E., Sabatie, M-R. & Evanno, G. (2010) Communal spawning of brook and river lampreys (*Lampetra planeri* and *L. fluviatilis*) is common in the Oir River (France). Ecology of Freshwater Fish 2010: 19: 323–325.

Louhi, P., Mäki-Petäys, A., & Erkinaro, J. (2008). Spawning habitat of Atlantic salmon and brown trout: general criteria and intragravel factors. River research and applications, 24(3), 330-339.

Louhi, P., Ovaska, M., Mäki-Petäys, A., Erkinaro, J., & Muotka, T. (2011). Does fine sediment constrain salmonid alevin development and survival? Canadian Journal of Fisheries and Aquatic Sciences, 68(10), 1819-1826.

Macklin, R., Brazier, B. & Gallagher, C. (2018). Fisheries assessment of selected weir sites on the River Barrow, Counties Carlow & Kilkenny. Unpublished report prepared by Triturus Environmental Services for McCarthy-Keville O' Sullivan on behalf of Waterways Ireland.

Maitland, P.S. (2003). Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

Matson, R., Delanty, K., Shephard, S., Coghlan, B., & Kelly, F. (2018). Moving from multiple pass depletion to single pass timed electrofishing for fish community assessment in wadeable streams. Fisheries Research, 198, 99-108.

Nika N. & Virbickas T. (2010). Brown trout *Salmo trutta* redd superimposition by spawning *Lampetra* species in lowland stream. Journal of Fish Biology 77: 2358–2372.

Niven, A.J. & McCauley, M. (2013). Lamprey Baseline Survey No2: River Faughan and Tributaries SAC. Loughs Agency, 22, Victoria Road, Derry.

O'Connor, L. & Kennedy, R.J (2002). A comparison of catchment-based salmon habitat survey techniques on three rivers in N. Ireland. Fisheries Management and Ecology, 9, 149-161.

O'Reilly, P. (2009). Rivers of Ireland, a Flyfisher's Guide (7th Edition). Merlin Unwin Books, Shropshire, UK.

O'Grady, M.F. (2006). Channels and challenges: enhancing Salmonid rivers. Irish Fresh- water Fisheries Ecology and Management Series: Number 4. Central Fisheries Board, Dublin.

Pike, C., Crook, V. & Gollock, M. (2020). *Anguilla anguilla*. The IUCN Red List of Threatened Species 2020:e.T60344A152845178. https://dx.doi.org/10.2305/IUCN.UK.20202.RLTS.T60344A152845178.en

Potter, I. C., & Osborne, T.S. (1975). The systematics of British larval lampreys. Journal of Zoology, 176(3), 311-329.

Potter, I.C. (1980) Ecology of larval metamorphosing lampreys. Canadian Journal of Fisheries and Aquatic Sciences 37, 1641–57.

Slade, J. W., Adams, J. V., Christie, G. C., Cuddy, D. W., Fodale, M. F., Heinrich, J. W. & Young, R. J. (2003). Techniques and methods for estimating abundance of larval and metamorphosed sea lampreys in Great Lakes tributaries, 1995 to 2001. Journal of Great Lakes Research, 29, 137-151.

Soulsby, C., Youngson, A. F., Moir, H. J., & Malcolm, I. A. (2001). Fine sediment influence on salmonid spawning habitat in a lowland agricultural stream: a preliminary assessment. Science of the Total Environment, 265(1-3), 295-307

Walling, D. E., Collins, A. L., & McMellin, G. K. (2003). A reconnaissance survey of the source of interstitial fine sediment recovered from salmonid spawning gravels in England and Wales. Hydrobiologia, 497(1), 91-108.

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10. Appendix B – freshwater pearl mussel survey report

Freshwater pearl mussel (*Margaritifera margaritifera*) survey for Annagh wind farm, Co. Cork

Prepared by Triturus Environmental Ltd. for Fehily Timoney & Company

October 2021

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1. Introduction

1.1 Background

Triturus Environmental Ltd. were contracted by Fehily Timoney & Company to undertake a baseline freshwater pearl mussel (*Margaritifera margaritifera*) survey of the watercourses in the vicinity of the proposed Annagh wind farm, located near Charleville, Co. Cork (**Figure 2.1, Table 2.1**).

The survey was undertaken in September 2020 to establish the presence/absence of freshwater pearl mussel in the vicinity of the proposed wind farm, thus informing impact assessment and mitigation for the project. The watercourses in vicinity of the project included the Awbeg River and numerous tributaries within the Awbeg [Buttevant]_SC_010 river sub-catchment, itself present within the wider Munster Blackwater catchment. The survey area overlapped with the Munster Blackwater *Margaritifera* sensitive area.

In the vicinity of the wind farm site, the Ardglass River (18A23), Milltown Stream (18M57), Oakfront River (18O02) and Rathnacally Stream (18R32) all shared downstream hydrological connectivity with the Blackwater River SAC (site code: 002170), to the south of the survey area. Freshwater pearl mussel are listed as a qualifying interest for this European site (NPWS, 2012) although it is the populations within the Allow, Licky and Munster Blackwater river sub-basins which are responsible for this designation (DEHLG, 2010) (i.e. not the Awbeg River).

1.2 Conservation status of freshwater pearl mussel in Ireland

The freshwater pearl mussel (*Margaritifera margaritifera*) is listed on the IUCN Invertebrate Red Data List as an 'endangered species' (Moorkens et al., 2018) according to the most recent status classification. It is also protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). Pearl mussel are protected by law in Ireland under the Wildlife Acts 1976 to 2018 (S.I. 112, 1990) and the species is listed on Annex II and Annex V of the EU Habitats Directive (92/43/EEC).

Three Article 17 reports have been prepared for pearl mussel (to report on national status as part of the requirements of the Habitats Directive) with the overall conservation status being considered as 'Bad' on three occasions (NPWS, 2008, 2013, 2019). During 2009, The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations S.I. No. 296/2009 were created to establish environmental quality objectives for SAC pearl mussel populations, including the preparation of sub-basin management plans. These regulations set out conservation targets for pearl mussel, as shown in **Table 1.1** below.

1.3 Status of freshwater pearl mussel in the Munster Blackwater catchment

The Munster Blackwater catchment is the largest pearl mussel catchment encompassing over 2300km^2 in County Cork (SWRBD). The current conservation status of the pearl mussel population within the Blackwater River SAC is assessed as 'unfavourable', with numerous significant pressures to pearl mussel populations identified, including erosion, diffuse nutrient enrichment, field drainage and fish migration barriers. However, siltation is the greatest pressure within the catchment (Igoe & Murphy, 2015; DEHLG, 2010).

Whilst pearl mussels still may be relatively widespread in the Blackwater catchment, and there are still small localised areas with moderately high densities, the numbers have declined, and the population is composed entirely of aged adults with no evidence of recruitment for a considerable time (i.e. 20-30 years) (DEHLG, 2010). Regarding the population size of the catchment, the same document stated that, "*While it is likely to be considerably less than 10,000, it may even be reduced to the 100's. The prognosis for the population is very poor. Any measures towards the rehabilitation of juvenile mussel conditions are likely to be slow to achieve…*".

Table 1.1 Targets for sustainable pearl mussel population structure under the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009

Criterion	Target to pass	Notes
Numbers of live adults	No recent decline	Based on comparative results from the most recent surveys
Numbers of dead shells	<1% of population and scattered distribution	1% considered to be indicative of natural losses
Mussels shell length ≤65mm	At least 20% of populations ≤65mm in length	Field survey of 0.5 x 0.5 m quadrats must be carried out in suitable habitat areas for juveniles
Mussels shell length ≤30mm	At least 5% of populations ≤30mm in length	Field survey of 0.5 x 0.5m quadrats must be carried out in suitable habitat areas for juveniles

2. Methodology

2.1 Desktop review

A desktop survey of available pearl mussel data for the survey area and wider River Blackwater catchment was undertaken. This included a National Parks & Wildlife Service (NPWS) sensitive species data request for the Awbeg River and tributaries in the in vicinity of the proposed Annagh wind farm (issued January 20th 2021, received January 26th 2021). This helped to establish the presence of the nearest downstream mussel populations from the proposed project.

2.2 Freshwater pearl mussel surveys

The pearl mussel surveys were carried out on Tuesday 22nd September 2020 in bright weather, with good underwater visibility and under base flow conditions. This helped to maximise visibility of pearl mussel against dark substrata and also helped increase chances of detection when mussels are filtering in brighter conditions. The visual pearl mussel survey (stage 1 and stage 2) was carried out under Section 23 & 34 of the Wildlife Acts 1976 to 2018, licence number C201/2020, issued by the National Parks and Wildlife Service (NPWS) on the 15th September 2020. The survey methodology used was in accordance with the Stage 1 and 2 guidelines given by the NPWS in the Irish Wildlife Manual No. 12 (Anon., 2004) (guidelines currently being updated but unpublished at the time of survey). The surveys were also cognisant of the latest European-wide guidance for freshwater pearl mussel survey methodology (e.g. CEN, 2017; Boon et al., 2019).

Stage 1 presence-absence surveys were undertaken at a total of *n*=14 sites across the Ardglass River, Oakfront River, Rathnacally Stream and Awbeg River (**Table 2.1, Figure 2.1**) through a combination of bathyscope surveying and snorkelling techniques, dependant on local water depths and flow regimes. To maximise detection rates and efficiency, two operators worked in tandem, with one surveyor in-stream and one bank manager to collate data. As per best practice, surveys began downstream and worked upstream at each site to avoid silt and debris blocking the view of pearl mussels and to avoid damage to pearl mussels by trampling (i.e. because of better visibility). Notes were also taken on the aquatic habitat conditions and suitability for freshwater pearl mussels at each site, based on the criteria of Hastie et al. (2000) and Skinner et al. (2003).

2.3 Biosecurity

A strict biosecurity protocol following the Check-Clean-Dry approach was employed during the survey. Equipment and PPE used was disinfected with Virkon® between survey sites to prevent the transfer of pathogens and/or invasive species between survey areas. As per best practice, surveys were undertaken at sites in a downstream order (i.e. uppermost site surveyed first etc.) to prevent the upstream mobilisation of invasive propagules and pathogens.

Table 2.1 Location of the *n*=14 freshwater pearl mussel survey sites in the vicinity of Annagh wind farm, Co. Cork.

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
Ar1	Ardglass River	18A23	Annagh Bogs	549606	616770
O1	Oakfront River	18O02	Cooliney Bridge	550181	618654
O2	Oakfront River	18O02	Annagh North	550775	617421
O3	Oakfront River	18O02	Bridge at Coolcaum	551050	616256
O4	Oakfront River	18O02	0.5km d/s bridge at Coolcaum	551075	615737
A1	Awbeg River	18A09	Annagh Bridge	549823	615649
A2	Awbeg River	18A09	d/s Oakfront confluence	550751	614883
A3	Awbeg River	18A09	Scart Bridge	552200	615051
A4	Awbeg River (east branch)	18A08	Bridge at Caherconnor	552453	615374
A5	Awbeg River (east branch)	18A08	u/s Scart Bridge	552222	615075
A6	Awbeg River	18A09	L1320 road bridge	552780	614388
R1	Rathnacally Stream	18R32	Bridge at Rathnacally	552633	619468
R2	Rathnacally Stream	18R32	Ballnadrideen	552222	618157
R3	Rathnacally Stream	18R32	Awbeg River (east branch) confluence	552428	616052

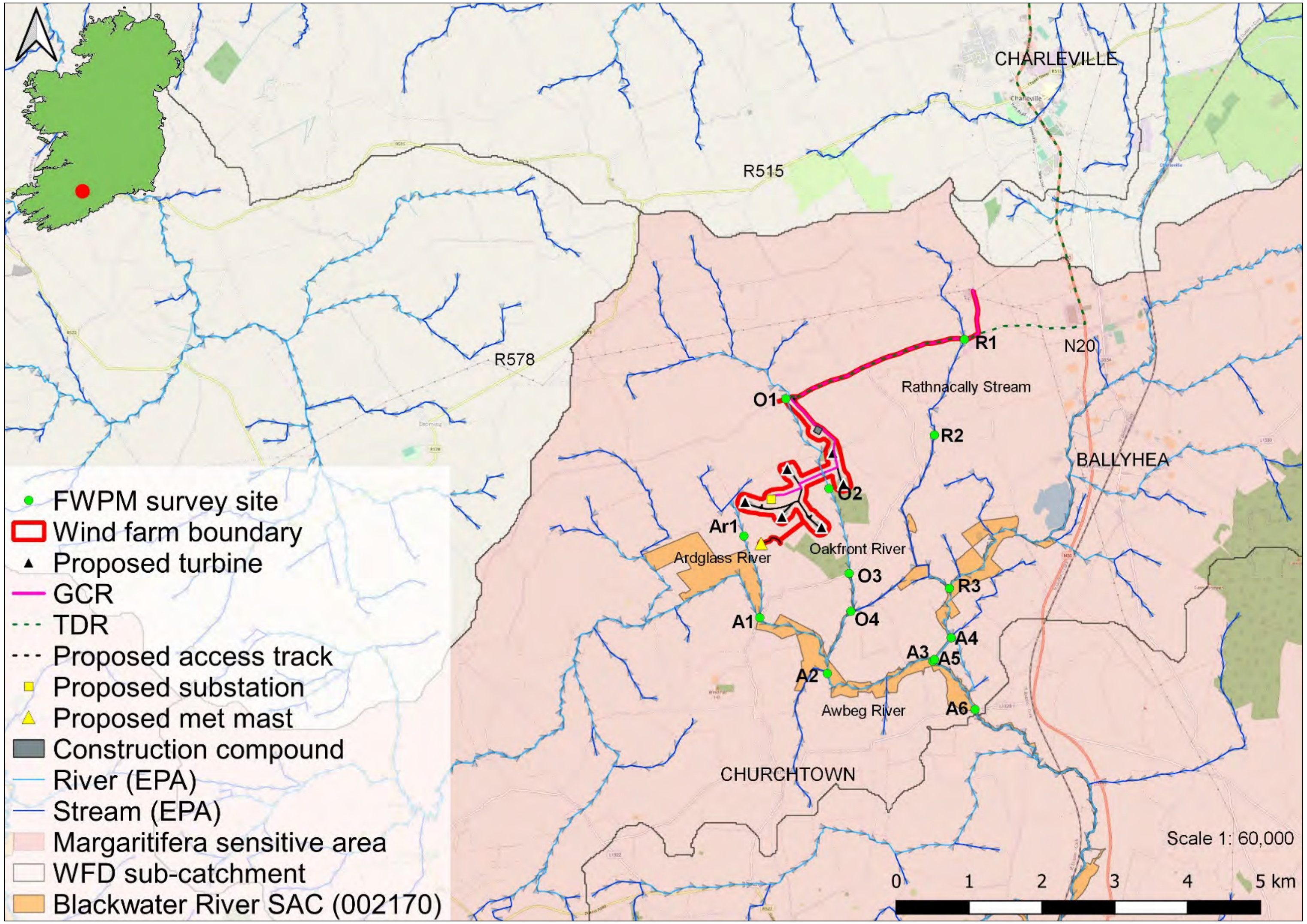

Figure 2.1 Overview of the proposed freshwater pearl mussel survey sites in the vicinity of Annagh wind farm near Charleville, Co. Cork.

3. Results

Freshwater pearl mussel surveys were undertaken on Tuesday 22nd September 2020. The results of the surveys are presented below in terms of the number of mussels recorded (live or dead), number of shells and overall pearl mussel suitability as well as general observations on the ecology of each site. The survey sites are summarised per river below and in more detail in **Appendix A**. Scientific names are provided at first mention only.

3.1 Desktop review

A desktop review revealed no known historical or contemporary freshwater pearl mussel records in the Ardglass River, Oakfront River, Rathnacally Stream or Awbeg River in the vicinity of the proposed Annagh wind farm project (NPWS sensitive species data request).

All survey areas shared downstream hydrological connectivity with or were located within the Blackwater River SAC (site code: 002170). Freshwater pearl mussel are listed as a qualifying interest for this European site (NPWS, 2012) although it is the populations within the Allow, Licky and Munster Blackwater river sub-basins which are responsible for this designation (DEHLG, 2010) (i.e. not the Awbeg River or vicinity of the proposed wind farm).

3.2 Site descriptions & pearl mussel habitat

3.2.1 Ardglass River (site Ar1)

No live or dead freshwater pearl mussels were recorded via bathyscope survey or snorkelling at site Ar1 on the Ardglass River (**Figure 3.1**). The Ardglass River flowed through an intensive agricultural landscape (improved grassland) and was heavily modified throughout its course (i.e. historically straightened and deepened). The small river represented a drainage channel habitat throughout its length. Arterial drainage had resulted in a narrow channel with very poor hydromorphology, low flows, high instream macrophyte coverage (often approaching 90%) and high levels of siltation. As such, there was no suitability for freshwater pearl mussel.

3.2.2 Oakfront River (sites O1, O2, O3 & O4)

No live or dead freshwater pearl mussels were recorded at a total of *n*=4 sites along the Oakfront River via bathyscope survey or snorkelling (**Figure 3.1**). The river flowed through an intensive agricultural landscape (improved grassland) and was heavily modified throughout its course (i.e. historically straightened and deepened). Arterial drainage had resulted in a channel with very poor hydromorphology and high levels of siltation (particularly excessive in the lower reaches, e.g. site O4). Whilst some better-quality habitat was present at faster-flowing sites O1 and O2 by way of exposed cobble and gravel substrata, these were bedded, compacted and moderately to heavily silted. There was no suitability for freshwater pearl mussel throughout the Oakfront River.

Plate 3.1 The straightened, deepened and heavily-silted Ardglass River near site Ar1

Plate 3.2 The extensively straightened Oakfront River at site O1, downstream of Cooliney Bridge

Plate 3.3 The heavily modified and silted Oakfront River at site O3, located upstream of the Blackwater River SAC boundary

Plate 3.4 The heavily modified and silted Oakfront River at site O4, upstream of the Blackwater River SAC boundary

3.2.3 Awbeg River (sites A1, A2, A3, A4, A5 & A6)

No live or dead freshwater pearl mussels were recorded at *n*=6 sites along the Awbeg River via bathyscope survey or snorkelling (**Figure 3.1**). Both the main (western) and eastern branch of the Awbeg flowed through an intensive agricultural landscape (improved grassland) and the channel was heavily modified throughout its course (i.e. historically straightened and deepened). Arterial drainage had resulted in a channel with poor hydromorphology, poor floodplain connectivity, often high macrophyte coverage and particularly high levels of siltation (silt deposits often >0.2m in depth). The better-quality habitat was located at sites with faster-flowing glide and or riffle areas. For example, sites A3, A4 and A5 featured frequent gravel and cobble areas as opposed to the deep (>0.3m) silt deposits present at site A1 and A2. However, these harder substrata were partially bedded and moderately silted, thus reducing any potential for freshwater pearl mussel. The lowermost site A6, located at the L1320 road bridge, featured the best instream recovery (from arterial drainage) with superior hydromorphology, unbedded gravel and cobble substrata and lower rates of silt deposition. However, as per upstream sites, the river was evidently impacted by enrichment and siltation. In summary, despite some localised habitat suitability at survey sites A4 and A6, no freshwater pearl mussel were recorded along the Awbeg River.

Plate 3.5 Representative image of the Awbeg River (left) and Oakfront River (right) near site A2, demonstrating extensive historical modification

Plate 3.6 Representative image of the Awbeg River at Scart Bridge (site A3), demonstrating historically straightened and deepened channel

Plate 3.7 Representative image of the Awbeg River eastern branch at site A4, a site with improved hydromorphology but still not supporting freshwater pearl mussel

Plate 3.8 Representative image of the Awbeg River eastern branch adjoining the main river at Scart Bridge (site A5)

Plate 3.9 The Awbeg River at the L1320 road bridge (site A6)

3.2.4 Rathnacally Stream (sites R1, R2 & R3)

No live or dead freshwater pearl mussels were recorded at a total of *n*=3 sites on the Rathnacally Stream via bathyscope survey or snorkelling. The river flowed through an intensive agricultural landscape (dominated by improved grassland) and the channel was heavily modified throughout its course (i.e. historically straightened and deepened). Arterial drainage had resulted in a channel with poor hydromorphology, often poor floodplain connectivity and high levels of siltation. Riparian shading was invariably high (tunnelling) and the stream suffered from low flows in the upper reaches. Furthermore, salmonids were not recorded present (via electro-fishing, see accompanying fisheries report), with the impacts of siltation and poor water quality evident. There was no suitability for freshwater pearl mussel throughout the Rathnacally Stream.

Plate 3.10 The Rathnacally Stream at site R1 showing modified, heavily-silted channel

Plate 3.11 The Rathnacally Stream at site R2 downstream of a local road crossing at Ballnadrideen (historically straightened, heavy siltation)

Plate 3.12 The Rathnacally Stream (right foreground) at site R3 at the Awbeg River (east branch) confluence

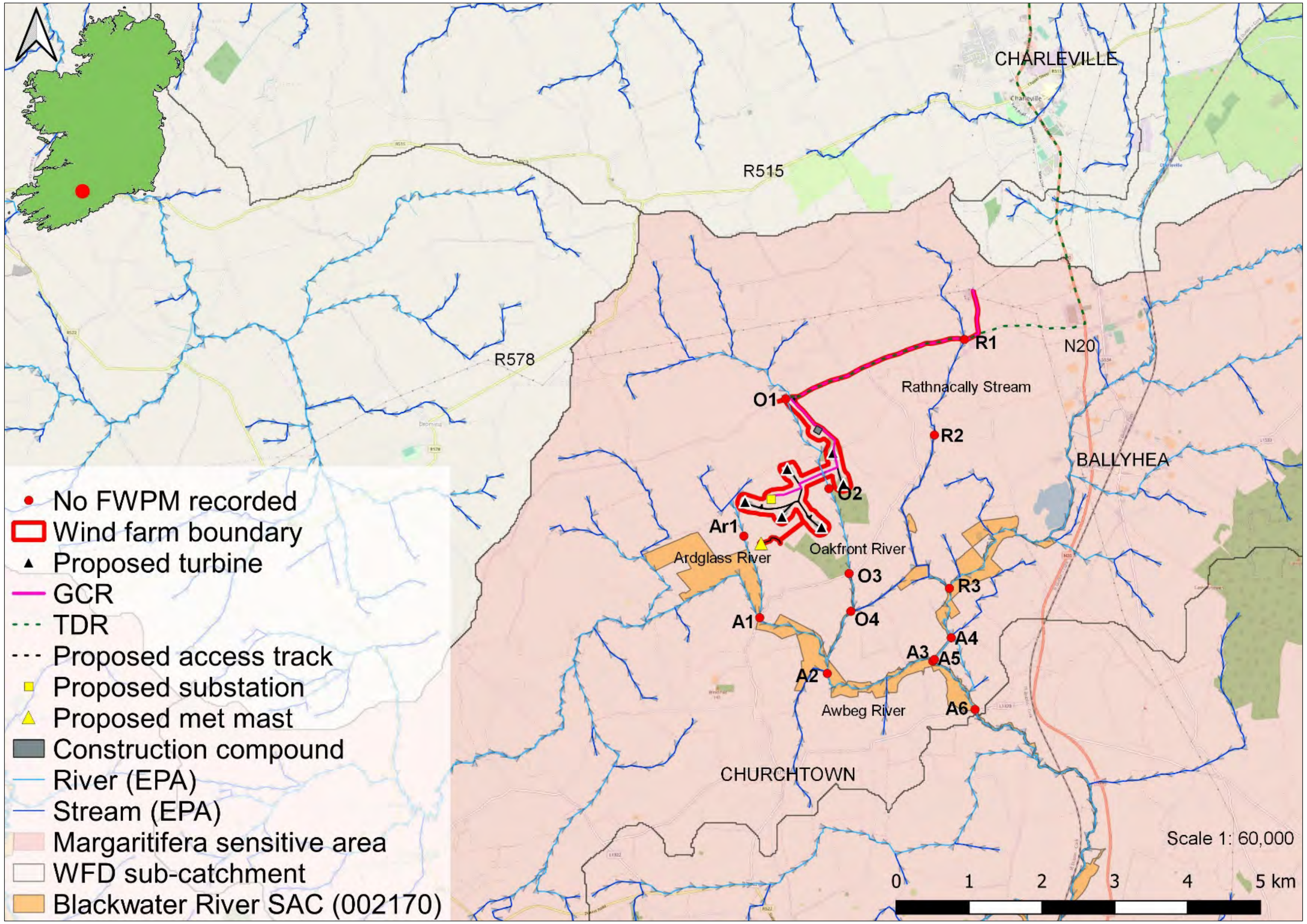

Figure 3.1 Results of freshwater pearl mussel survey in the vicinity of Annagh wind farm, September 2020

4. Discussion

Stage 1 freshwater pearl mussel surveys undertaken in September 2020 identified no freshwater pearl mussels (live or dead) on the Ardglass River, Oakfront River, Rathnacally Stream or Awbeg River in the vicinity of the proposed Annagh wind farm (**Figure 3.1**).

No historical *Margaritifera margaritifera* records were available for the survey area and the arterially-drained, historically straightened (and often deepened) survey sites were found to provide no suitability for the species. Overall, pearl mussel habitat was very poor in the agriculturally-dominated study area given high siltation levels via fine sediment deposition, bedded substrata, poor hydromorphology, seasonally low flows (affecting dissolved oxygen levels), high filamentous algal cover and or excessive macrophyte vegetation (indicating strong eutrophication). Indeed, high levels of siltation and eutrophication pressures have been identified as significant in the wider Blackwater catchment (Igoe & Murphy, 2015), leading to unfavourable conservation status within the River Blackwater SAC. Riverbed quality appears to be the most important habitat factor limiting the recruitment of the endangered freshwater pearl mussel in many European rivers (Geist & Auerswald, 2007) and the heavy siltation observed in the survey watercourses would preclude pearl mussel presence.

Furthermore, the observed poor water quality of the Ardglass River, Oakfront River, Rathnacally Stream and downstream Awbeg River channel (Q2, Q2-3 or Q3; see main EIAR report) would also preclude freshwater pearl mussel from the watercourses in the vicinity of Annagh wind farm, given that the species typically requires water quality corresponding to high ecological status (i.e. ≥Q4-5) under the Freshwater Pearl Mussel Regulations S.I. No. 296 (2009).

5. References

Anon., (2004). *Margaritifera margaritifera*. Stage 1 and Stage 2 survey guidelines. Irish Wildlife Manuals, No. 12. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Boon, P.J., Cooksley, S.L., Geist, J., Killeen, I.J., Moorkens, E.A., & Sime, I. (2019). Developing a standard approach for monitoring freshwater pearl mussel (*Margaritifera margaritifera*) populations in European rivers. Aquatic Conservation: Marine and Freshwater Ecosystems.

CEN (2017). Water quality - Guidance standard on monitoring freshwater pearl mussel (*Margaritifera margaritifera*) populations and their environment. In EN 16859. Brussels, Belgium: European Committee for Standardization.

DEHLG (2010). Freshwater Pearl Mussel Second Draft Munster Blackwater Sub-Basin Management Plan. Produced by NS2, funded by Department of the Environment, Heritage and Local Government.

Geist, J., & Auerswald, K. (2007). Physicochemical stream bed characteristics and recruitment of the freshwater pearl mussel (Margaritifera margaritifera). Freshwater Biology, 52(12), 2299–2316.

Hastie L.C., Boon P.J. and Young M.R. (2000). Physical microhabitat requirements of freshwater pearl mussel *Margaritifera margaritifera* (L.). Hydrobiologia 429 59-71

Igoe, F & Murphy, K. (2015). River Blackwater Special Area of Conservation – Management Plan. IRD DuhallowLIFE Project (Blackwater SAM OK – LIFE09 NAT/IE/000220). IRD Duhallow, James O'Keeffe Institute, Newmarket, Co. Cork, Ireland#

Moorkens, E., Cordeiro, J., Seddon, M.B., von Proschwitz, T. & Woolnough, D. (2018). *Margaritifera margaritifera* (errata version published in 2018). The IUCN Red List of Threatened Species 2018: http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T12799A508865.en.

NPWS (2008) The Status of EU Protected Habitats and Species in Ireland. Unpublished report, National Parks and Wildlife Services, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland. 81.

NPWS (2012). Conservation Objectives: Blackwater River (Cork/Waterford) SAC 002170. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013). The Status of Protected EU Habitats and Species in Ireland. Overview Volume 1. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland. Editor: Deirdre Lynn. 81.

NPWS (2019). The Status of EU Protected Habitats and Species in Ireland. Volume 3: Species Assessments. Unpublished NPWS report. Edited by: Deirdre Lynn and Fionnuala O'Neill. 84.

Skinner, A, Young M. & Hastie, L. (2003). Ecology of the Freshwater Pearl Mussel. Conserving Natura 2000 Rivers Ecology Series No. 2 English Nature, Peterborough.

6. Appendix A – survey site characteristics

Table A1 Summary characteristics of each freshwater pearl mussel survey site, September 2020

Site	Watercourse	River profile	Bordering land uses & riparian habitat	Substrata	Riverbed condition & siltation	Macrophytes & bryophytes (DAFOR)	FWPM recorded	Threats & pressures
Ar1	Ardglass River, Annagh Bogs	1.5-2m wide drainage ditch-like channel (FW4), 0.3-0.6m deep, historically straightened & deepened, steep 2m bankfull heights, imperceptible flow, high shading, high instream vegetation cover, poorly recovered riparian zone	Wet grassland (GS4), scrub (WS1), immature woodland (WS2)	100% (deep) silt	Very heavy siltation	*Phragmites australis* (A), *Lemna minuta* (F)	No	Arterial drainage (straightening and deepening), agricultural enrichment, siltation
O1	Oakfront River, Cooliney Bridge	2.5m wide, 0.2-0.3m deep, historically straightened lowland river (FW2), fast-flowing shallow glide with limited pool, steep 2m bankfull heights, low shading, low instream vegetation cover, cleared riparian zone (former treelines)	Improved agricultural grassland (GA1)	Cobble & small boulder with localised fine-medium gravels and sand/silt deposits	Bedded & compacted with low-moderate siltation	*Apium nodiflorum* (O), *Hygroamblystegium tenax* (O)	No	Arterial drainage (straightening and deepening), agricultural enrichment, siltation
O2	Oakfront River, Annagh North	2.5m wide, 0.2-0.3m deep, historically straightened lowland river (FW2), fast-flowing shallow glide with limited pool, 1- 2m bankfull heights, moderate shading, low instream vegetation cover, mature riparian zone (treelines)	Improved agricultural grassland (GA1), treelines (WL2)	Fine-medium gravels with frequent sand and occasional cobble	Partially bedded, moderate siltation	*Apium nodiflorum* (O), *Berula erecta* (R)	No	Arterial drainage (straightening and deepening), agricultural enrichment, siltation
O3	Oakfront River, bridge at Coolcaum	2-2.5m wide, 0.8-1.2m deep, historically straightened & deepened	Improved agricultural grassland (GA1),	Deep silt with very localised fine-medium	Very heavy siltation	*Callitriche stagnalis* (O), *Berula erecta* (O)	No	Arterial drainage (straightening and deepening),

Site	Watercourse	River profile	Bordering land uses & riparian habitat	Substrata	Riverbed condition & siltation	Macrophytes & bryophytes (DAFOR)	FWPM recorded	Threats & pressures
		lowland river (FW2), moderate flow, 100% deep glide, low bankfull heights (floodplain connectivity locally) but flood embankments present on west bank, low shading, moderate instream vegetation cover, little or no riparian zone (farmed to edge)	coniferous plantation (WD4)	gravels & small cobble in faster-flowing areas				agricultural enrichment, siltation
O4	Oakfront River, 0.5km d/s bridge at Coolcaum	2.5-3m wide, 0.5-1.2m deep, historically straightened & deepened lowland river (FW2), moderate flow, 100% deep glide, low bankfull heights (floodplain connectivity locally) but flood embankments present locally, low shading, moderate instream vegetation cover, little or no riparian zone (farmed to edge)	Improved agricultural grassland (GA1)	Deep silt with very localised fine-medium gravels & small cobble in faster-flowing areas	Very heavy siltation	*Sparganium erectum* (F), *Callitriche stagnalis* (O), *Berula erecta* (O), Apium nodiflorum (O), *Potamogeton perfoliatus* (R)	No	Arterial drainage (straightening and deepening), agricultural enrichment, siltation
A1	Awbeg River, Annagh Bridge	7-10m wide, 0.8-1.5m deep, historically straightened & deepened lowland river (FW2), moderate flow, 100% deep glide, low bankfull heights (floodplain connectivity locally) but flood embankments present, low shading, moderate instream	Improved agricultural grassland (GA1), scrub (WS1)	Deep silt with very localised fine-medium gravels & small cobble near bridge with occasional boulder	Very heavy siltation	*Sparganium erectum* (F), *Lemna minuta* (F), *Berula erecta* (F), *Callitriche stagnalis* (O)	No	Arterial drainage (straightening and deepening), agricultural enrichment, siltation

Site	Watercourse	River profile	Bordering land uses & riparian habitat	Substrata	Riverbed condition & siltation	Macrophytes & bryophytes (DAFOR)	FWPM recorded	Threats & pressures
		vegetation cover, little or no riparian zone (farmed to egde)						
A2	Awbeg River, d/s Oakfront River confluence	7-8m wide, 0.5-1m deep, historically straightened & deepened lowland river (FW2), moderate flow, 100% deep glide, low bankfull heights (floodplain connectivity locally) but flood embankments present, low shading, moderate instream vegetation cover, little or no riparian zone (farmed to edge)	Improved agricultural grassland (GA1), scrub (WS1)	100% deep silt	Very heavy siltation	*Sparganium erectum* (F), *Lemna minuta* (F), *Berula erecta* (F), *Callitriche stagnalis* (O)	No	Arterial drainage (straightening and deepening), agricultural enrichment, siltation
A3	Awbeg River, Scart Bridge	7-8m wide, 0.8-1.2m deep, historically straightened & deepened lowland river (FW2), moderate flow, deep glide with localised pool, 2-2.5m bankfull heights (floodplain connectivity locally) but flood embankments present, low shading, moderate instream vegetation cover, little or no riparian zone (farmed to edge)	Improved agricultural grassland (GA1), scrub (WS1)	Soft silt & sand deposits with localised compacted cobble, mixed gravels & scattered boulder	Partially bedded, heavy siltation	*Ranunculus* subsp. *Batrachion* agg. (F) *Sparganium emersum* (F), *Callitriche stagnalis* (O)	No	Arterial drainage (straightening and deepening), agricultural enrichment, siltation
A4	Awbeg River (east branch), bridge at Caherconnor	4-5m wide, 0.3-0.6m deep, fast-flowing lowland river (FW2), fast-glide & riffle dominated, historically straightened & deepened d/s of bridge	Improved agricultural grassland (GA1), scrub (WS1), treelines (WL2), buildings and	Mixed gravels & cobble with occasional boulder, localised silt & sand deposits	Partially bedded due to high flows, moderate siltation (more than expected for flow type)	*Ranunculus* subsp. *Batrachion* agg. (O), *Potamogeton perfoliatus* (R), *Oenanthe crocata* (R), *Apium nodiflorum* (R)	No	Arterial drainage (straightening and deepening), agricultural enrichment, siltation

Site	Watercourse	River profile	Bordering land uses & riparian habitat	Substrata	Riverbed condition & siltation	Macrophytes & bryophytes (DAFOR)	FWPM recorded	Threats & pressures
		but some good recovery, 1.5-2m bankfull heights, low shading, moderate instream vegetation cover, little or no riparian zone (farmed to edge)	artificial surfaces (BL3) (road)					
A5	Awbeg River (east branch), u/s Scart Bridge	4-6m wide, 0.3-0.6m deep, fast-flowing lowland river (FW2), 100% fast-glide, historically straightened & deepened, 1.5-2m bankfull heights, low shading, moderate instream vegetation cover, little or no riparian zone (farmed to edge)	Improved agricultural grassland (GA1), scrub (WS1), buildings and artificial surfaces (BL3) (road)	Mixed gravels & sand with cobble, localised silt deposits	Partially bedded due to high flows, moderate siltation (more than expected for flow type)	*Ranunculus* subsp. *Batrachion* agg. (F), *Potamogeton perfoliatus* (R), *Myriophyllum spicatum* (R)	No	Arterial drainage (straightening and deepening), agricultural enrichment, siltation
A6	Awbeg River, L1320 road bridge	10-15m wide, 0.3-0.5m deep, fast-flowing lowland river (FW2), fast-glide & riffle dominated, historically straightened & deepened, 4-5m bankfull heights, low shading, moderate instream vegetation cover, poorly recovered riparian zone	Improved agricultural grassland (GA1), scrub (WS1)	Coarse gravels and cobble with occasional boulder	Unbedded substrata (mobile), low siltation but moderate-high filamentous algal cover (30%)	*Ranunculus* subsp. *Batrachion* agg. (F), *Potamogeton perfoliatus* (O), *Myriophyllum spicatum* (O)	No	Arterial drainage (straightening and deepening), agricultural enrichment, siltation
R1	Rathnacally Stream, bridge at Rathnacally	1-1.5m wide, 0.1-0.3m deep lowland river (FW2), historically straightened & deepened, shallow glide dominated, <1m bankfull heights, high shading, low instream	Improved agricultural grassland (GA1), scrub (WS1), hedgerows (WL1), treelines (WL2)	Deep silt with high clay fraction (historically excavated to clay layer) with localised cobble and medium-coarse gravels	Bedded substrata, very heavy siltation	*Apium nodiflorum* (O), *Lemna minuta* (O)	No	Arterial drainage (straightening and deepening), agricultural enrichment, siltation, surface water run-off (cattle mart)

Site	Watercourse	River profile	Bordering land uses & riparian habitat	Substrata	Riverbed condition & siltation	Macrophytes & bryophytes (DAFOR)	FWPM recorded	Threats & pressures
		vegetation cover, mature riparian zone						
R2	Rathnacally Stream, Ballnadrideen	1.5-2m wide, 0.3-0.4m deep lowland river (FW2), historically straightened & deepened, deep glide dominated, <1m bankfull heights, high shading, low instream vegetation cover, mature riparian zone	Improved agricultural grassland (GA1), scrub (WS1), hedgerows (WL1), treelines (WL2)	Deep silt with high clay fraction (historically excavated to clay layer) with very localised cobble and mixed gravels	Bedded substrata, very heavy siltation	*Apium nodiflorum* (O), *Lemna minuta* (O)	No	Arterial drainage (straightening and deepening), agricultural enrichment, siltation
R3	Rathnacally Stream, Awbeg River (east branch) confluence	1-1.5m wide shallow, heavily-silted, slow-flowing drainage ditch-like channel adjoining Awbeg River (FW2), historically straightened & deepened, 2m bankfull heights, high shading, narrow riparian zone (often farmed to edge)	Improved agricultural grassland (GA1), scrub (WS1), hedgerows (WL1)	100% silt with mixed gravels and cobble in main river channel	Very heavy siltation in Rathnacally Stream with heavily compacted substrata in main river	*Apium nodiflorum* (O), *Lemna minuta* (O) & (main river only) *Ranunculus* subsp. *Batrachion* agg. (O), *Potamogeton perfoliatus* (O)	No	Arterial drainage (straightening and deepening), agricultural enrichment, siltation

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11. Appendix C – Q-sample results (biological water quality)

Table B1 Macro-invertebrate Q-sampling results for survey sites A2, B1, B2, B3, B5, C2 and C3, September 2020

Group	Family	Species	Site A2	Site B1	Site B2	Site B3	Site B5	Site C2	Site C3	EPA class
Trichoptera	Limnephilidae	*Limnephilus* sp.			1		2			B
Ephemeroptera	Baetidae	*Baetis rhodani*			14	9			15	C
Trichoptera	Sericostomatidae	*Sericostoma personatum*		2	4		3		4	C
Trichoptera	Philopotamidae	*Wormaldia occipitalius*		1						C
Trichoptera	Racophilidae	*Ryacophila dorsalis*			2					C
Crustacea	Gammaridae	*Gammarus duebenii*	13	21	129					C
Mollusca	Planorbidae	*Planorbis* sp.	2			1	1	3		C
Coleoptera	Hydraenidae	*Hydraena* sp.				1				C
Coleoptera	Dytiscidae	*Agabus bipustulatus*	1				1			C
Coleoptera	Elmidae	*Limnius volckmari*			14	19			7	C
Coleoptera	Elmidae	*Elmis aenea*				3			1	C
Platyhelminthes	Planorbidae	*Polycelis felina*		5	3					C
Diptera	Simulidae	*Simulium* sp.		3	10					C
Diptera	Tipulidae	*Dicranota* sp.		1		3				C
Diptera	Tipulidae	*Tipula* sp.							2	C
Crustacea	Asellidae	*Asellus aquaticus*	26				22	23		D
Mollusca	Lymnaeidae	*Radix balthica*	4				6	5		D
Diptera	Chironomidae	*Chironomus* sp.					2	17	8	E
Oligochaeta	Naididae (Tubificidae)	*Tubificid* sp.		6	12			32	13	E
Oligochaeta	Oligochaeta	Unidentified species			1			13	4	n/a
Abundance			46	39	190	36	37	93	54	
Taxon richness			5	7	10	5	7	8	9	
Q-rating			Q2-3	Q3	Q3	Q2-3	Q3	Q2	Q3	
WFD status			Poor	Poor	Poor	Poor	Poor	Bad	Poor	

12. Appendix D – eDNA analysis lab report

Folio No: E9170
Report No: 1
Purchase Order: Anagh Wind Farm
Client: Triturus Environmental Limited
Contact: Ross Macklin

TECHNICAL REPORT

ANALYSIS OF ENVIRONMENTAL DNA SAMPLES FOR THE DETECTION OF CRAYFISH SPECIES AND CRAYFISH PLAGUE

SUMMARY

All organisms continuously release small amounts of environmental DNA (eDNA) into their habitat. By collecting and analysing this eDNA from water samples from lakes, ponds or rivers we can detect the presence or absence of crayfish species including: the white-clawed crayfish (Austropotamobius pallipes), signal crayfish (*Pacifastacus leniusculus*), the marbled crayfish (*Procambarus virginalis*) and the crayfish plague (*Aphanomyces astaci*).

RESULTS

Date sample received at Laboratory: 06/04/2021
Date Reported: 15/04/2021
Matters Affecting Results: None

Lab Sample ID.	Site Name	O/S Reference	Species	Result	SIC	DC	IC	Positive Replicates
C0269	ANNAGH WIND FARM 2	-	*White-Clawed Crayfish*	Positive	Pass	Pass	Pass	10
			Crayfish Plague	Negative	Pass	Pass	Pass	0
C0277	ANNAGH WIND FARM 1	-	*White-Clawed Crayfish*	Positive	Pass	Pass	Pass	2
			Crayfish Plague	Negative	Pass	Pass	Pass	0

If you have any questions regarding results, please contact us: ForensicEcology@surescreen.com

Reported by: Chris Troth **Approved by:** Chris Troth

METHODOLOGY

The analysis is conducted in two phases. The sample first goes through an extraction process where the filter is incubated in order to obtain any DNA within the sample. The extracted sample is then tested via real time PCR (also called q-PCR) for each of the selected target species. This process uses species-specific molecular markers (known as primers) to amplify a select part of the DNA, allowing it to be detected and measured in 'real time' as the analytical process develops. qPCR combines amplification and detection of target DNA into a single step. With qPCR, fluorescent dyes specific to the target sequence are used to label targeted PCR products during thermal cycling. The accumulation of fluorescent signals during this reaction is measured for fast and objective data analysis. The primers used in this process are specific to a part of mitochondrial DNA only found in each individual species. Separate primers are used for each of the species: white-clawed crayfish, signal crayfish and crayfish plague, ensuring no DNA from any other species present in the water is amplified.

Analysis of eDNA requires scrupulous attention to detail to prevent risk of contamination. True positive controls, negative controls and spiked synthetic DNA are included in every analysis and these have to be correct before any result is declared and reported. Stages of the DNA analysis are also conducted in different buildings at our premises for added security. These methods have been extensively tested since 2015 in a number of different environments, habitats, conditions and ecological situations in order to successfully enable the full application of eDNA for the detection of crayfish species and the crayfish plague.

RESULTS INTERPRETATION

SIC: **Sample Integrity Check** [Pass/Fail]
When samples are received in the laboratory, they are inspected for any tube leakage, suitability of sample (not too much mud or weed etc.) and absence of any factors that could potentially lead to inconclusive results.

DC: **Degradation Check** [Pass/Fail]
Analysis of the spiked DNA marker to see if there has been degradation of the kit or sample, between the date it was made to the date of analysis. Degradation of the spiked DNA marker may indicate a risk of false negative results.

IC: **Inhibition Check** [Pass/Fail]
The presence of inhibitors within a sample are assessed using a DNA marker. If inhibition is detected, samples are purified and re-analysed. Inhibitors cannot always be removed, if the inhibition check fails, the sample should be re-collected.

Result: **Presence of eDNA** [Positive/Negative/Inconclusive]
Positive: DNA was identified within the sample, indicative of species presence within the sampling location at the time the sample was taken or within the recent past at the sampling location.
Positive Replicates: Number of positive qPCR replicates out of a series of 12. If one or more of these are found to be positive the pond is declared positive for species presence. It may be assumed that small fractions of positive analyses suggest low level presence, but this cannot currently be used for population studies. In accordance with Natural England protocol, even a score of 1/12 is declared positive. 0/12 indicates negative species presence.
Negative: eDNA was not detected or is below the threshold detection level and the test result should be considered as evidence of species absence, however, does not exclude the potential for species presence below the limit of detection.
Inconclusive: Controls indicate inhibition or degradation of the sample, resulting in the inability to provide conclusive evidence for species presence or absence.

Forensic Scientists and Consultant Engineers
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CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 4

CEMP

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CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

ANNAGH WIND FARM, CO. CORK

CONSTRUCTION AND ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

Prepared for: EMPower

EMPower

Date: November 2021

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1. INTRODUCTION

1.1 General Introduction and Purpose

This document is the Construction and Environmental Management Plan (CEMP) for the proposed Annagh Wind Farm and has been prepared by Fehily Timoney and Company (FT) on behalf of EMPower.

The CEMP will be updated prior to construction to take account of any relevant conditions attached to the planning permission and will be implemented for the duration of the construction phase of the project. The CEMP will be a live document and will be subject to ongoing review through regular environmental auditing and site inspections and updated as required. For the avoidance of doubt, all measures stipulated in this CEMP will be implemented in full.

The CEMP sets out the key construction and environmental management issues associated with the proposed project and will be developed further at the post-planning and construction stages by the client and on the appointment of the main contractor to the project.

In the case of any ambiguity or contradiction between this CEMP and the EIAR, the EIAR shall take precedence.

This CEMP sets out the key environmental management issues associated with the construction, operation and decommissioning of the proposed project, to ensure that during these phases of the development, the environment is protected and impacts on the environment are minimised.

The document is divided into six sections:

Section 1: *Introduction* provides an overview of the existing site and the proposed project

Section 2: *Existing Site Environmental Conditions* provides details of the main existing geotechnical, hydrological, ecological and archaeological conditions onsite. These conditions are to be considered by the contractor in the construction, operation and decommissioning of this proposed project.

Section 3: *Overview of Construction Works*, this section provides an overview of the construction works proposed, including drainage and sediment controls to be installed.

Section 4: *Environmental Management Plan (EMP)*, this section outlines the main requirements of the EMP and outlines operational controls for the protection of the environment including soil management, habitat and species, site drainage control, archaeology, construction traffic, site reinstatement and decommissioning, waste management.

Section 5: *Safety & Health Management Plan,* this section defines the work practices, procedures and management responsibilities relating to the management of safety and health during the design, construction and operation of the Annagh Wind Farm.

Section 6: *Emergency Response Plan* contains predetermined guidelines and procedures to ensure the safety, health and welfare of everybody involved in the project and to protect the environment during the construction phase of Annagh Wind Farm.

1.2 The Applicant

The applicant for the proposed project is Annagh Wind Farm Limited, a subsidiary of EMP Energy Limited (EMPower).

1.3 The Site

The proposed wind farm site is located in north County Cork, approximately 45km north of Cork City. The Site is located approximately 6km south west of Charleville and approximately 8km north west of Buttevant. The Site includes lands in the townlands of Annagh North, Fiddane, Cooliney, Coolcaum. The Site encompasses a mixture of habitat types, with mixed broadleaved woodland (plantations), wet grassland and improved agricultural grassland, the main types of land cover present.

The location of the development is shown on Figure 1-1.

1.4 The Project

The proposed project will primarily consist of a wind farm of 6 no. wind turbine generators (WTG's), 1 no. permanent meteorological mast (PMM), and 1 no. substation compound along with ancillary civil and electrical infrastructure.

The associated grid connection route (GCR) will consist entirely of underground 38kV cable and will connect the on-site substation to the existing Charleville 110kV Substation within the townland of Rathnacally. The GCR will be approx. 5.9km in length including 3.4km to be constructed primarily within the existing road corridor and 2.5km of underground cables to be installed within private lands within the wind farm site. The proposed GCR arrangement is illustrated in Figure 2-2. The GCR includes two stream crossings, indicated in Figure 2-2.

Large components associated with the wind farm construction will be transported to site via the identified turbine delivery route (TDR) from the Port of Foynes, County Limerick to the wind farm site.

A detailed description of the proposed construction works is outlined in Section **3.**

A site layout plan of the proposed project is shown in Figure 1-2.

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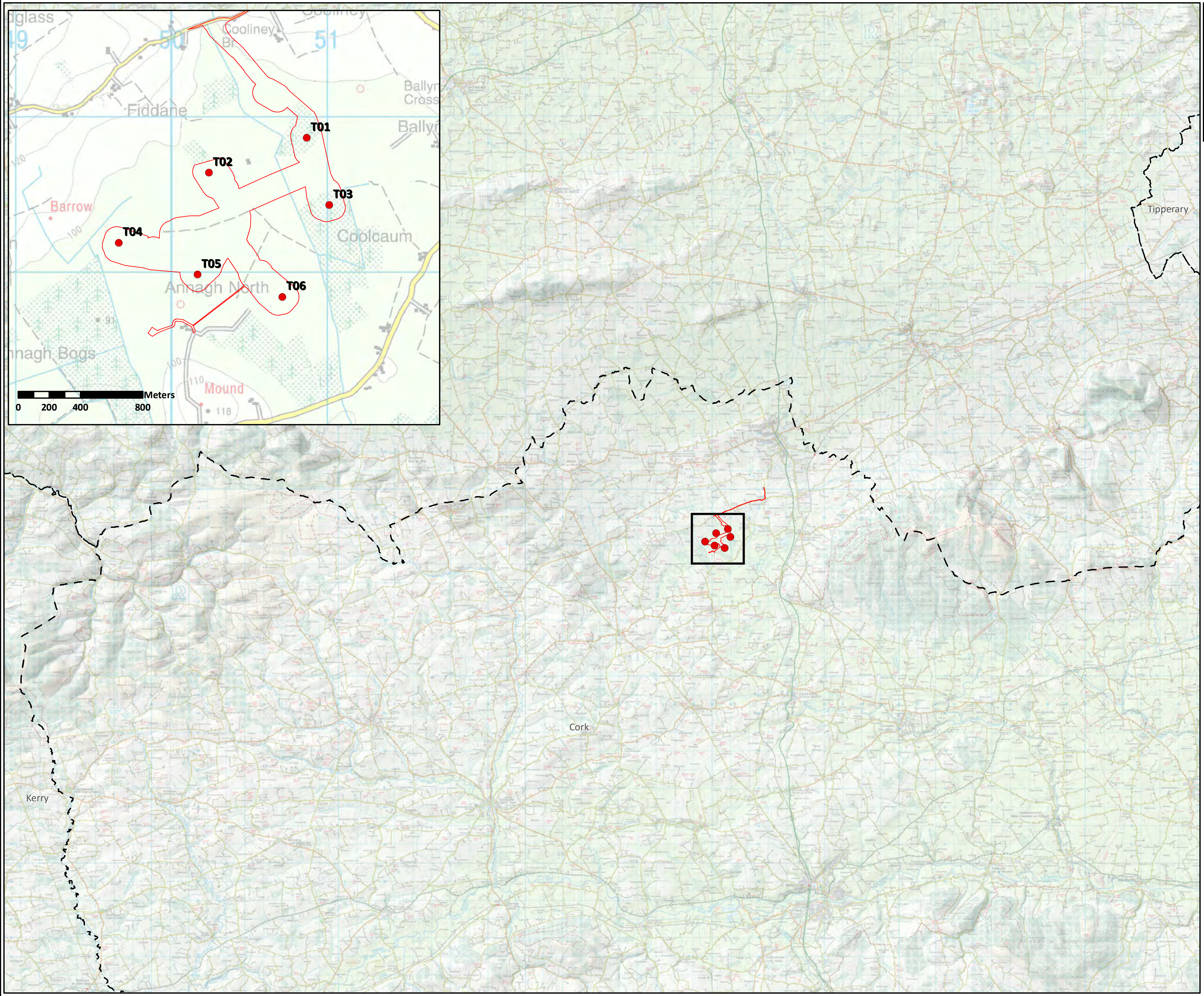

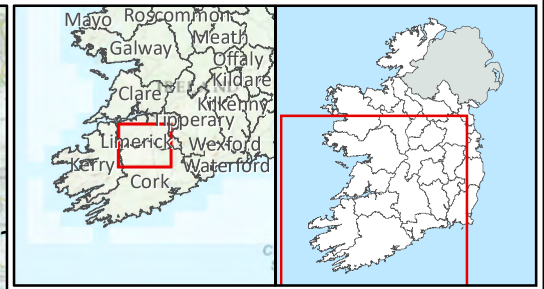

Legend

- County Boundaries
- Proposed Site Boundary
- Proposed Turbine Layout

TITLE:	Site Location
PROJECT:	Annagh Wind Farm, Co. Cork
FIGURE NO:	1.1
CLIENT:	EMPower
SCALE: 1:200000	**REVISION:** 0
DATE: 14/10/2021	**PAGE SIZE:** A3

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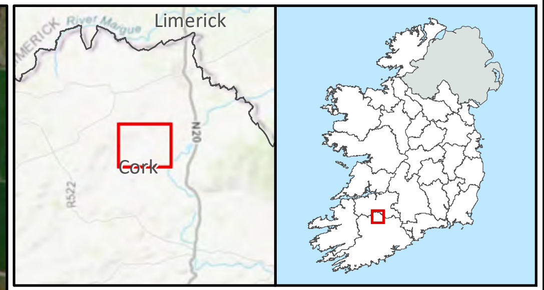

Legend

- Site Boundary
- Turbine Layout
- Met Mast
- Underground Cable Route
- Substation
- Construction Compound
- Turbine Hardstanding
- Turning Heads

Roads

- New
- Upgrade

TITLE: Wind Farm Site Layout	
PROJECT: Annagh Wind Farm, Co. Cork	
FIGURE NO: 1.2	
CLIENT: EMPower	
SCALE: 1:12500	**REVISION:** 0
DATE: 14/10/2021	**PAGE SIZE:** A3

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2. EXISTING SITE ENVIRONMENTAL CONDITIONS

2.1 Existing Site Description

2.1.1 Main Wind Farm Site

The proposed wind farm site is located in north County Cork, approximately 45km north of Cork City. The Site is located approximately 6km south west of Charleville and approximately 8km north west of Buttevant. The Site is located in a rural area. The nearest settlement is the village of Churchtown which is located approximately 3km to the south of the Site.

Access to the main wind farm site is made from the L1322 local road which meets the N20 at Ballyhea, approximately 4km to the east of the proposed site entrance. HGV's shall approach the site via this route.

The main wind farm site is situated within a single sub-catchment as defined by the WFD, the Awbeg [Buttevant]_SC_010.

A detailed description of the existing site environment can be found in Chapter 3 of the EIAR.

2.1.2 Turbine Delivery Route (TDR)

Large components associated with the wind farm construction will be transported to site via the identified turbine delivery route (TDR). The proposed access route to site is as follows:

- Loads will depart the Port of Foynes and turn left onto the N69 towards Limerick;
- Loads will travel onto the N18 and turn onto the M20/N21;
- Loads will turn onto the N20 and travel south through the town of Charleville
- The route then turns onto the L1322 local road at Ballyhea; and
- The route continues westwards on the L1322 for approx. 4km before entering the proposed wind farm site.

Temporary accommodation works required for the delivery of turbines are summarised in Table 2-1 below. The general location of accommodation works locations, or TDR nodes, are shown in Figure 2-1. The works required at each POI are assessed throughout this EIAR. Many of the POIs can be accommodated through a road opening licence. POIs which require planning consent do not form part of this application for planning permission but are assessed as part of the project.

Table 2-1: TDR Temporary Accommodation Works

TDR Node Reference Number (POI__)	Location	Summary Description of Proposed Temporary Accommodation Works
2	Foynes Port Access Road/N69	Vegetation on right will require trimming to 2.5m over road level to boundary fence. Road sign will require temporary removal. Lampposts require temporary removal and vegetation on left will be trimmed above 1m in height for mid oversail. The top 40cm (approx.) of the wall on the left-hand side should be removed to allow for mid oversail.
4	Clarina Roundabout	Temporary hard surface in the form of compacted aggregate hard standing required on roundabout to provide a cut-through track through the centre island. This will require tree removal in the area identified in the TDR Report and temporary signage removal (see Appendix 1).
5	Mungret Interchange – West Roundabout	Temporary load bearing surface required on roundabout to provide a cut-through track through the centre island. This will require vegetation removal and temporary signage removal.
6	Mungret Interchange – East Roundabout.	Temporary load bearing surface required on roundabout to allow for turn and oversail. Temporary removal of signage and public lighting required.
7	M20- N20 off ramp Southbound	Temporary removal of signs and street lamp on left side and scrub clearance on left and right for mid and rear oversail.
8	N20 Right Curve. Ballymacrory	Vegetation trimming required to facilitate vehicle oversail on both sides of the road. Hedgerow to be lowered to 0.5m above road level on the right hand side to facilitate mid-oversail.
9	N20 – L1322 Junction, Ballyhea	Regrading and temporary load bearing surface required. Temporary removal of road signs to facilitate oversail.
10	L1322 Local Road – from Ballyhea to Site Entrance	Road will require upgrading and widening at various points to facilitate blade transport. There are ten POIs along the L1322 described below and illustrated in Appendix 13.1.
10.1	L1322	Temporary removal of fence and road markers to facilitate mid-oversail. Hedge trimming to facilitate vehicle oversail.
10.2	L1322	Vegetation trimming to facilitate vehicle oversail. Temporary removal of utility pole.
10.3	L1322	Vegetation trimming to tree canopy required. Vegetation removal to facilitated vehicle oversail.
10.4	L1322	Vegetation trimming to facilitate vehicle oversail.
10.5	L1322	Hedge and pump enclosure wall to be lowered to 0.5m above road level to facilitate vehicle oversail. Road narrows from this point onwards.
10.6	L1322	Section of wall to be lowered to 0.5m above existing road level to facilitate mid-oversail.
10.7	L1322	Vegetation trimming and temporary removal of utility pole.

TDR Node Reference Number (POI__)	Location	Summary Description of Proposed Temporary Accommodation Works
10.8	L1322	Hedgerow and tree branch trimming to facilitate vehicle oversail.
10.9	L1322	Hedgerow trimming required on both sides of the road throughout this section to facilitate vehicle oversail.
10.10	L1322	Hedgerow trimming on the right-hand side to facilitate vehicle oversail.
10.11	L1322	This node forms the main site entrance as described below.

The location and nature of proposed temporary accommodation works are described in further detail in the TDR report included in Appendix 1.

Site Entrance

Annagh Wind Farm shall have one main site entrance which will be used for both construction and operation. Access to the site shall be via an existing agricultural entrance on the L1322. The location of the site entrance is shown in Figure 3-2 and is further detailed in Chapter 13: Traffic & Transportation.

The site entrance will be upgraded and a section of treeline and hedgerow will require removal to allow for safe visibility and to accommodate a wider turning point for turbine delivery. The site entrance will form a bell mouth and land will be reprofiled to allow for safe vehicular entrance.

Access to the met mast for construction, operational maintenance and decommissioning will be made from the south of the site via an existing agricultural laneway, in the townland of Annagh North. This southern entrance will not be utilised for other elements of the proposed project and will not be linked to the proposed wind farm access track network.

2.1.3 Grid Connection

The project will connect to the national grid from the onsite substation via underground 38kV cable to the Charleville 110kV substation in the townland of Rathnacally, County Cork. The cable will be installed along the public road**.** No overhead lines are proposed for this connection.

Further details of the proposed grid connection can be found in Section 3.1.4.

The proposed grid connection route is shown on Figure 2-2.

Path: R:\Map Production\2020\P2359\Workspace\CEMP\P2359_GIS_Fig2-1_TurbineDeliveryRoute_A3.mxd

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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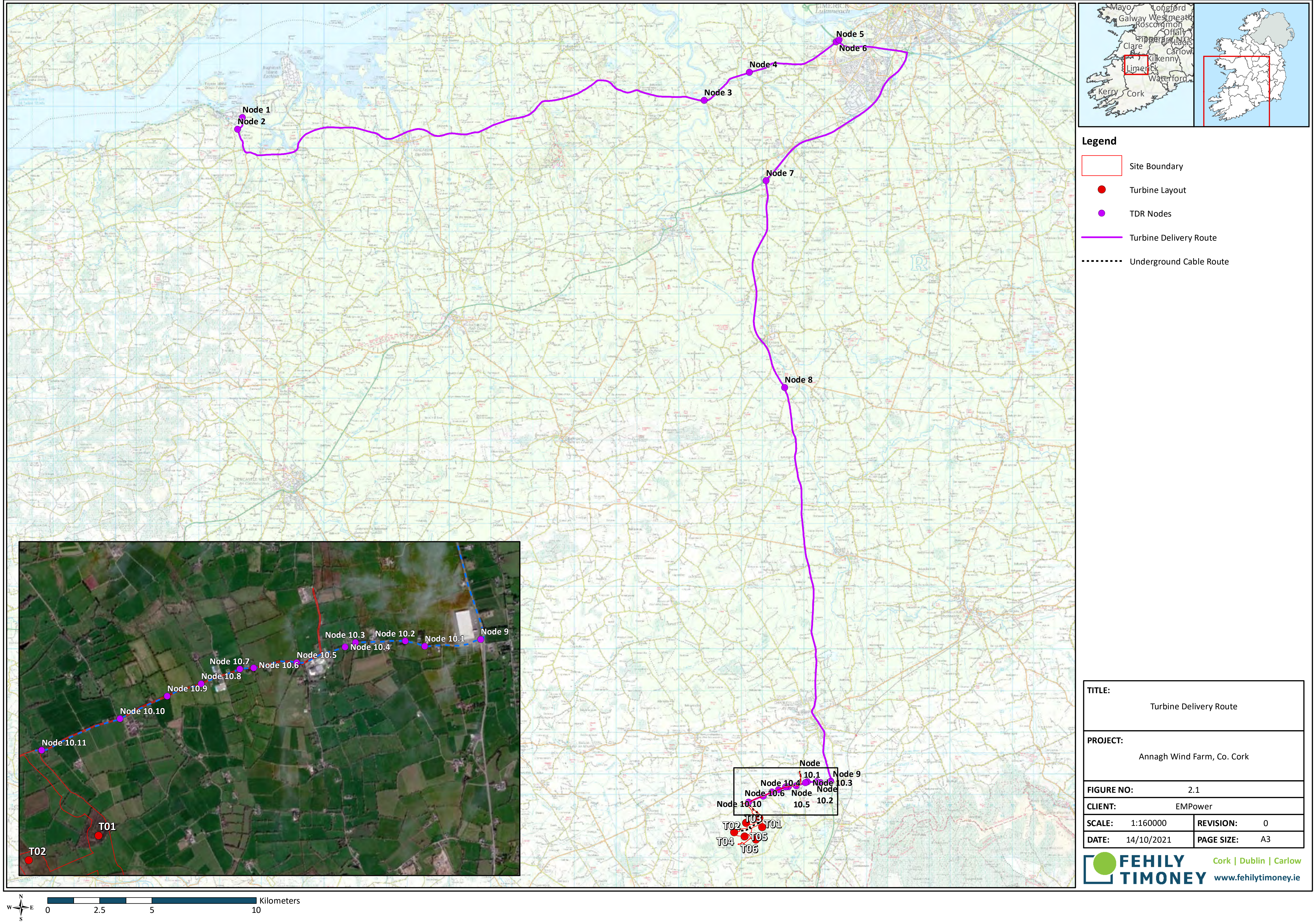

Legend

- Site Boundary
- Turbine Layout
- TDR Nodes
- Turbine Delivery Route
- Underground Cable Route

TITLE:	Turbine Delivery Route
PROJECT:	Annagh Wind Farm, Co. Cork
FIGURE NO:	2.1
CLIENT:	EMPower
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DATE: 14/10/2021	PAGE SIZE: A3

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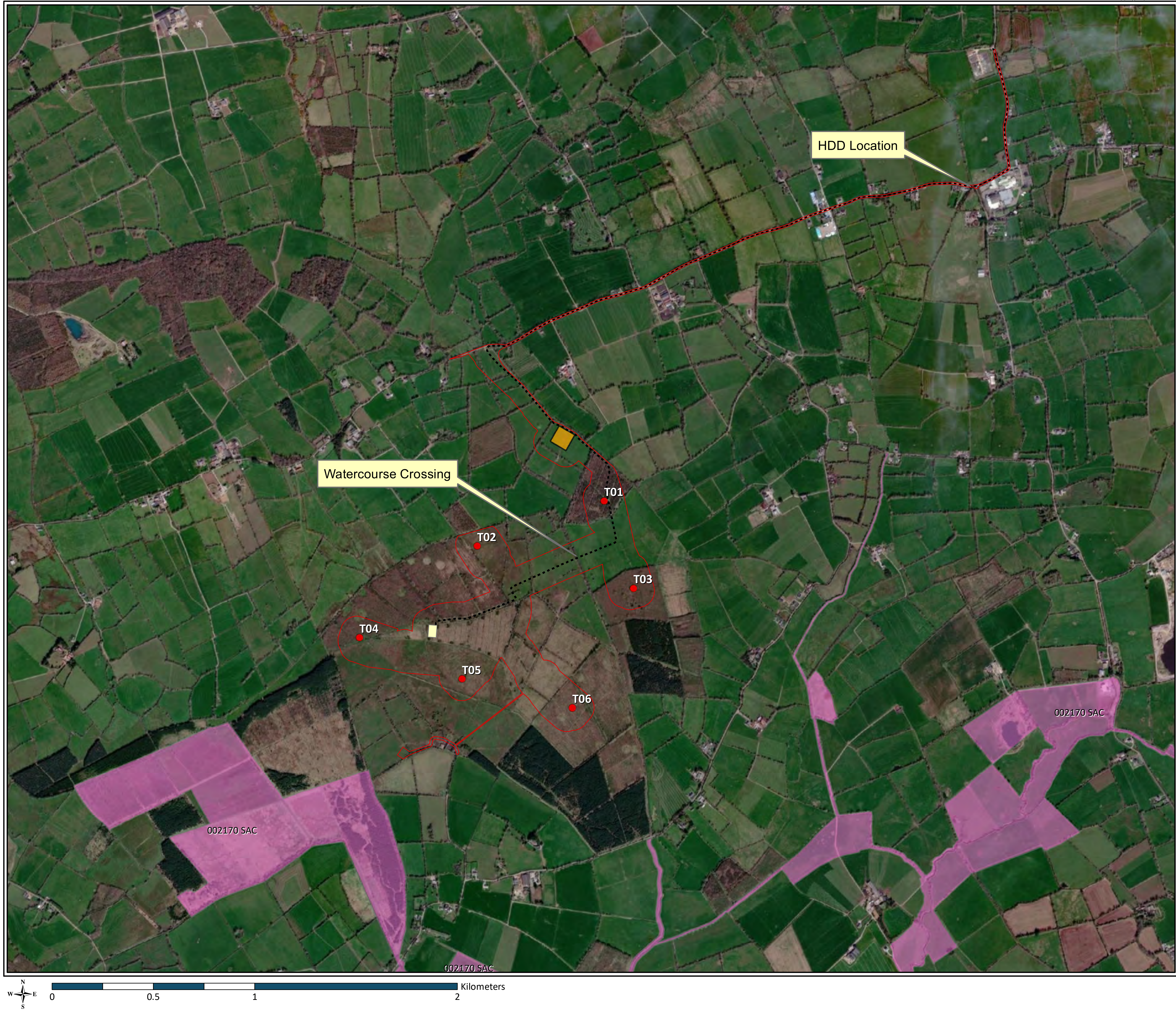

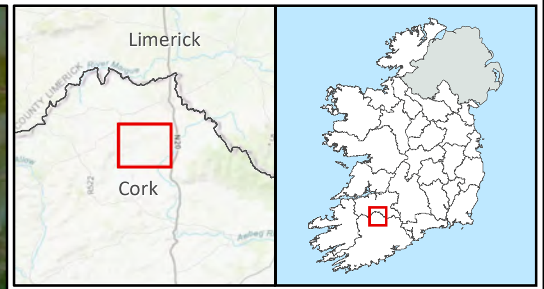

Legend

- Site Boundary
- Turbine Layout
- Underground Cable Route
- Substation
- Construction Compound
- Special Area of Conservation (SAC)

TITLE:	Grid Connection
PROJECT:	Annagh Wind Farm, Co. Cork
FIGURE NO:	2.2
CLIENT:	EMPower
SCALE: 1:18000	**REVISION:** 0
DATE: 14/10/2021	**PAGE SIZE:** A3

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2.2 Biodiversity

The area of the proposed wind farm is rural in nature with the closest settlements being Churchtown village c. 3 km south of the site and Ballyhea village located c. 3.6 km east of the site with the town of Charleville located c. 4.7 km north-east of the wind farm site. The proposed wind farm site is located at Annagh North, in a level depression to the west of the Ballyhoura Mountains. The land on which the proposed turbines are located ranges in elevation from 90 m OD to 110 m OD.

The wind farm site is largely covered in broadleaved forestry plantation, with wet grassland and improved agricultural grassland also present.

The following watercourses drain the proposed wind farm site:

The Fiddane Stream is a small, historically modified tributary of the Ardglass River which runs along the north-western land ownership boundary for approx. 0.5km

The Ardglass River is a small, historically modified tributary of the Awbeg River, to which it joined at Annagh Bridge. The short watercourse (2.6km length) river flows in a loosely north-south direction, forming the western land ownership boundary. The lowermost c.1km of the river forms a boundary of the Blackwater River SAC (002170).

The Awbeg River (west branch) is the major watercourse associated with the proposed Annagh development. The Awbeg flows in a loosely north-west-south-east direction and joined the River Blackwater south of Castletownroche, approx. 37.5km downstream of the proposed wind farm site. Much of the river's course is located within the Blackwater River SAC (002170)

The Oakfront River is a small, historically straightened tributary of the Awbeg, which it joins approx. 1.3km south of the bridge at Coolcaum. The Oakfront drains an area north of the proposed wind farm and flows through the centre of the site in a loosely north-south direction. The lowermost 1.3km of the river forms part of the Blackwater River SAC (002170)

The Rathnacally Stream is a small, historically straightened tributary of the Awbeg River (east branch), which adjoins the main (western) branch of the Awbeg at Scart Bridge. The TDR and GCR cross this watercourse via a local road bridge at Rathnacally, near Ardnageehy Cross Roads.

2.2.1 Sites of International and National Importance

Candidate Special Areas of Conservation (SACs) are protected under the European Union (EU) 'Habitats Directive' (92/43/EEC), as implemented in Ireland by the European Communities (Birds and Natural Habitats) Regulations, 2011

Special Protection Areas (SPAs) are designated under the EU Birds Directive (2009/147/EC) ('The Birds Directive').

There are two SACs within the potential Zone of Influence (ZoI) of the proposed Annagh Wind Farm Study Area. The Zone of Influence is described in Section 8.3.2.1 of Chapter 8. One of these is also within the potential ZoI of the GCR due to a hydrological linkage.

There are five SACs within the potential Zone of Influence (ZoI) of the TDR (including one SAC >500m from a TDR Node but with a hydrological linkage).

There are two SPAs within the potential Zone of Influence (ZoI) of the proposed Annagh Wind Farm Study Area.

There is one SPA within the potential Zone of Influence (ZoI) of the TDR.

There are three SPAs within the potential ZoI of the proposed replant lands at Emlagh, Co. Clare

Sites of National Importance in Ireland are termed Natural Heritage Areas (NHA) and proposed Natural Heritage Areas (pNHA).

No NHAs and seven pNHAs are present within 15 km of the proposed wind farm and grid connection route.

A further four pNHAs and no NHAs are present within the potential ZOI of the TDR. One of these pNHAs is over 20 km downstream but has been included in the initial identification of sites within the potential ZoI due to the hydrological linkage.

One NHA and nine pNHAs are within 15 km of the proposed replant lands.

A summary of relevant sites of importance is presented in Table 2-1 below:

Table 2-1: Summary of European Sites within potential ZoI of wind farm, GCR or TDR

Designated Site	Site code	Features of Interest	Distance to closest turbine (km)	Distance to grid connection (km)	Distance to TDR (km)
Blackwater River (Cork/Waterford) cSAC	002170	• Estuaries [1130] • Mudflats and sandflats not covered by seawater at low tide [1140] • Perennial vegetation of stony banks [1220] • Salicornia and other annuals colonising mud and sand [1310] • Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] • Mediterranean salt meadows (*Juncetalia maritimi*) [1410] • Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] • Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0] • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*	0.65 km	>500m (0.74 km straight line) (1.5 km in-stream)	>500m (1.9 km straight line) (1.5 km in-stream)

Designated Site	Site code	Features of Interest	Distance to closest turbine (km)	Distance to grid connection (km)	Distance to TDR (km)
		(*Alno-Padion, Alnion incanae, Salicion albae*) [91E0] • *Margaritifera* (Freshwater Pearl Mussel) [1029] • *Austropotamobius pallipes* (White-clawed Crayfish) [1092] • *Petromyzon marinus* (Sea Lamprey) [1095] • *Lampetra planeri* (Brook Lamprey) [1096] • *Lampetra fluviatilis* (River Lamprey) [1099] • *Alosa fallax fallax* (Twaite Shad) [1103] • *Salmo salar* (Salmon) [1106] • *Lutra lutra* (Otter) [1355] • *Trichomanes speciosum* (Killarney Fern) [1421]			
Ballyhoura Mountains SAC	002036	• Northern Atlantic wet heaths with Erica tetralix [4010] • European dry heaths [4030] • Blanket bogs (* if active bog) [7130]	8.2 km	>500m (6.8 km)	>500m (5.5 km)
Kilcolman Bog SPA	004095	• Whooper Swan (Cygnus cygnus) [A038] • Teal (Anas crecca) [A052] • Shoveler (Anas clypeata) [A056] • Wetland and Waterbirds [A999]	9.1 km	>500m (9.5 km)	>500m (9.2 km)
Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA	004161	• Hen Harrier (Circus cyaneus) [A082]	17.8 km	>500m (18 km)	>500m (5 km)
Lower River Shannon SAC	002165	• Sandbanks which are slightly covered by sea water all the time [1110] • Estuaries [1130] • Mudflats and sandflats not covered by seawater at low tide [1140] • Coastal lagoons [1150] • Large shallow inlets and bays [1160]	>15 Km (28.9 km)	>500m (27.0 km)	0 m (TDR route)

Designated Site	Site code	Features of Interest	Distance to closest turbine (km)	Distance to grid connection (km)	Distance to TDR (km)
		• Reefs [1170] • Perennial vegetation of stony banks [1220] • Vegetated sea cliffs of the Atlantic and Baltic coasts [1230] • Salicornia and other annuals colonising mud and sand [1310] • Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330] • Mediterranean salt meadows (Juncetalia maritimi) [1410] • Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260] • Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae) [6410] • Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0] • Margaritifera margaritifera (Freshwater Pearl Mussel) [1029] • Petromyzon marinus (Sea Lamprey) [1095] • Lampetra planeri (Brook Lamprey) [1096] • Lampetra fluviatilis (River Lamprey) [1099] • Salmo salar (Salmon) [1106] • Tursiops truncatus (Common Bottlenose Dolphin) [1349] • Lutra lutra (Otter) [1355]			
River Shannon and River Fergus Estuaries SPA	004077	• Cormorant (Phalacrocorax carbo) [A017] • Whooper Swan (Cygnus cygnus) [A038] • Light-bellied Brent Goose (Branta bernicla hrota) [A046] • Shelduck (Tadorna tadorna) [A048] • Wigeon (Anas penelope) [A050] • Teal (Anas crecca) [A052] • Pintail (Anas acuta) [A054]	>15 Km (34.5 km)	>500m (32.5 km)	0 m (TDR route) 360m (TDR Node 5) 380m

Designated Site	Site code	Features of Interest	Distance to closest turbine (km)	Distance to grid connection (km)	Distance to TDR (km)
		• Shoveler (Anas clypeata) [A056] • Scaup (Aythya marila) [A062] • Ringed Plover (Charadrius hiaticula) [A137] • Golden Plover (Pluvialis apricaria) [A140] • Grey Plover (Pluvialis squatarola) [A141] • Lapwing (Vanellus vanellus) [A142] • Knot (Calidris canutus) [A143] • Dunlin (Calidris alpina) [A149] • Black-tailed Godwit (Limosa limosa) [A156] • Bar-tailed Godwit (Limosa lapponica) [A157] • Curlew (Numenius arquata) [A160] • Redshank (Tringa totanus) [A162] • Greenshank (Tringa nebularia) [A164] • Black-headed Gull (Chroicocephalus ridibundus) [A179] • Wetland and Waterbirds [A999]			(TDR Node 6)
Barrigone SAC	000432	• Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) [6210] • Limestone pavements [8240] • Euphydryas aurinia (Marsh Fritillary) [1065]	>15 Km (37.2 km)	>500m (37.0 km)	0 m (TDR route)
Curraghchase Woods SAC	000174	• Taxus baccata woods of the British Isles [91J0] • Vertigo moulinsiana (Desmoulin's Whorl Snail) [1016] • Rhinolophus hipposideros (Lesser Horseshoe Bat) [1303]	>15 Km (31.5 km)	>500m (30.1 km)	0 m (TDR route)
Askeaton Fen Complex SAC	002279	• Calcareous fens with Cladium mariscus and species of the Caricion davallianae [7210] • Alkaline fens [7230]	>15 Km (30.8 km)	>500m (29.7 km)	0 m (TDR route)

2.2.1 Habitat Evaluation Summary

The habitats within the proposed wind farm site are dominated by Mixed Broadleaved Woodland WD1, Mixed Broadleaved/Conifer Woodland WD2, Immature Woodland WS1 (all the preceding are plantations of recent origin), Wet Grassland GS4 and Improved Agricultural Grassland GA1.

The dominant habitat along the GCR outside the wind farm site is Buildings and artificial surfaces BL3 represented by road surfaces, bounded by Dry meadows and grassy verges GS2. The roads are also bounded by Hedgerows WL1, Treelines WL2 and a mosaic of these habitats. Other habitats abutting the grid connection include Improved agricultural grassland GA1, Scrub WS1, Amenity grassland GA2, Flower beds and borders BC4, Spoil and bare ground ED2, Stone walls and other stonework BL1 and Buildings and artificial surfaces BL3. The GCR intersects Lowland rivers FW2 within the wind farm site (Oakfront stream) and along the L1322 local road (Rathnacally Stream). The Rathnacally bridge is categorised as Buildings and artificial surfaces BL3. The habitats along the GCR are subject to disturbance due to their close proximity to roads and dwellings.

The habitats at TDR Nodes include Buildings and artificial surfaces, BL3 Ornamental/non-native shrub WS3, Improved agricultural grassland GA1, Hedgerows WL1, Mixed broadleaved woodland WD1, Stone walls and other stonework BL1 (bridge structure), Tidal Rivers CW2, Amenity grassland GA2, Dry meadows and grassy verges GS2, Amenity grassland GA2, Immature woodland WS2, Hedgerows/Mixed broadleaved woodland mosaic WL1/WD1, Hedgerow/Treeline mosaic WL1/WL2, Drainage ditches FW4, Dry meadows and grassy verges/Earth banks mosaic GS2/BL2, Treelines WL2 and Wet Grassland GS4. Similar to the GCR, the habitats at TDR Nodes are subject to disturbance due to their proximity to roads and dwellings.

Habitats evaluated as Local Importance (Higher Value) and above which are within the development footprint or zone of influence of proposed infrastructure are classified as key receptors, while habitats outside the development footprint or zone of influence or those within the development footprint evaluated as Local Importance (Lower Value) are not classified as key receptors.

2.2.2 Invasive Species Recorded

The Main Wind Farm Site

Cherry laurel is present at the proposed site entrance. This species has been planted along the L1322 road/field boundary where an older hedgerow has been cut back.

Sycamore is present at the proposed site entrance.

Montbretia is present on the banks of the Oakfront river near the site entrance. This area is outside the proposed development footprint. The invasiveness of this species has not been assessed by the National Biodiversity Data Centre (NBDC), however this species is known to be a successful invader of grassy margins and other open habitats.

The non-native species Wilson's honeysuckle *Lonicera nitida* is also present at the proposed site entrance. The invasiveness of this species has not been assessed by the NBDC and as such it is noted here on a precautionary basis.

The Grid Connection

A total of three invasive species were recorded along the grid connection route. These were cherry laurel (high risk; one location), snowberry Symphoricarpos albus (low risk of impact; common along route) and sycamore (medium risk) which is also common along the route. No Schedule III listed species are present along the route.

In addition, two further non-native species whose invasiveness has not yet been assessed, Wilson's honeysuckle and flowering currant Ribes sanguineum are present in association with older dwellings along the route.

Table 2-2: Invasive and non-native species recorded along the proposed grid connection route

Species	Invasive Impact	Legal Status
Snowberry *Symphoricarpus albus*	Low Risk	None
Sycamore Acer pseudoplatanus	Medium Risk	None
Cherry laurel *Prunus laurocerasus*	High Risk	None
Montbretia *Crocosmia x crocosmiiflora*	Not Assessed	None
Flowering currant *Ribes sanguineum*	Not Assessed	None
Wilson's honeysuckle *Lonicera nitida*	Not Assessed	None

Turbine Delivery Route (TDR)

Botanical / Habitat surveys along the TDR was undertaken between 10th – 11th June 2021. Survey effort during the walkover of the TDR focussed on turbine delivery work locations (nodes) where vegetation trimming/clearance or enabling works are proposed to accommodate the TDR.

A total of nine invasive species were recorded across eleven locations along the TDR. Of these nine invasive species one is classified as High Risk, four are Medium Risk and four are Low Risk. See Table 2-3 for more information. One of the Low-Risk species, Spanish bluebell, is also a Third Schedule listed species. This was located outside the TDR footprint however, c. 10m from the load bearing area at Node 4 Clarina Roundabout.

Table 2-3: Invasive & non-native species recorded along the TDR

Species	Invasive Impact	Location
Node 1 – Port Exit		
No vegetation present. No invasive species.		
Node 2 – Port Access Road/N69		
Red osier dogwood *Cornus sericea*	Low Risk	Node 2.0 - Ornamental planting in oversail area footprint
Old man's beard *Clematis vitalba*	Medium Risk	Node 2.0 - Growing in pine tree in oversail area footprint
Butterfly bush *Buddleja davidii*	Medium Risk	Node 2.3 - Ornamental planting immediately adjacent to outer extent of trailer path
Node 3 - Ferrybridge		
No vegetation present. No invasive species.	-	-
Node 4 – Clarina Roundabout		
Norway maple *Acer platanoides*	Low Risk	Ornamental planting in load bearing footprint
Spanish bluebell *Hyacinthoides hispanica*	Low Risk/ Schedule III	Ornamental outside load bearing footprint (c. 10m away)
Node 5 -Mungret Interchange – Western Roundabout		
Norway maple *Acer platanoides*	Low Risk	Ornamental planting in load bearing footprint
Small-leaved lime *Tilia cordata*	Not assessed	Ornamental planting outside load bearing & oversail footprint
Node 6 -Mungret Interchange – Eastern Roundabout		
Norway maple *Acer platanoides*	Low Risk	Ornamental planting outside load bearing & oversail footprint
Small-leaved lime *Tilia cordata*	Not assessed	Ornamental planting outside load bearing & oversail footprint
Node 7 – M20/N20 Off-ramp Southbound		
Red osier dogwood *Cornus sericea*	Low Risk	Ornamental planting in oversail area footprint
Turkey oak *Quercus cerris*	Medium Risk	Ornamental planting in oversail area footprint
Node 8 – N20 Right Curve Ballymacrory		
No invasive species.	-	-
Node 9 – N20/L1322 Junction Ballyhea		
No invasive species.	-	-

Species	Invasive Impact	Location
Node 10 – L1322		
Sycamore *Acer pseudoplatanus*	Medium Risk	Node 10.3 – in hedgerow in oversail area footprint; Node 10.5 – grassy bank/hedgerow in oversail area footprint; Node 10.10 – grassy bank/hedgerow in oversail area footprint
Wilson's honeysuckle *Lonicera nitida*	Not assessed	Node 10.3 – in hedgerow in oversail area footprint Node 10.11 – in woodland in bell-mouth entrance footprint
Cherry laurel *Prunus laurocerasus*	High Risk	Node 10.6 – in garden immediately adjacent to oversail area footprint
Snowberry *Symphoricarpus albus*	Low Risk	Node 10.9 – in hedgerow in oversail area footprint; Node 10.10 – in hedgerow in oversail area footprint

Aquatic Surveys

During aquatic surveys Montbretia was recorded in the area of the following survey sites/waterbody:

- Site B2 – Oakfront River, Cooliney Bridge

For further information on the existing ecological environment at the project site, refer to Chapter 8 of the EIAR.

2.3 Land, Soils and Geology

The land use across the site is predominantly made up of agricultural lands and mature forest.

The subsoils across the site comprise of Alluvium, Till derived from Namurian Sandstones and Shales and Bedrock outcrop or subcrop.

The slopes of the southern portion of the proposed development site are characterised by elevated lands with gentle slopes and typical elevations of between 90m to 110m AOD. Slopes within the proposed site and at proposed infrastructure locations generally comprise gentle slopes of between 1 to 4 degrees. Slopes at proposed turbine locations are classed as gentle (<3 degrees).

Based on the GSI aquifer vulnerability mapping, overburden deposits are generally <10 m deep across the majority of the site.

From a review of the GSI Landslide Susceptibility database, the proposed development and proposed infrastructure locations are located within areas of 'Low' susceptibility.

No evidence of slope instability was observed at the site and there are no historical records of landslide activity within or close to the site, on the GSI database. Detailed information on land, soils and geology is provided in Chapter 9 of EIAR.

2.4 Hydrology & Water Quality

The wind farm site is situated within Awbeg (Buttevant)_SC_010 sub-catchment as defined by the WFD. This sub-catchment is part of the Blackwater Munster (ID 18) catchment.

The wind farm site is situated within two sub-basins as defined by the WFD. These waterbodies are known as:

- Awbeg (Buttevant)-West_020 (IE_SW_18A090400),
- Oakfront_010 (IE_SW_18O120820).

The main hydrology features within the wind farm site are the Ardglass Stream and Oakfront Stream which drain into the River Awbeg (Buttevant) West approximately 1.3km downstream of the site. This river is part of the Blackwater River (Cork/Waterford) SAC.

The OPW has produced indicative flood mapping to assist in a preliminary flood risk assessment (PFRA). The indicative flood mapping for Annagh Wind Farm is shown in Figure 2-3.

The proposed development is within flood zone A. However, the majority of the site is within flood zone C. Turbines and substation are located within Flood zone C. According to the FRA, the proposed crossing point over the Oakfront stream does not flood for 1% AEP MRFS event. This will allow for the site to be accessed during extreme storm events. The proposed substation will have a drainage system in place to mitigate the potential risk of flooding at the sub-station and downstream of it. The proposed on-site substation is within flood zone C.

Existing hydrological features recorded within the site area are shown on Figure 2-4.

WFD water quality status and river waterbody risk within the study area is provided in Table 2-4:

Table 2-4: River Status and River Waterbody Risk

Waterbody	Waterbody	River Status	Waterbody Risk
Wind Farm			
Awbeg (Buttevant)-West_020	IE_SW_18A090400	Poor	At Risk
Oakfront_010	IE_SW_18O120820	Unassigned	Review
Grid Connection			
Oakfront_010	IE_SW_18O120820	Unassigned	Review
Awbeg (Buttevant)_010	IE_SW_18A050550	Good	Review

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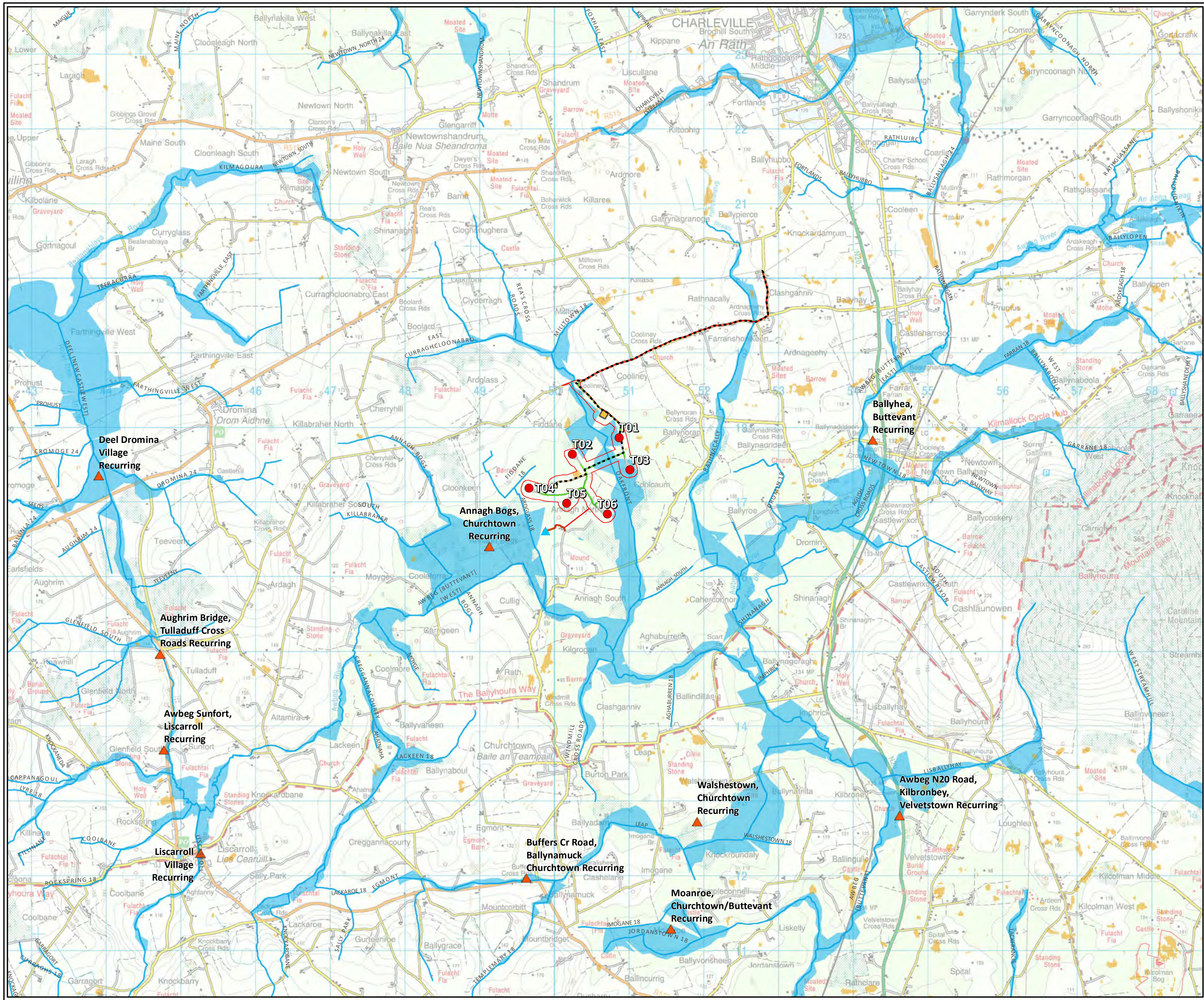

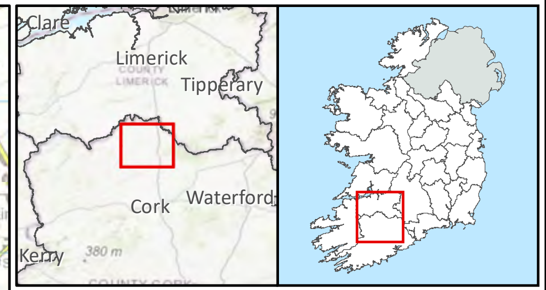

Legend

- Site Boundary
- Turbine Layout
- Met Mast
- Underground Cable Route
- Substation
- Construction Compound
- Turbine Hardstanding
- OPW Historic Flood Points
- Rivers
- PFRA 1% AEP Pluvial Flood Extent
- PFRA 1% AEP Fluvial Flood Extent

Roads

- New
- Upgrade

TITLE:	OPW Flood Data
PROJECT:	Annagh Wind Farm, Co. Cork
FIGURE NO:	2.3
CLIENT:	EMPower
SCALE: 1:50000	REVISION: 0
DATE: 14/10/2021	PAGE SIZE: A3

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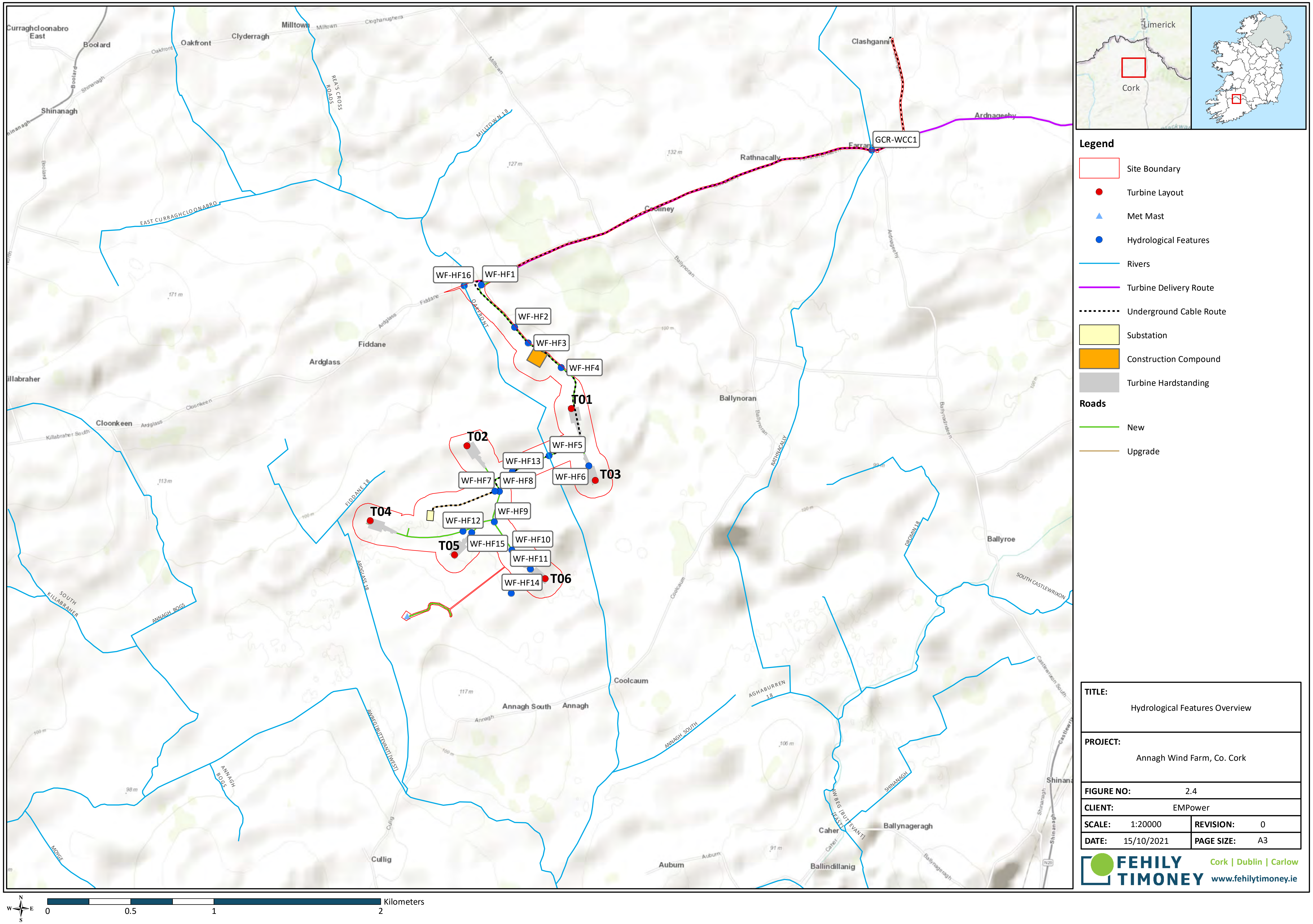

TITLE:	Hydrological Features Overview
PROJECT:	Annagh Wind Farm, Co. Cork
FIGURE NO:	2.4
CLIENT:	EMPower
SCALE:	1:20000
REVISION:	0
DATE:	15/10/2021
PAGE SIZE:	A3

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2.5 Archaeological, Architectural and Cultural Heritage

There are no recorded archaeological sites located on the footprint of proposed construction areas within the Site while there are 23 known examples within the surrounding 1km study area. There are also six recorded archaeological sites in the lands located within 100m of either side of the local road extending to the east of the Site which will form sections of grid connection and turbine delivery routes. See Table 14-5 and 14-9 of chapter 14 of the EIAR for details.

The proposed Wind Farm will have no impact on any UNESCO World Heritage sites or candidate sites.

There is one recorded archaeological site located within close proximity to a proposed work area and this is a Mound site (CO007-043----) in a field adjacent to an existing farm lane in the south end of the Site. The existing hedgerow between the Mound site and the lane will be maintained during the upgrade of this farm lane. There are no other recorded archaeological sites or architectural heritage structures located within close proximity to any proposed construction areas and no indirect negative impacts are predicted to arise during the construction phase.

The locations of all recorded archaeological sites within the fields in the environs of construction areas will be cordoned off and the outer edges of their Zones of Notification clearly signed as 'No Entry: Archaeological Areas' for the duration of the construction phase. These onsite constraints comprise Ringfort CO007-072001-, Enclosures CO007-072002- and CO007-074----, Fulacht Fia CO007-175---- and Mound CO007-073----. The locations of the two derelict, late 19th century farmyards will also be clearly marked as no entry areas. Onsite work crews will be notified of these locations during onsite inductions. Their locations will be subject to inspections by the appointed archaeologist at regular intervals during the construction phase to ensure that the protective measures are being successfully implemented.

There are no recorded archaeological sites or architectural heritage structures located on the footprint of the grid connection route and it does not extend into any historical villages or towns. The grid connection will entail a cable trench excavated into the existing roadway surface which will result in no predicted direct impacts on the known cultural heritage resource. While the potential for the survival of unrecorded subsurface archaeological remains beneath the constructed road surface is deemed to be low, the potential for direct impacts on any such remains cannot be entirely discounted, particularly within the sections of the road located in the general environs of known archaeological sites.

3. OVERVIEW OF CONSTRUCTION WORKS

3.1 Description of the Proposed Project

3.1.1 Overall Project

The proposed project consists of three main elements:

- Main Wind Farm Site;
- Turbine Delivery Route (TDR);
- Grid connection;

In summary the proposed project will consist of the following:

- Erection of 6 no. wind turbines with a blade tip height of 175m, rotor diameter of 150m and a hub height of 100m;
- Construction of turbine foundations and crane pad hardstanding areas;
- Construction of new site tracks and associated drainage infrastructure;
- Upgrading of existing tracks and associated drainage infrastructure where necessary including upgrade of entrance onto Local Road L1322.
- All associated drainage and sediment control including the installation of new watercourse or drain crossings and the re-use or upgrading of existing internal watercourse and drain crossings;
- Construction of 1 no. permanent onsite 38kV electrical substation to ESBN specifications including:
  - Control Building with welfare facilities;
  - Electrical infrastructure;
  - Parking;
  - Wastewater holding tank;
  - Rainwater harvesting;
  - Security fencing;
  - All associated infrastructure, services and site works.
- Temporary accommodation works associated with the Turbine Delivery Route to facilitate the delivery of turbine components;
- 1 no. Temporary construction site compound and associated ancillary infrastructure including parking;
- Tree felling and associated replanting to facilitate construction and operation of the proposed development;
- Installation of underground medium voltage (20/33kV) and communication cabling between the proposed turbines and the proposed on-site substation and associated ancillary works;
- Erection of 1 no. permanent meteorological mast with a height of 100m above ground level and associated access track;

- Installation of medium voltage (up to 38kV) underground cabling between the proposed on-site substation and the existing Charleville substation and associated ancillary works. The proposed grid connection cable works will include 2 no. watercourse crossings and the installation of 9 no. pre-cast joint bays;
- All associated site development works;
- A 10 year planning permission and 35 year operational life from the date of commissioning of the entire wind farm.

3.1.2 Main Wind Farm Site Layout

The main wind farm site layout is shown in **Figure 1-2.** The co-ordinates of each turbine are detailed in Table 3-1 in Irish Transverse Mercator (ITM):

Table 3-1: Proposed Turbine Coordinates

Turbine ID	ITM Coordinates	
	X	Y
T1	550828	617916
T2	550202	617693
T3	550973	617485
T4	549622	617242
T5	550128	617038
T6	550672	616895

3.1.3 Turbine Delivery Route

Large components associated with the wind farm construction will be transported to site via the identified turbine delivery route (TDR). The proposed access route to site is as follows:

- Loads will depart the Port of Foynes and turn left onto the N69 towards Limerick;
- Loads will travel onto the N18 and turn onto the M20/N21;
- Loads will turn onto the N20 and travel south through the town of Charleville
- The route then turns onto the L1322 local road at Ballyhea; and
- The route continues westwards on the L1322 for approx. 4km before entering the proposed wind farm site.

The general location of accommodation works locations, or TDR nodes, are shown in Figure 2-1. The works required at each POI are assessed throughout this EIAR. Many of the POIs can be accommodated through a road opening licence. POIs which require planning consent do not form part of this application for planning permission but are assessed as part of the project.

The location and nature of proposed temporary accommodation works are described in further detail in Chapter 13.

3.1.4 Grid Connection

Electricity generated from wind turbines shall be collected at medium voltage (20/33 kV) by an internal circuit of buried cables which will follow on-site access tracks. This circuit shall be terminated at the proposed onsite substation and exported to the grid via a 38 kV buried cable to the existing Charleville substation, located in the townland of Rathnacally, County Cork. This section describes the 38 kV underground grid connection between the proposed onsite substation and the existing Charleville substation.

The proposed wind farm will have an export capacity of Approximately 37.2 MW, depending on final turbine technology installed. Connection will be sought under the Enduring Connection Process (ECP) grid access regime. The cable will be installed in private lands at the wind farm site where it leaves the on-site substation and will be installed in the proposed access tracks. The cable route will then enter the L1322 public road at the proposed site entrance. The route then continues for 3.4km east then turning north along an unnamed local road towards the Charleville 110kV Substation. This section of the route will be installed within the public road. The proposed grid connection route (GCR) is shown in Figure 2-2. No overhead lines are proposed for this connection.

There is 1 no. watercourse crossing located along the public road and there is 1 no. watercourse crossing located at the Wind Farm Site within private lands. These watercourse crossings are described in Section 3.3.1.6.

Connection works to Charleville substation will involve the installation of ducting, joint bays, drainage and ancillary infrastructure and the subsequent running of cables predominantly along the existing road network. This will require delivery of plant and construction materials, followed by excavation, laying of cables and subsequent reinstatement of trenches.

It is expected that full road closures will be put in place to facilitate cabling works in combination with lane closures, partial road closures and stop/go systems. This will enable the works to be completed as quickly and as safely as possible, with minimal disruption time for residents of the area. These works shall be undertaken on a rolling basis with short sections closed for short periods before moving onto the next section. This is described in more detail in Chapter 13 of the EIAR - Traffic and Transportation.

3.1.4.1 Onsite Electricity Substation

A permanent onsite electricity substation will be constructed within the proposed wind farm site as shown in Figure 1-2. This will provide a connection point between the wind farm and the proposed grid connection point at the existing Charleville Substation.

Electricity generated from wind turbines shall be collected at medium voltage (20/33 kV) by an internal circuit of buried cables which will follow on-site access tracks. This circuit shall be terminated at a proposed onsite substation and exported to the grid via a 38 kV buried cable to the existing Charleville substation.

The dimensions of the substation compounds will be approximately 50m x 25m and will include a substation control building and electrical components necessary to export the electricity generated from the wind farm to the national grid. The substation compound will be surrounded by a ca. 2.5 metre high steel palisade fence and internal fences will also be provided to segregate different areas within the main substation compound.

Lighting will be required on site and this will be provided by lighting poles located around the substation and exterior wall mounted lights on the control buildings.

The control building located within the substation compound will measure approximately 22m by 8m and 6m in height. The control building will include the Independent Power Production (IPP) and grid operator control rooms, an office space and welfare facilities for staff during the operational phase of the wind farm. As a result, there will be a small water requirement for occasional toilet flushing/hand washing with a rainwater harvesting tank adjacent to the control building.

A wastewater holding tank will be provided outside the substation compound fence line so that it can be maintained where required without requiring access to the substation compound. The wastewater holding tank will be a sealed storage tank with all wastewater transported by tanker off site as required by an authorised waste collector to a wastewater treatment plant. Only waste collectors holding valid waste collection permits under the Waste Management (Collection Permit) Regulations, 2007, will be employed to transport wastewater away from the site. The proposed wastewater storage tank will be fitted with an automated alarm system that will provide sufficient notice that the tank requires emptying. The wastewater storage tank alarm will be part of a continuous stream of data from the site's turbines, wind measurement devices and electricity substation that will be monitored remotely 24 hours a day, 7 days per week. This approach for managing wastewater on site has become standard practice on wind farm sites, which are often proposed in areas where finding the necessary percolation requirements for on-site treatment can be challenging and has been accepted by numerous Planning Authorities and An Bord Pleanála as an acceptable proposal.

3.1.4.2 Electrical Cabling

Electricity generated from wind turbines shall be collected at medium voltage (20/33kV) by an internal circuit of buried cables which will follow on-site access tracks. This circuit shall be terminated at a proposed onsite substation. Electricity generated from the site will be exported to the grid via a 38kV buried cable to the existing Charleville substation. The grid connection location is shown in Figure 2-2.

Internal collector circuit cable routes follow the alignment of the internal access tracks.

The electricity will be transmitted as a three-phase power supply so there will be three individual conductors (or individual cables) in each cable circuit. The three conductors will each be laid in separate ducts which will usually be laid in a trefoil formation but may also be laid in a flat formation at stream/drain crossings, or where cabling crosses other on-site cables. The specification for the cables and cable-laying will be in accordance with ESBN requirements.

The width of a cable trench with a trefoil formation will be 600mm, a flat formation requires a wider trench width of 1040mm. The depth of cover to the ducts carrying the cables will usually be up to 950mm cover to the top of the upper duct in public roadways and grassed areas.

The depth of trench for the cables will be up to 1220mm. However, in certain instances, for example when crossing a bridge with shallow cover, a shallower depth of 450-950mm could be utilised. In those circumstances, the particular design will be agreed with ESBN and additional cable protection measures such as steel plates or reinforced concrete cover may be required.

Cables laid within the site in field locations adjacent access tracks will be laid to a depth of 1100mm to the top of the upper duct. The diameter of the ducting will be selected to suit the range of cross-sectional areas of electrical cables and is likely to fall between 100mm and 200mm diameter.

3.2 Construction Period

It is expected that the construction phase, including civil, electrical and grid works, and turbine assembly will take between approximately 12 – 18 months. The proposed construction programme upon which assessments in the EIAR have been based is presented in Figure 3-1 below:

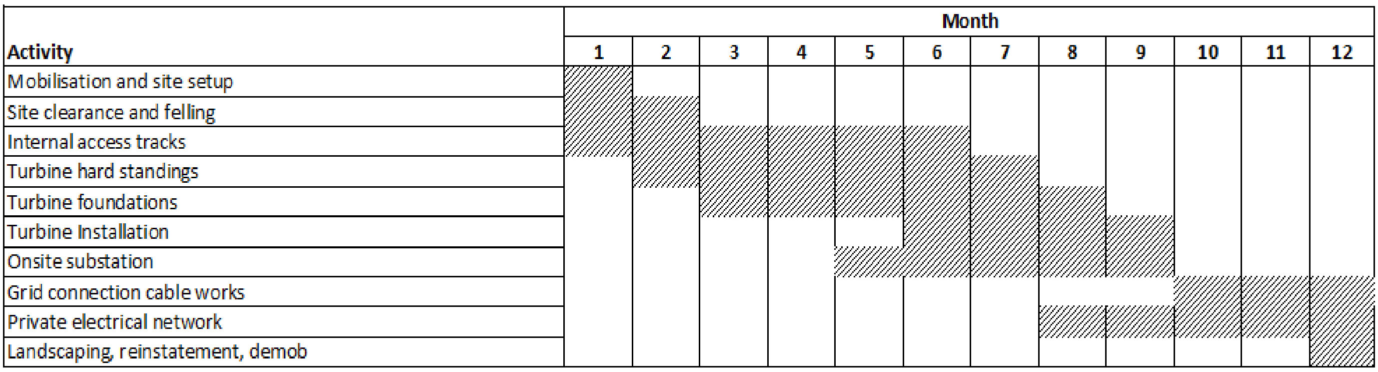

Figure 3-1: Proposed Construction Programme

The layout of the site lends itself to clearly defined phases (civil construction, cables, turbines, on-site substation) where the various work elements can overlap without a significant increase in local traffic movements or congestion on site.

The final programme will be developed post planning in consultation with the turbine manufacturer and the main construction contractor, based on projected turbine delivery dates.

3.3 Overview of the Construction Sequence

The construction of a wind farm project is a significant infrastructural project. The construction of this project will involve many inter-related, inter-dependent and overlapping elements of a complex nature.

The following section outlines the construction methodology for the proposed project. Upon mobilisation for the construction of the development, upgrading of existing site tracks, felling and the provision of new site tracks will precede all other activities. Drainage infrastructure will be constructed in parallel with the track construction. Typically, this will be followed by the construction of the turbine foundations and the provision of the hardstanding areas. In parallel with these works the on-site electrical works; sub-station and internal cable network are constructed. The proposed grid connection cable route works will commence following the completion of the proposed on-site wind farm works.

3.3.1 Overview of the Construction Methodology

Method statements are presented below for the key elements of the construction process. Please note that the contractor for the main construction works will, following appointment, take ownership, expand upon and generally develop these method statements.

The proposed construction methodology is summarised under the following headings:

- Site Entrance
- Temporary Site Compound
- Concrete Washout Area and Wheel Washing
- New Site Access Tracks
- Upgrade of Existing Internal Access Tracks
- Watercourse Crossings
- Cable Works
- Crane Hardstands
- Turbine Foundations
- Substation Compound
- Electrical Works
- Turbine Erection
- Grid Connection works
- Felling

3.3.1.1 Site Entrance

Prior to the commencement of any other works, Site Entrance upgrade works will be carried out. The site entrance shall be designed in accordance with TII design standard DN-GEO-03060: Geometric Design of Junctions (TII, June 2017). Upgrade works will consist primarily of surface improvements. Felling of an existing treeline will be required to improve visibility and allow for large turbine components to be delivered to site.

The site entrance will be secured and locked when not in use. Where required, the entrances will be controlled by flagmen to assist traffic movements.

3.3.1.2 Temporary Site Compound

During the construction phase, it will be necessary to provide temporary facilities for construction personnel. Annagh will have 1 no. temporary compound located near the entrance to the site which will include welfare facilities and offices. The location of the temporary site compound is shown in Figure 1-2. A wheel wash facility will be provided within the temporary compound area.

The temporary compound shall be an aggregate hard standing, located as shown on the accompanying drawings. Temporary facilities will be removed, and the lands reinstated on completion of the construction phase.

Facilities to be provided in the temporary site compounds will include the following:

- site offices, of portacabin type construction
- portaloos
- bottled water for potable supply
- a water tanker to supply water used for other purposes
- canteen facilities
- storage areas
- employee parking
- bunded fuel storage
- contractor lock-up facility
- diesel generator
- waste management areas

3.3.1.3 Concrete Washout Area and Wheel Washing

All concrete will be delivered to site via ready-mix trucks from a local supplier.

Concrete washout will be carried out in a dedicated area of the temporary compound or at a designated washout pit on site. Only the washing of chutes will be permitted. Every concrete truck delivering concrete to the site must use the concrete washout facility prior to leaving the site. Chutes will be washed out at the designated area with a settlement lagoon provided to receive all run-off.

The concrete wash-out area will be constructed as follows:

- The topsoil and subsoil, if necessary, will be stripped out and placed adjacent to the temporary compound area.
- An impermeable membrane will be installed directly onto the subsoil, and or subsoil, to form the impermeable concrete wash-out settlement lagoon.
- A designated truck wash-down concrete apron shall be constructed next to this settlement lagoon.
- Impermeable lined drains will direct the wash-out flow to the wash-out settlement lagoon.
- The residual liquids and solids will be disposed of off-site at an appropriate licenced waste facility.

Upon completion of the projects the concrete wash-out area and settlement lagoon will be decommissioned by removing the impermeable membrane and backfilling the area with the material arising during excavation. The removed material will be recovered or disposed of off-site at an appropriate facility.

Wheel wash facilities will be located at the site entrance to reduce construction traffic fouling public roads. Each wheel wash will come with an additional water tank which will be filled regularly. These units will be self-contained and will filter the waste for ease of disposal. Waste will be removed from each unit and from site by a proposed contractor.

3.3.1.4 New Site Access Tracks

All site tracks will be designed taking account of the loadings required by the turbine manufacturer and will consist of a compacted stone structure. Suitable granular fill material for the sub-base of the track will be imported from a licensed quarry as required to meet the requirements of the detailed design. Class 6F2 and clause 804 granular material for track base course and running surface will be imported from a licensed quarry.

All delivery truck movements from external sources will follow the predefined haul route as agreed with Cork County Council. The proposed haul route is illustrated in Figure 3-2.

All tracks on the site will be constructed using the traditional track construction and best practice construction methods from suitable load bearing strata. This system will consist of either one or two layers of stone depending on the load bearing capacity of the base layer. Where the underlying layer is mineral subsoil, two layers of stone are used; a stone capping layer and running layer. In areas where the load bearing layer is rock, the capping layer is omitted, and the running layer is installed directly onto the rock surface. Drainage runs and associated settlement ponds will be installed.

Track construction details shall be as follows:

- Establish alignment of the new site tracks from the construction drawings and mark out the centrelines with ranging rods or timber posts.
- The access tracks will be of single-track design with an overall width of up to 5m. There will be some local widening on the bends to a width of 5.6m. Widening at junctions and around Turbine Foundations will also be necessary for the safe passage of large vehicles. All bends have been designed to suit the requirements of the delivery vehicles. The access track to the proposed permanent met mast will be 3.5m wide as larger vehicles will not be required to access this area.
- All machinery shall work within designated construction areas indicated on the contract drawings. Vehicle movement will be restricted to site access tracks and agreed haul routes.

All access for construction vehicles within the site shall follow the proposed internal access tracks as shown in Figure 1-2.

- Topsoil/subsoil will be stripped back to required levels. All material will be bunded and stored separately. Section 4.3.5 contains a Soil Management Plan which details the storage and movement of materials on site.
- The soil will be excavated down to a suitable formation layer of either firm subsoil or rock.
- Well-graded granular fill will be spread and compacted in layers to provide a homogeneous running surface. The thickness of layers and amount of compaction required will be decided by the Site Manager based on the characteristics of the material and the compaction plant to be used.
- Batters will have a slope of between 1:1 and 1:5 (depending on depth and type of material) and will be left as cut to re-vegetate naturally with local species.

3.3.1.5 Upgrade of Existing Internal Access Tracks

Figure 1-2 illustrates the internal access tracks within the main wind farm site. The proposed internal site track layout will permit access for vehicles during the construction phase, for maintenance during the operational phase and for vehicles to decommission the turbines at the end of the life of the development.

Existing access tracks have been utilised wherever possible for the proposed project.

All access tracks will be 5m wide along straight sections and wider at bends up to 5.6m in width. The tracks will be finished with a well graded aggregate. The drainage system will be installed adjacent to the internal access tracks. Existing drainage infrastructure will be maintained and upgraded where necessary.

The need for floating roads is not expected at this site.

It is proposed that the stone required for the construction of the internal access roads will be sourced from licenced quarries in the vicinity.

Access track formation will consist of a minimum 500mm hardcore on geo-textile membrane. The predicted construction methodology for upgraded tracks will be as follows:

- The formation will be prepared to receive the geotextile membrane.
- Stone will be placed and compacted in layers to minimum 500mm depth.
- A drainage ditch will be formed, within the excavated width and along the sides of the track.
- Surplus excavated material will be placed along the side of sections of the tracks in suitable locations as identified in the soil management plan and dressed to blend in with surrounding landscaping and partially obscure sight of the track.

3.3.1.6 Watercourse Crossings

Watercourse crossings can generally be classified as follows:

- Existing structures (bridges or culverts) that need to be crossed by infrastructure (access tracks or cables) associated with the proposed project, without a need to modify the existing structure;
- Installation of new structures to facilitate the crossing of existing watercourses by infrastructure associated with the proposed project;
- Existing structures that need to be either replaced or upgraded to facilitate the crossing of existing watercourses by infrastructure associated with the proposed project;
- Crossing of existing open streams or drains by cable ducts.

The methodology/sequence of works associated with the proposed watercourse crossing methods are described below.

3.3.1.6.1 Main Wind Farm Site

Minor Watercourses and Drain Crossings (Access Tracks)

It is expected that all minor watercourse and drain crossings within the site will be crossed using piped culverts. Piped culverts will only be used over very short stretches i.e. at track crossings. Pipe culverts will be sized to take the 1 in 100-year flood flow with a 20% allowance for Climate Change. Concrete or HDPE pipes may be used depending on the size of the watercourse to be crossed.

Minor drains such as manmade agricultural and forest drains will be crossed using 450mm diameter pipes.

Where cross drains are to be provided to convey the drainage across the track, the sizes of these cross drains are 225 mm diameter pipes.

Silt Protection Controls (SPCs) are proposed at the location of the drain crossings SPCs will consist of a minimum of silt traps containing filter stone and filter material staked across the width of the swales and upstream of the outfall to any watercourse.

Pipe culverts will be installed in accordance with the design shown in Plate 3-1 below:

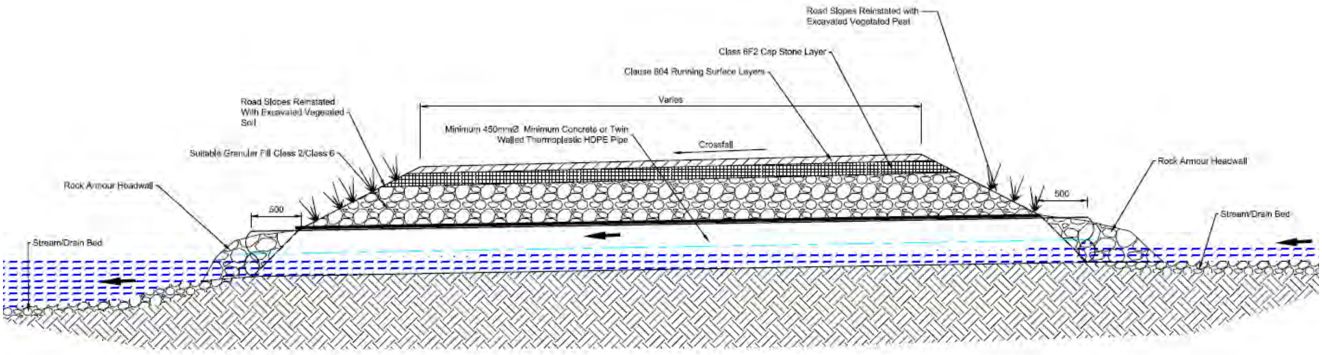

Plate 3-1: Piped Culvert Crossing Long Section

For a minor watercourse/drain crossing using a piped culvert, the following methodology will be used.

- The access track construction will finish at least 10m from the nearside bank of the minor watercourse/drain.
- All environmental mitigation measures will be implemented locally in advance of the works, in accordance with the measures outlined in Section 4.
- Pipe culvert installation will only take place during dry periods.
- The bed of the watercourse will be prepared using a mechanical digger and hand tools to the required levels in accordance with the design.
- A bedding layer will be laid in the base of the minor watercourse/drain using Class 6 aggregate material and blinding to the desired levels in accordance with the design.
- The pipe is laid in one lift or in sections using a crane in accordance with an approved lift plan.
- Bedding material is placed and compacted around the pipe to the desired levels in accordance with the design.
- Suitable bedding material in the form of clean round gravel between 10-100mm diameter, shall be laid in the base of the pipe in accordance with the recommendations set out in *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Watercourses from* Inland Fisheries Ireland*.*
- The pipe is covered using compacted Class 6N fill material in accordance with the design up to the levels required by the access track sub formation.
- Rock armour headwalls will be constructed where necessary to protect pipe ends and the base of slope embankments on either side of the track.
- For small drain crossings, pipes of suitable diameter will be laid directly into the bed of the drain.

Minor Watercourses and Drain Crossings (Cable Trenching)

For a minor watercourse/drain crossing, the following methodology will be used.

- The cable trench construction will finish at least 10m from the nearside bank of the minor watercourse/drain.
- No water flow shall be present in the watercourse/drain during the works. Duct installation will only take place during dry periods to ensure no in-stream works and a qualified environmental monitor or ecological clerk of works (ECoW) shall supervise the works.
- All environmental mitigation measures will be implemented locally in advance of the works, in accordance with the measures outlined in Section 4.
- The bed of the watercourse will be excavated using a mechanical digger and hand tools to the required levels in accordance with the design along the alignment of the cable route.
- Once the trench has been excavated, a bedding layer of sand will be installed and compacted.
- PVC ducts will be installed on top of the compacted base layer material in the trench.
- Once the ducts have been installed, couplers will be fitted and capped to prevent any dirt etc. entering the unjointed open end of the duct. In poor ground conditions, the open end of the duct will be shimmed up off the bed of the trench to prevent any possible ingress of water and dirt into the duct. The shims will be removed once the next length of duct has been joined to the duct system.
- The as-built location of the installed ducts will be surveyed and recorded using a total station/GPS before the trench is backfilled to ensure recording of exact location of the ducts, and hence the operational electricity cable. These co-ordinates will be plotted on as-built record drawings for the grid connection cable operational phase.
- When ducts have been installed in the correct position on the trench base layer, sand will be carefully installed in the trench around the ducts so as not to displace the duct and compacted.
- A red cable protection strip will be installed above duct surround layer of material.
- A layer of excavated material will be installed on top of the duct surround material to the correct level.
- Yellow marker warning tape will be installed for the full width of the trench.
- The bed of the watercourse, stream banks and agricultural land will be reinstated as per their original condition.

3.3.1.6.2 Grid Connection

The following table summarises existing watercourse and service crossing locations and the proposed method for crossing same along the grid connection route:

Table 3-2: Grid Connection Route Watercourse Crossings

Feature ID	ITM_X	ITM_Y	EPA Name	EPA Code	WFD Waterbody Designation	Description
GCR-WCC1	550639	617750	Oakfront	18O12	Awbeg [Buttevant]	Proposed clear span bridge will accommodate GCR cable and internal collector cables within its deck.
GCR-WCC2	552635	619466	Rathnacally	18R32	Awbeg [Buttevant]	HDD in public road corridor

For crossings where HDD has been identified as the preferred crossing method, open cut trenching methods are proposed in dry conditions where there is no-flow in the watercourse and there is no risk of in-stream works. In such instances, cable ducts will be laid under the stream bed which would then be fully reinstated to its pre-existing condition.

Horizontal Directional Drilling (HDD) Under Existing Structure

HDD will be employed at one location along the proposed grid connection route as part of the project as shown on Figure 2-2.

The depth of the bore shall be at least 3m below the level of the public road and stream bed. A survey of buried services within the public road to confirm the conditions predicted in this EIAR will be carried out by the contractor prior to commencement of the operation. The council will be made aware in advance of the operation and invited to oversee the activity.

The location of the launch and reception pit will be adequately spaced from the carriageway to ensure the bore is at such depth as not to conflict with the drainage or surface of the road or associated infrastructure.

There is sufficient room available to accommodate the necessary equipment. The cables will be laid at sufficient depth below the road to stay below the drainage and without impacting on the road foundations.

The operation shall take place from one side of the watercourse within the public road corridor and will be carried out by an experienced HDD specialist. The crossing is expected to take place in a single day under one mobilisation.

The HDD works shall be carried out under a road closure and road opening license in accordance with measures described in the Traffic Management Plan.

A pilot hole will be bored as per the agreed alignment and shall be tracked and controlled using a transmitter in the drill head. By tracking the depth, position and pitch of the drill head the operator can accurately steer the line of the drilling operation. The drilling operation is lubricated using a fluid. When the pilot hole has been drilled to the correct profile, its diameter is increased if necessary, to match the external diameter of the cable duct. The flexible plastic ducting is then pulled through the pre-drilled hole and sealed at each end until required for cable installation.

HDD will be carried out using Vermeer D36 x 50 Directional Drill, or similar plant. The launch and reception pit will be approximately 0.55 m wide, 2.5 m long and 1.5 m deep. The pit will be excavated with a suitably sized excavator and shall employ the same mitigation measures outlined herein for trenching and joint bay excavations.

The drilling rig will be securely anchored to the ground by means of anchor pins which will be attached to the front of the machine. The drill head will then be secured to the first drill rod and the operator shall commence to drill into the launch pit to a suitable angle which will enable the excavation to obtain the depths and pitch required to the line and level of the required profile. Drilling of the pilot bore shall continue with the addition of 3.0 m long drill rods, mechanically loaded and connected into position.

During the drilling process, a mixture of a natural, inert and fully biodegradable drilling fluid such as Clear Bore™ (environmentally friendly product (not toxic to aquatic organisms)) and water is pumped through the centre of the drill rods to the reamer head and is forced into void and enables the annulus which has been created to support the surrounding sub soil and thus prevent collapse of the reamed length. Depending on the prevalent ground conditions, it may be necessary to repeat the drilling process by incrementally increasing the size of the reamers.

When the reamer enters the launch pit, it is removed from the drill rods which are then passed back up the bore to the reception pit and the next size reamer is attached to the drill rods and the process is repeated until the required bore with the allowable tolerance is achieved.

The use of a natural, inert and biodegradable drilling fluid such as Clear Bore™ is intended to negate any adverse effects arising from the use of other, traditional polymer-based drilling fluids and will be used sparingly as part of the drilling operations. It will be appropriately stored prior to use and deployed in the required amounts to avoid surplus. Should any excess drilling fluid accumulate in the reception or drilling pits, it will be contained and removed from the site in the same manner as other subsoil materials associated with the drilling process to an approved disposal site. Backfilling of launch & reception pits will be conducted in accordance with the normal specification for backfilling excavated trenches and joint bays.

Minimum environmental protection measures to be implemented on site shall include the following:

- A site-specific drilling design, risk assessment and method statement shall be prepared by the contractor prior to the works.
- If drilling fluids are required, a biodegradable fluid such as CLEARBORE shall be used rather than Bentonite.
- HDD operations to be limited to daytime hours and conditions when low levels of rainfall are forecast.
- The depth of the bore shall be at least 3m below the bed of the watercourse.
- Visual inspection to take place at all times along the bore path of the alignment.
- A field response plan to minimize loss of returns of drilling fluid and actions to restore returns shall be provided.
- Silt fences will be constructed around proposed work areas prior to commencement of works.

- No refuelling will take place within 50m of the watercourse or any sensitive habitats.
- Pre-construction verification surveys shall take place at drilling sites to confirm the presence of any sensitive species.
- A qualified environmental monitor or ecological clerk of works (ECoW) will be onsite for the duration of the drilling operation.

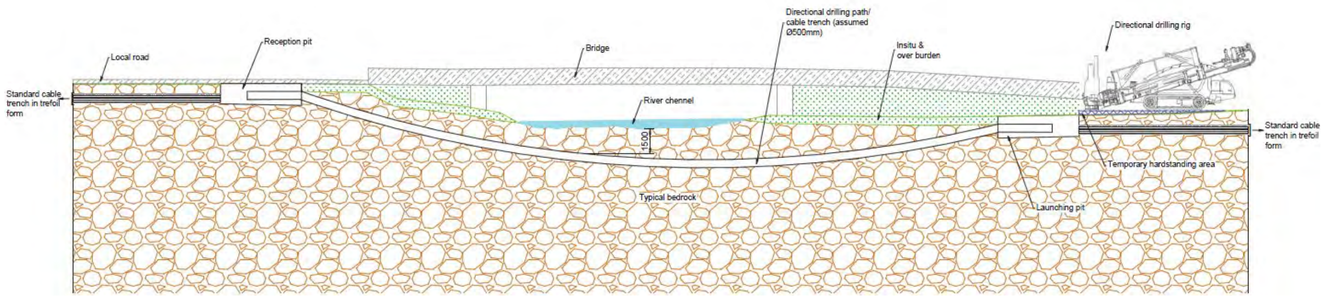

Plate 3-2: HDD Activity Profile

Single-span Bridge Crossing at the Oakfront Stream

The method for crossing the Oakfront Stream within the wind farm site is by single-span concrete bridge. It is proposed to construct a clear span bridge at this location to minimise environmental impacts by avoiding instream works.

The bridge will be of adequate length and will be designed to ensure that no in-stream works will be required and that the existing stream banks are not disturbed during construction. Sufficient free-board will be allowed for in the proposed bridge designs to allow for 1 in 100-year fluvial flood conditions. In order that flood flows will not be obstructed, the stream crossings will be sized to convey a 1 in 100-year flood flow with a 20 % allowance for Climate Change.

So as not to interfere in any way with the bed or bank of the watercourse, bridge foundations will be designed and positioned at least 2.5m from the river bank. Silt fencing will be erected at the location of the crossing.

The beams of the bridge will be precast off site and transported to the site for installation. The beams will house a flat formation of precast ducts to allow for both the export grid connection cable and internal circuit cables to cross the stream at this point. Cover of 450mm will be provided in the deck between the bridge surface and the 38kV export cable ducts.

For the construction of the bridge crossing, the following methodology shall apply:

- Construction of the water crossing will be scheduled to adhere with fisheries seasonal restrictions.
- The access road on the approach to the watercourse will be completed to a formation level which is suitable for the passing of plant and equipment required for the installation of the watercourse crossing.
- All drainage measures, including check-dams and /or silt traps, along the proposed road will be installed in advance of the works.
- All earthworks adjacent to the crossing locations will be carried out so as to prevent soil entering the watercourse.

- Safe access over the stream for this installation will be via a steel walkway & handrail which will span the stream.
- Excavation near river banks is required to install and secure pre-cast concrete abutments meaning that dry instream working conditions will need to be established.
- Abutments will be set back 2.5m from 1% AEP flood height (100-year event). It is envisaged that dry working conditions at these sites will be maintained by retaining the existing bank and using a short section of sand bag cofferdam. This will isolate flow either side of the channel in sequence, to allow dry working conditions while each abutment is installed. The required working area is relatively small for each abutment and the cofferdam set-up allows continuous flow during the short construction period.
- Strong polyethylene bags filled with clean sand will be used and will be wrapped between geotextile to create watertight conditions. Once complete, the water retained by the coffer dam within the work area will be pumped out to a sediment retention device before being discharged, so as to create the dry working area.
- On alternate sides of the stream, within the sequenced cofferdam set-ups, the base will be excavated to rock or competent stratum with a mechanical excavator.
- The foundations and abutments will be constructed using a pre-cast concrete section and will be lifted into place on the base. The area around the abutments up to access road level will be infilled with a structural fill.
- Once each abutment is in place and secured with structural fill, the pre-cast concrete deck will be laid down on the abutments, anchored and a thin screed of concrete will be poured on top.
- When the concrete deck is connected to the abutments, the filling and compaction of the road will be completed.
- The access road leading to and from the crossing will be profiled using cut from other areas across the site. Where necessary, depending on the quality of the ground, clean imported fill with low fines content may be required.
- Cables will be pulled through the bridge deck following completion of the bridge structure.

Standard Trench Crossings of Existing Culverts or Services

For the crossing of buried pipe drains, culverts or services, if encountered, the following options for construction may be used:

- Piped Culvert Crossings – Where sufficient cover is available, the cable ducts will be laid above the culvert with a minimum separation distance, 300mm to be agreed with the local authority and ESBN within the parameters assessed in the EIAR.
- Piped Culvert Crossings - Where sufficient cover is not available, the cable ducts will be laid under the culvert with a minimum separation distance, 300mm to be agreed with the local authority and ESBN within the parameters assessed in the EIAR.
- Flatbed Formation over Culverts - where the cable duct is to be installed over an existing culvert where sufficient cover is not available, the ducts will be laid in a much shallower trench the depth of which will be determined by the location of the top of the culvert. The duct will be laid in this trench in a flatbed formation over the existing culvert and will be encased in a reinforced concrete surround as per ESBN specification within the parameters assessed in the EIAR.

A Summary of Standard Specification for ESB Networks 38kV Ducting is contained in Appendix 3.

When crossing existing culverts or buried services, the following methodology will be employed:

- The general method of trench construction will follow the procedure outlined above for Installation of cable ducting.
- The service infrastructure shall be located and marked by an engineer in accordance with the Code of Practice for Avoiding Underground Services.
- All services will be safeguarded and protected in accordance with the asset owner's specifications.
- Within 500mm of the existing service, hand digging will be employed to expose it.
- Cable ducts shall pass over or under the existing service, depending on the depth of the service and other constraints. Plate 3-3 shows design details for ducts passing in flat formation above existing culverts and buried services.
- A minimum separation distance of 300mm shall be maintained between the cable ducts and the existing service.
- Existing services within the trench shall be left in the same condition as they were found. Any issues shall be reported to the asset owner immediately.

Piped Culvert Crossing – Ducting Over Culvert

Where sufficient cover exists above the culvert, the trench will be excavated above the culvert and the ducts will be installed in the trefoil arrangement passing over the sealed pipe where no contact will be made with the watercourses. This method of duct installation is further detailed in Plate 3-3.

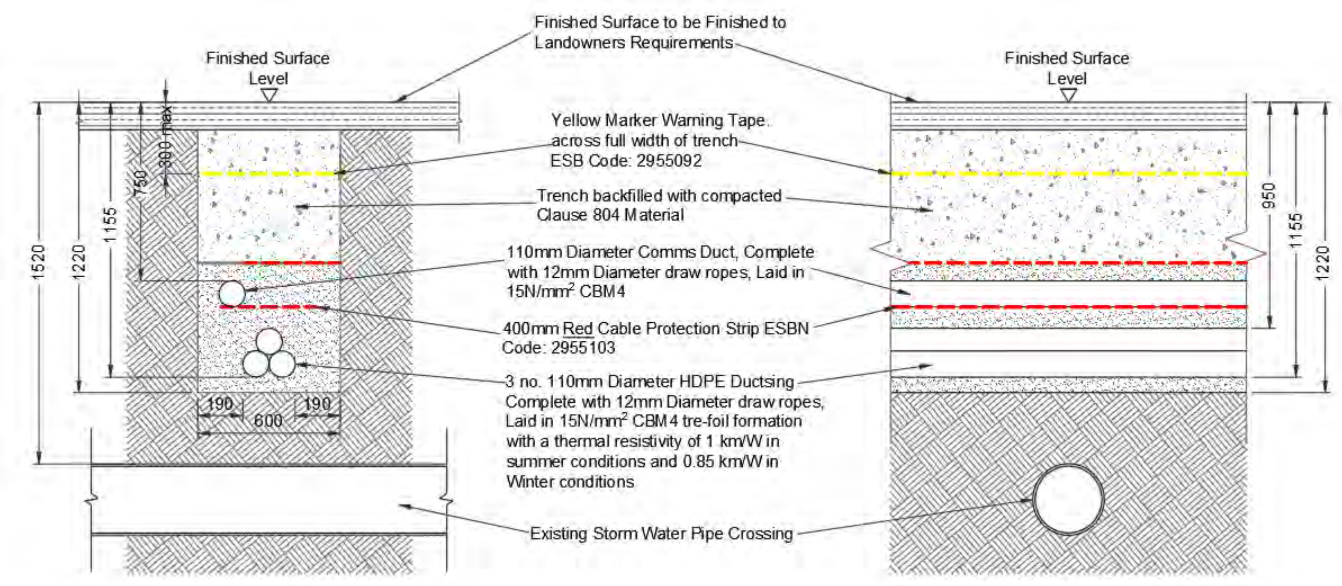

Plate 3-3: Piped Culvert Crossing – Ducting Over Culvert Crossing Details

Piped Culvert Crossings – Ducting Under Culvert

Where the culvert consists of a socketed concrete or sealed plastic pipe where sufficient cover over the culvert does not exist to accommodate the cable trench, a trench will then be excavated beneath the culvert and cable ducts will be installed in the trefoil arrangement under the sealed pipe.

This method of crossing is illustrated in Plate 3-4 below. If these duct installation methods cannot be achieved or utilized, the ducts will be installed by alternative means as set out in the following sections:

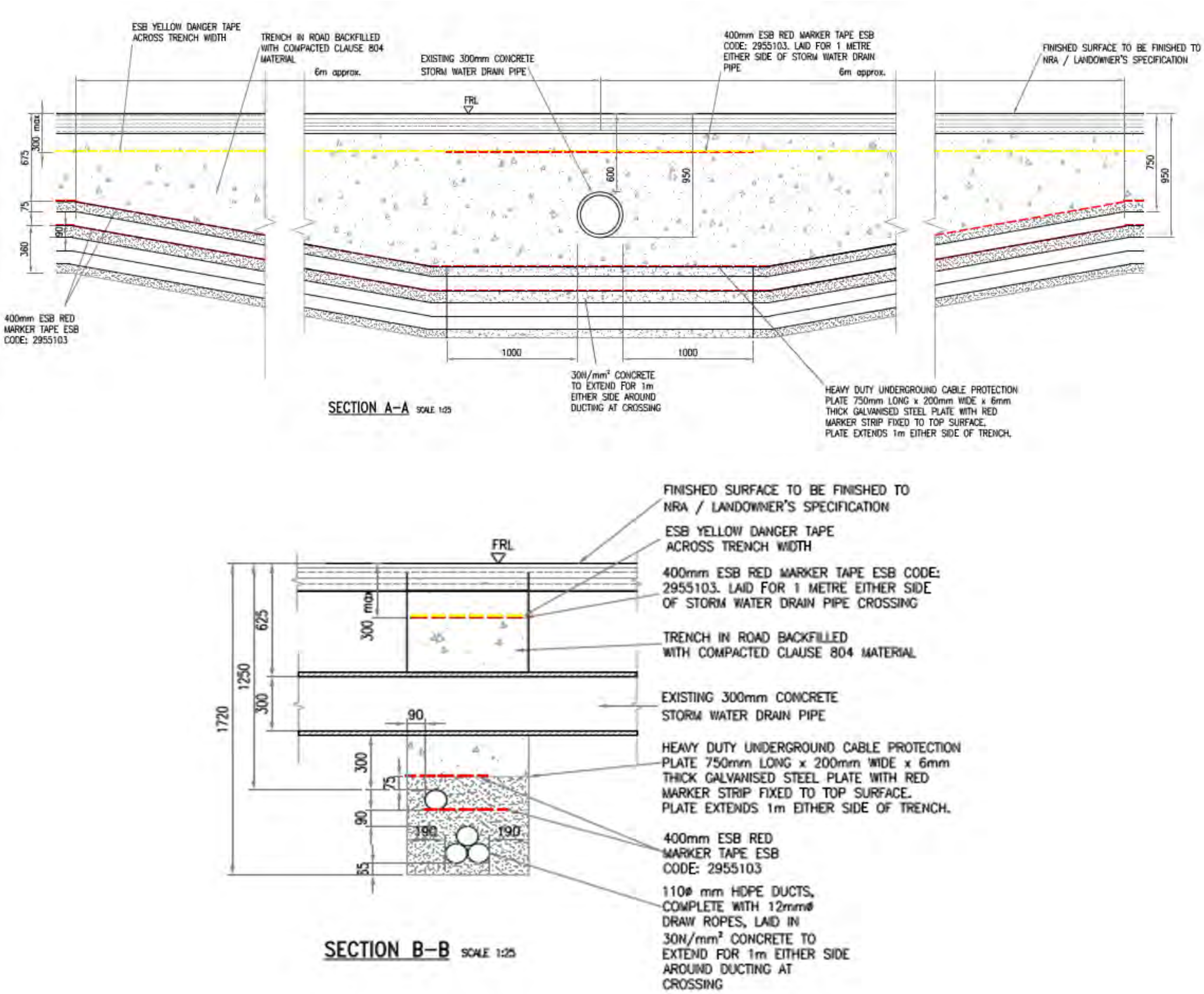

Plate 3-4: Piped Culvert Crossings - Ducting under Culvert Crossing Details

Flatbed Formation Over Culverts

Where cable ducts are to be installed over an existing culvert where sufficient cover cannot be achieved by installing the ducts in a standard trefoil arrangement, the ducts will be laid in a much shallower trench the depth of which will be determined by the location of the top of the culvert. The ducts will be laid in a flatbed formation over the existing service and will be encased in a reinforced concrete surround as per Eirgrid specification.

After the crossing over the culvert has been achieved, the ducts will resume to the trefoil arrangement within a standard trench. This will be done gradually to comply with minimum duct and cable design bend requirements. In transition sections between trefoil and flat formation, the base of the trench shall be graded to eliminate stepping and minimum bedding and surround material will be maintained throughout.

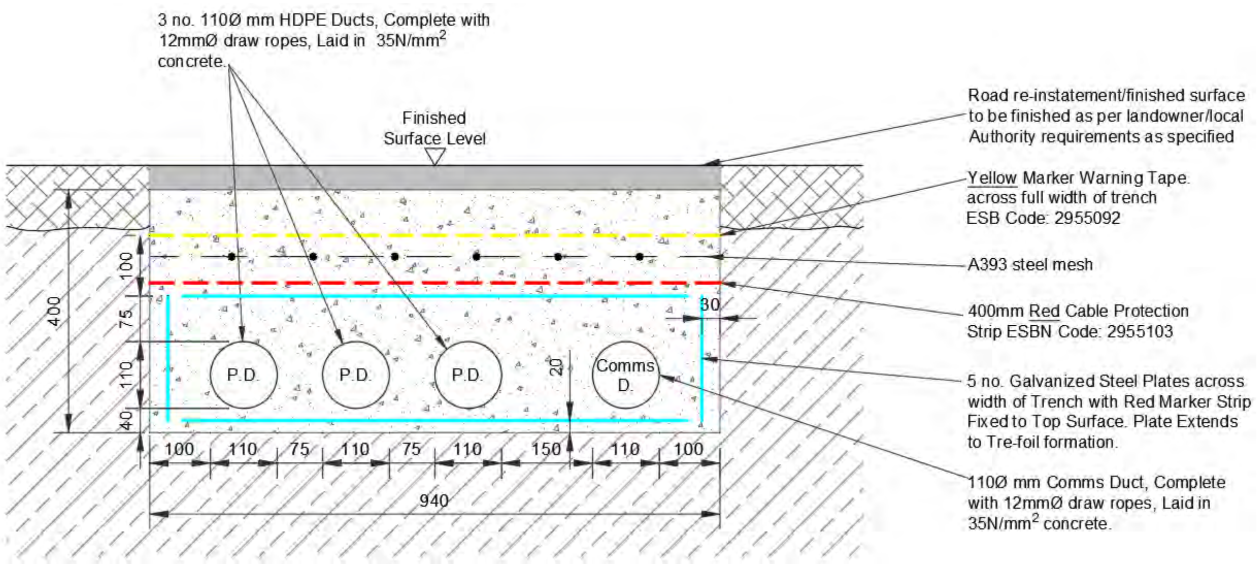

Plate 3-5: Flatbed Formation Detail

Open Surface Drain/Minor Watercourse Crossing – Open Cut Method

As described above, for the crossing where HDD has been identified as the preferred crossing method, open cut trenching methods are proposed in dry conditions where there is no-flow in the watercourse and there is no risk of in-stream works. In such instances, cable ducts will be laid under the stream bed which would then be fully reinstated to its pre-existing condition.

For the above situation, the following methodology will be used.

- The cable trench construction will finish at least 10m from the nearside bank of the minor watercourse/drain.
- No water flow shall be present in the watercourse/drain during the works. Duct installation will only take place during dry periods to ensure no in-stream works and an environmental monitor or Ecological Clerk of Works (ECoW) shall supervise the works.
- All environmental mitigation measures will be implemented locally in advance of the works, in accordance with the measures outlined in Section 4.

- The bed of the watercourse will be excavated using a mechanical digger and hand tools to the required levels in accordance with the design along the alignment of the cable route.
- Once the trench has been excavated, a bedding layer of sand will be installed and compacted.
- PVC ducts will be installed on top of the compacted base layer material in the trench.
- Once the ducts have been installed, couplers will be fitted and capped to prevent any dirt etc. entering the unjointed open end of the duct. In poor ground conditions, the open end of the duct will be shimmed up off the bed of the trench to prevent any possible ingress of water and dirt into the duct. The shims will be removed once the next length of duct has been joined to the duct system.
- The as-built location of the installed ducts will be surveyed and recorded using a total station/GPS before the trench is backfilled to ensure recording of exact location of the ducts, and hence the operational electricity cable. These co-ordinates will be plotted on as-built record drawings for the grid connection cable operational phase.
- When ducts have been installed in the correct position on the trench base layer, sand will be carefully installed in the trench around the ducts so as not to displace the duct and compacted.
- A red cable protection strip will be installed above duct surround layer of material.
- A layer of excavated material will be installed on top of the duct surround material to the correct level.
- Yellow marker warning tape will be installed for the full width of the trench.
- The bed of the watercourse, stream banks and agricultural land will be reinstated as per their original condition.

3.3.1.6.3 Turbine Delivery Route

The TDR crosses a number of watercourses along the route between the Port of Foynes and the proposed wind farm site. There are no specific accomodation works requried at bridge points along the TDR. Works will be requried at Node 10.5 in proximity to the Rathnacally Stream on the L1322. These works include hedgerow trimming and the lowering of a wall to accommodate vehicle oversail. There are no works requried within the stream, however, watercourse pollution control measures, as described in section 4.3.6, will be put in place at this point during the construction phase.

3.3.1.7 Cable Works

The specification for cable trenches will vary slightly depending on cable voltage, location and existing land use. Typical cable trench construction details can be found on the 05813 series of planning drawings prepared by TLI Group and included in Appendix 2, which shows construction details for electricity cables in public roads and beside internal site access tracks.

All electrical and fibre-optic cabling on site between the wind turbines and the substation building will be buried in trenches approximately 0.6m wide by 1.2m deep located directly adjacent to the internal access tracks.

The following describes the construction methodology for cable installation works inside the wind farm site.

For direct buried cables, the following outline methodology shall apply:

- All environmental mitigation measures will be implemented locally in advance of the works, in accordance with the measures outlined in Section 4 of this CEMP.
- The line of the cable trench will run beside the site access tracks until it exits to the public road.
- The ground will be excavated using a mechanical digger. The top layer of soil will be removed and placed to one side. It will be used for landscaping the top of the backfilled cable trench following the laying of the cables. The remaining subsoil, excavated to the required depth, will be placed separately and used as backfill.
- Safe ladder access/egress to trenches will be provided into the trench.
- The cables will be laid directly onto a bed of suitable material, free from sharp stones and debris*****.
- A suitable material will be placed over the top of the cables to protect them during backfilling*****.
- Warning tape and plates will be installed by hand in accordance with the trench design and ESBN specifications and the engineer's design.
- On completion, the ground will be reinstated, and marker posts will be positioned at agreed centres to the side of the trench highlighting the presence of cables below.
- Trenches will vary in width depending on the number of cables in the circuit. Where there is more than one set of cables they will be separated as per cable manufacturers and ESB/ EirGrid requirements.
- Where cables need to cross access tracks, suitable cable ducts will be used to protect the cables.
- The method of construction involves the contractor initially excavating the trench to the specified depth and laying high density polyethylene (HDPE) ducting in the trench in a surround of CBM (cement bound material). A rope will be inserted into the ducts to facilitate cable-pulling later. The as-constructed detail of the cable duct locations will be carefully recorded. Cable marker strips will be placed at a specified distance above the ducts and the two communication ducts will also be laid. An additional layer of cable marker strips will be laid above the communication ducts and the trench backfilled.
- Small jointing pits will be located along the route of the trench which will be left open until jointing takes place. A protective handrail/ barrier will be placed around each pit for health and safety reasons.
- Once the cables are joined and sealed the jointing container will be removed and the cables at the joint-bay locations will be back-filled in the same manner as the rest of the cable trench.
- The cables will be terminated on the switchgear terminals at each turbine location and at the substation switchboard. Ducts will be cast into each foundation to provide access for the cables into the turbine. Likewise, at the substation, ducts will be cast through the building foundation to provide access for the cables.
- There are no existing buried services expected within the site however the appointed contractor will be responsible for carrying out pre-construction survey ahead of construction. Prior to commencement of the works, records of services such as watermains, sewers, gas mains and other power cables will be obtained from the relevant service providers. Cable detection tools, ground penetrating radar and slit trenches will be used, as appropriate, to find the exact locations of existing services. The final locations of the cable trenches will be selected to minimise conflicts with other services.
- Trenches where ducts are laid will be back filled every evening. During excavation works signage will be erected local to the works warning of the dangers.

Where ducting is required within the wind farm site, tasks marked by an asterisk (*) in the above methodology will be replaced by the following steps:

- Ducts will be placed into trench manually, having been delivered to road side embankment/verge areas by way of tractor and pipe trailer and then offloaded by hand.
- Approved bedding material will be used to surround the ducts and delivered straight from a concrete truck or by skid steer at tight points along the route.
- Approved fill material will be compacted at the base, again above the power cable ducting as per the engineer's design.
- Exposed duct ends will be capped.
- A 12mm Draw rope will be blown through the ducting at a later date.

Back-filling and reinstatement in public roads will be to a specification to be agreed with the road authority or at the minimum, to pre-construction condition. Where cable trenches traverse private agricultural lands, tracks or forestry where agricultural vehicles are expected to drive as part of future agricultural or forestry activities, cable trenches shall be backfilled with suitable backfill material.

3.3.1.8 Crane Hardstands

All crane pads and associated splays will be designed within the parameters assessed in the EIAR, taking account of the loadings provided by the turbine manufacturer and will consist of a compacted stone structure in accordance with the detailed engineering designs and employer's requirements.

All crane pads will be formed from a suitably stiff layer and the finished crane pad surface will provide a minimum bearing capacity of up to 260kN/m^2. Where excavations beyond 5m below ground level are required to reach a suitable bearing, pile foundations may be required. Piles used for turbine foundations are either pre-cast driven piles or bored piles. Pile length is site-specific but tend to be approximately 12 m to 20 m long.

Crane pad and associated splay formation will consist of either 1 or 2 layers of suitable fill material depending on the properties of the underlying load bearing layer. Where the underlying layer is soft soil, 2 layers of suitable fill formation are used and the stone capping layer. In areas where the load bearing layer is rock, the capping layer is omitted, and the running layer is installed directly onto the rock surface however it is not likely this will be the case at this site. The crane pads are approximately 28m x 82m and have a maximum cross and longitudinal fall tolerance of 2%.

The crane hardstands will be constructed in one of two following ways:

- Typical excavation method;
- Piled hardstand method.

It is unlikely that a piled construction method will be required for the hard standings.

The excavation method can be summarised as follows:

Excavation Method:

All environmental mitigation measures will be implemented locally in advance of the works, in accordance with the measures outlined in Section 4 of this CEMP.

- Establish alignment of the hardstands from the construction drawings and mark out the corners with ranging rods or timber posts.
- Drainage runs and associated settlement ponds will be installed.
- The excavated material will be stored close to the hardstand. Topsoil and subsoil stockpiles will be formed, and the side compacted to prevent silt run-off during heavy rain or air bourn dust during dry periods.
- The soil will be excavated down to a suitable formation layer of either firm clay or rock.
- Suitable granular fill will be spread and compacted in layers to provide a homogeneous running surface.
- Batters to have a slope of between 1:1 and 1:5 (depending on depth and type of material) and will be left as cut to re-vegetate naturally with local species.

Piled Hardstand Method:

This system involves:

- Construction of the founded hard standing as per the above methodology.
- Piles will be positioned to match the outrigger pads of the turbine crane and as agreed with the turbine supplier. Geotechnical analysis of the site investigation information will dictate the type of pile to be used. There are several methods however the most likely will either be pre-cast driven piles and auger bored piles.
- A reinforced concrete pad will be constructed on top of the piles. Shuttering will be used lined with polythene and an antibleeding admixture used to prevent any concrete leachate.

3.3.1.9 Turbine Foundations

The wind turbine foundations will be constructed using standard reinforced concrete construction techniques and will be designed as either:

- Submerged foundation design.
- Non-Submerged Foundation design.

Turbine foundations will be designed to Eurocode Standards. Foundation loads will be provided by the wind turbine supplier, and factors of safety will be applied to these in accordance with European design regulations. The turbine will be anchored to the foundation as per the turbine manufacturer's guidelines which will be incorporated in the civil foundation design. The shape and size of the foundation can vary in size and shape to approximately 22m in diameter and 4m in depth.

The turbine foundations will be constructed as follows:

Standard Excavated Reinforced Concrete Base:

a) The extent of the excavation will be marked out and will include an allowance for trimming the sides of the excavation to provide a safe working area and slope batter.

b) The excavated material will be stored at agreed locations close to the base. Topsoil and subsoil stockpiles will be formed, and the side compacted to prevent silt run off during heavy rain or air bourn dust during dry periods. The subsoil material will be used as backfill and the topsoil will be used for landscaping around the finished turbine post construction.

c) No material will be removed from site and storage areas will be stripped of vegetation prior to stockpiling in line with best working practises.

d) Around the perimeter of the foundation formation a shallow drain will be formed to catch ground water entering the excavation. The drain will direct the water to a sump if required where it will be pumped out to a settlement pond away from the excavation.

e) A layer of concrete blinding will be laid approximately 75mm thick directly on top of the newly exposed formation, tamped and finished with a screed board to leave a flat level surface. If required, geogrid and soil replacement will be laid according to the foundation design, followed by placement of the concrete blinding layer.

f) If soil replacement is required, the aggregate used must be tested and approved by the project geotechnical engineer.

g) High tensile steel reinforcement will be fixed in accordance with the designer's drawings & schedules. The foundation anchorage system will be installed, levelled and secured to the blinding using steel box section stools.

h) Ductwork will be installed as required, and formwork erected around the steel cage and propped from the backside as required.

i) The foundation anchorage system will be checked both for level and line prior to the concrete being installed in the base.

j) Concrete will be placed using a concrete pump and compacted using vibrating pokers to the levels and profile indicated on the construction drawings.

k) Upon completion of the concreting works the foundation base will be covered from the elements that could cause hydration cracking and or delay setting in any way.

l) Steel shutters will be used to pour the upper plinth section.

m) The foundation will be backfilled with a cohesive material, where possible using the material arising during the excavation and landscaped using the top-soil set-aside during the excavation. The suitability of backfill material is to be approved by the project geotechnical engineer.

n) A gravel footpath will be formed from the access track to the turbine door and around the turbine for maintenance.

Reinforced Concrete Piled Foundations:

It is envisaged that an allowable ground bearing pressure to comply with the design and specification of the standard shallow turbine foundation design should be attained however, should piling be required the following will apply.

Follow Items (a) to (c) as above then for piled foundations:

Auger bored piles will be used for piled foundations.

- A piling platform for the piling rig will be constructed. This can be done in two ways depending on the bearing capacity of the underlying soil.
    - The first method is to lay geo-textile on the existing surface and a stone layer will then be placed on top of the geo-textile by an excavator and compacted in order to give the platform sufficient bearing capacity for the piling rig.
    - The second method is to excavate the soils to a suitable intermediate mineral subsoil and backfill to the formation level.
- The piling rig, fitted with an auger, will then bore through the soft material with a sleeve fitted around the auger to prevent the sidewalls of the soil from collapsing. The borehole is then extended to a suitable depth into the subsoil/bedrock.
- When the auger and the sleeve are removed high tensile steel cages will be lowered into the boreholes. These steel cages will extrude above the level of the top of the concrete pile.
- As the auger is removed concrete is pumped into the borehole.
- Reinforcing steel on the top of the pile will tie to the foundation base steel.

Base construction is then undertaken as per items (e) to (n) above.

3.3.1.10 Substation Compound

The compound surrounding the substation will measure approximately 50m x 25m as shown in planning application drawing 05813-DR-017. The compound will include a substation control building and electrical components necessary to import the electricity generated from the wind farm to the existing Charleville substation. The building's main function is to provide housing for switchgear, control equipment and monitoring equipment necessary for the proper functioning of the substation and wind farm. The building will be constructed by the following methodology:

- The area of the control buildings and compound will be marked out using ranging rods or wooden posts and the vegetable soil stripped and removed to the nearby storage area for later use in landscaping. No material will be removed from site and storage areas will be stripped of vegetation prior to stockpiling in line with best working practises.
- Drainage runs and associated settlement ponds will be installed
- The dimensions of the Building and Compound area will be set to meet the requirements of EirGrid/ ESB and the necessary equipment to safely and efficiently operate the wind farm.
- The foundations will be excavated down to the level indicated by the designer and concreted.

- The blockwork walls will be built up from the footings to DPC level and the floor slab constructed, having first located any ducts or trenches required by the follow on mechanical and electrical contractors.
- The blockwork will then be raised to wall plate level and the gables & internal partition walls formed. Scaffold will be erected around the outside of the building for this operation.
- The concrete roof slabs will be lifted into position using an adequately sized mobile crane.
- The wooden roof trusses will then be lifted into position using a telescopic load all or mobile crane depending on site conditions. The roof trusses will then be felted, battened, tiled and sealed against the weather.

The remainder of the substation compound will be brought up to the agreed formation and approved stone imported and graded to the correct level as per the detail design. Equipment plinths will be marked out, excavated and constructed using in-situ reinforced concrete or pre-cast concrete. Provision will be made in each plinth for earth connection.

Following the construction of the equipment plinths an earth mat will be installed throughout the compound. This will be connected to each plinth and the buildings as per the electrical earth protection design.

3.3.1.11 Electrical Works

Substation Fit Out and Switchgear Installation

The substations will have a domestic electrical system including lights, sockets, fire alarm and intruder alarm. The high voltage switchgear is installed through the following method.

- The switchboard units are delivered to site on a truck and unloaded using a forklift, front end loader or HIAB crane.
- Suitable task specific RAMS and lifting plans will be in place prior to the commencement of all works.
- The switchgear will be unloaded on to a concrete plinth directly outside the substation building.
- The units will be moved inside the substation building using a hand driven forklift and positioned over the internal trench supports, prepared previously.
- The switchgear is then secured as per manufacturer’s instructions, typically by bolting directly to steel support bars over the trench.
- The building is fitted out with small light and power and ancillary wind farm control equipment such as SCADA computer, remote telemetry units, metering etc.
- All equipment and fittings are then connected, wired tested and commissioned in accordance with the Electrical Contractor’s commissioning plan.

The equipment will be decommissioned in the reverse of the above, removed from site, dismantled and disposed of in an approved manner.

Transformers

- The turbine transformers will be placed directly onto the turbine foundation upon delivery to site, prior to the installation of the turbine towers.
- The transformers will be of the sealed type and will be inspected for any damage prior to offloading. It is likely that the units will be installed using a small mobile all-terrain crane and will be tested, commissioned and energised by suitably trained and authorised persons.
- The accessible sections of the transformer will be protected within an enclosure which shall be locked at all times and displaying appropriate warning signs. The units will be decommissioned in the same manner, removed from site and disposed of by a company certified to handle such materials. This specialist company will also dispose of any oil or residual waste products.
- Transformers and ancillary plinth-mounted equipment required in the substation compound will be delivered to site and unloaded directly in place by HIAB crane or similar.
- Suitable task specific RAMS and lifting plans will be in place prior to the commencement of all works and adequate hard standings will be provided prior to delivery to facilitate safe unloading.

3.3.1.12 Turbine Erection

Once the turbine components arrive on site they will be placed on the hardstand and lay down areas prior to assembly. The towers will be delivered in sections and each blade will be delivered in a separate delivery. Once there is a suitable weather window the turbine will be assembled.

It is anticipated that each turbine will take approximately 3 to 4 days to erect (depending on the weather), requiring two cranes. Finally, the turbines will be commissioned and tested.

It is expected that the construction phase, including civil, electrical and grid works, and turbine assembly will take between approximately 12 and 18 months.

3.3.1.13 Grid Connection Works

The following describes the outline construction methodology for cable installation works along the grid connection route between the wind farm onsite substation and the Charleville substation.

The proposed grid connection route is shown on Figure 2-2 and described in Section 2.1.3.

- Agreement will be sought from local authorities with respect to the location of trenches on roads to ensure no damage is caused to storm-water drains, water-mains or other services. All drain and culverts affected by the works are to be re-instated to the satisfaction of the Local Authorities. Particular care will be taken in order to minimise disruption to local residents and public road users.
- The location of the cable route will be set out by GPS (RTK enabled) equipment in accordance with the design drawings prepared for the site.
- Prior to any construction works commencing, a pre-commencement road survey will be carried out on the public roads in the vicinity of the works. The area where excavations are planned will be surveyed with a cable-avoiding scanning tool, by a person trained in Location of Underground Services. Location equipment to be calibrated within the previous 12 months.

- All environmental mitigation measures will be implemented locally in advance of the works, in accordance with the measures outlined in Section 4 of this CEMP.
- Traffic management measures will be implemented prior to works commencing accordance with the construction stage TMP and measures outlined in Section 4 of this CEMP.
- Overhead lines will be identified and overhead clearance limiting measures will be put in place at the start of each day. Machinery will also include automatic limiters to safeguard against interaction with overhead lines.
- Underground services may be encountered during the trenching works the locations and depth of these underground services the locating of these services will include the reviewing of service drawings, investigations along the trenching route, and consultation with the various service providers.
- All environmental buffer zones shall be identified and set out prior to construction works advancing. Where necessary a stock proof timber post and wire fence shall be erected to establish these areas and thus prevent the entry of contractor's plant within these buffers during construction works. It is noted that given the presence of large sections of the cable route on public roads, extensive adherence to buffer zones is unlikely.
- The cable infrastructure will follow the existing road infrastructure where possible. Cables will be laid underground using standard trenches, with pre-excavation drainage works in place prior to trench excavation.
- Temporary reinstatement of the road surface will be carried out at the end of the working day to allow safe re-opening of the road for public traffic. See below for sequence of works for temporary road reinstatement.
- A 360-degree excavator will first remove the top layer from the route along the roadside and load onto a haulage truck, this material will be recycled, then the excavation of trench will commence, and a trained spotter will be used to assist machine operators while reversing or when their visibility becomes restricted.
- Trench to be dug to agreed drawing specifications. All plant and stored material will be kept a safe distance back from the trench edges.
- No open trench will be left unattended. Pedestrian barriers will be erected to prevent unintentional entry occurring by the open trench. Cones and or barriers will be used on rural roads to maintain a safety zone in proximity to the trench.
- Safe ladder access/egress to trenches will be provided into the trench.
- Ducts will be placed into trench manually, having been delivered to roadside embankment/verge areas by way of tractor and pipe trailer and then offloaded by hand.
- Approved bedding material will be used to surround the ducts and delivered straight from a concrete truck or by skid steer at tight points along the route.
- Approved fill material will be compacted at the base, again above the power cable ducting as per the engineer's design.
- Warning tape and plates will be installed by hand in accordance with the trench design and ESBN specifications.
- Backfill materials will be delivered to site in tipper trucks and offloaded at agreed designated set down areas where it will be either loaded into site dumpers or a stoning cart then brought to trench area that requires being backfilled. Main material deliveries such as ducting and pre-cast joint bay sections will be to the temporary site compound and moved to the work area as required.

- Backfill materials will be compacted using suitable compaction equipment to prevent future settlement as per NRA Specification for Roadworks.
- Hand digging will be used when within 500mm of any known existing services.
- Trenches where ducts are laid will be back filled every evening. During excavation works signage will be erected local to the works warning of the dangers.
- Exposed duct ends will be capped.
- Spoil will be disposed of at a licenced facility
- Unauthorised access will be monitored and prevented.
- A 12mm draw rope will be blown through the ducting at a later date.
- The trench and the working strip will be reinstated to the satisfaction of the local authority and TII standards for public roads.
- Where the trench strip passes through agricultural land, the surface will be reinstated to the area's pre-existing condition.

Installation of Joint Bays and Link Box Chambers

- Setting out and location of services will be carried out in the same manner as for trench excavations.
- Traffic management to be set up as per the construction stage traffic management plan.
- A tracked excavator will be used for the excavation of the joint bay pits in accordance with detailed design drawings.
- Tractor/dump trailer and or tipper truck shall be used to remove excavated spoil from the work area. Spoil shall be removed to a licensed waste facility.
- A watchman will be used to assist machine operators while reversing or when their visibility is restricted.
- Where joint bays are located, the excavation shall be adequately protected with fencing with signage erected, warning of deep excavation.
- Safe ladder access/egress to excavation shall be in place, ladder to be footed at the base and tied at the top.
- Base materials will be placed by the excavator from a truck in the base of the excavation.
- Precast chamber sections will arrive on site via articulated lorries accompanied by a crane truck. The crane truck will load each unit separately from the articulated truck.
- The precast units will be transported to site and a flatbed trailer and a truck mounted crane will lift the section into position.
- A lift plan /DJSP will be required for all Joint Bay installations.
- When the joint bays are in place, the sections will be back filled using approved fill material and the road surface will be reinstated using cold tar/surface dressing.
- Unauthorised access will be monitored and prevented.

Plate 3-6: Typical Installation and Temporary Reinstatement of Joint Bay

Watercourse Crossings

Methodologies associated with watercourse crossings along the proposed grid connection route are detailed in Section 3.3.1.6.

Temporary Reinstatement of Excavations

- Hot works permit to be issued for the area where reinstatement works are required.
- A grader (if required), Roller and mini-patch plainer will be delivered to site by low-loader, 2 - in - 1 Tar - and Chipper or patch sprayer will be driven to site.
- A mini patch plainer will be attached to a skid steer and will plane a fresh cut line along the verge of the trench.
- The trench fill material will be graded to shape the trench to match the existing camber of the carriageway and compacted using a drum roller.
- The Tar - and - Chipper will make first pass, of one meter wide.
- Once the bitumen emulsion and chips have been dispensed from the 2- in 1 Tar and chipper and the drivers cab is clear of the area, the roller will follow and compact the chips into the emulsion.
- If the 2 - in - 1 - Tar - and - Chipper is not being used, a towable emulsion sprayer will be used. This process involves the towable sprayer been towed by a pickup truck, and an operative spraying the trench area by means of a lance from the unit.

- The emulsion is heated up to 70°C, the operator will wear protective overalls, heat resistant gloves and eye protection.
- The emulsion is sprayed out to cover the existing trench fill where a follow up crew will spread surface dressing chips over the sprayed area at a safe distance of 5m from the lance.
- Compaction will then take place by a drum roller.
- Both the 2 - in - 1 - Tar - and - Chipper and towable sprayer will have internal diesel burners, with no exposed naked flame.
- Delay set macadam may also be required on busier roads, 75mm of delay set shall be placed within the trench at the end of each working day, by means of skid steer and trench reinstatement bucket and compacted.

Plate 3-7: Towable Sprayer for Temporary Reinstatement

3.3.1.14 Felling

The proposed wind farm site comprises areas of broadleaf forestry plantations. Four of the proposed 6 no. turbines are located within or partly within forestry and consequently tree felling will be required as part of the project. Permanent felling of approximately 12.6 ha of broadleaf forestry is required within and around the wind farm infrastructure to accommodate the construction of turbines, hardstands, crane pads, access tracks and the proposed onsite substation.

To ensure a tree clearance method that reduces the potential for sediment and nutrient runoff, the construction methodology will follow the specifications set out in the Forest Service Forestry and Water Quality Guidelines (2000) and Forest Harvesting and Environmental Guidelines (2000).

The proposed method of tree felling near 'infrastructure' will be limited to the following where possible:

- 20m wide corridors for new and upgraded access tracks;
- 10m buffer surrounding hardstandings;

- 8m corridor for buried cables in private lands;
- Up to 92m radius around each turbine located in forestry for bat impact mitigation. Each turbine has a different felling radius depending on the surrounding tree height. This is calculated in line with Scottish Natural Heritage's Guidance Document: Bats and Onshore Wind Turbines (Jan 2019). The felling radius for each turbine is as follows:
    - T01: 86m
    - T02: 86m
    - T03: 92m
    - T04: 86m
    - T05: N/A
    - T06: 86m

Felling associated with the proposed project shall be carried out under license in accordance with the requirements as set out in Section 4.2.3.

3.4 Construction Working Hours

The hours of construction activity will avoid unsociable hours and will be agreed with the planning authority in advance of site start. It is anticipated that this will restrict working hours at the site during the installation phase to be limited to 08:00 to 19:00 Monday to Saturday inclusive. It should be noted that it may be necessary to commence turbine base concrete pours earlier due to time constraints incurred by the concrete curing process. Work on Sundays or public holidays will only be conducted in exceptional circumstances or in an emergency. Additional emergency works may also be required outside of normal working hours as described above. Work on Sundays or public holidays will only be conducted in exceptional circumstances and subject to prior notification insofar as possible with the local community.

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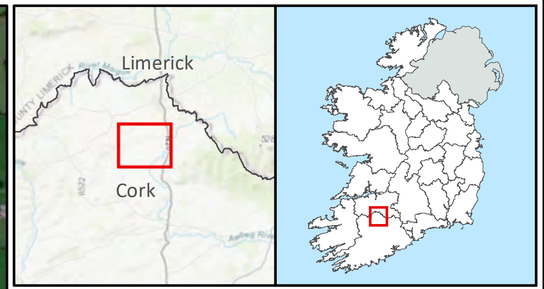

Legend

- Proposed Haul Route
- Met Mast
- Turbine Layout
- Turbine Hardstanding
- Substation
- Construction Compound

Roads

- New
- Upgrade

TITLE: Proposed Haul Route			
PROJECT: Annagh Wind Farm, Co. Cork			
FIGURE NO:	3.2		
CLIENT:	EMPower		
SCALE:	1:18000	**REVISION:**	0
DATE:	14/10/2021	**PAGE SIZE:**	A3

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4. ENVIRONMENTAL MANAGEMENT PLAN

4.1 Introduction

This Environmental Management Plan (EMP) defines the work practices, environmental management procedures and management responsibilities relating to the construction of the proposed Annagh Wind Farm.

This EMP describes how the Contractor for the main construction works will implement a site Environmental Management System (EMS) on this project to meet the specified contractual, regulatory and statutory requirements and identified mitigation measures. This plan will be further developed and expanded following the grant of planning permission and appointment of the Contractor for the main construction works. Please note that some items in this plan can only be finalised with appropriate input from the Contractor who will carry out the main construction works and once the planning conditions attached to any grant of planning are known. It is the Contractor's responsibility to implement an effective environmental management system to ensure that environmental requirements for the construction of this project are met.

All site personnel will be required to be familiar with the environmental management plan's requirements as related to their role on site. The plan describes the project organisation, sets out the environmental procedures that will be adopted on site and outlines the key performance indicators for the site.

- The EMP is a controlled document and will be reviewed and revised as necessary.
- A copy of the EMP will be located on the site H&S notice board.
- All employees, suppliers and contractors whose work activities cause/could cause impacts on the environment will be made aware of the EMP and its contents.

This section includes the mitigation measures to be employed by the contractor and client during the construction, operation and decommissioning of the proposed project as per the EIAR and NIS.

4.2 Project Obligations

In the construction of the proposed Annagh Wind Farm there are a number of environmental management obligations on the developer and the contractor. As well as statutory obligations, there are several specific obligations set out in the EIAR and NIS. These obligations are set out below. The final CEMP which will be produced by the main contractor following appointment will incorporate these obligations. The contractor and all of its sub-contractors will be fully aware of and in compliance with these environmental obligations.

4.2.1 EIA/NIS Obligations

The EIAR and NIS identified mitigation measures that will be put in place to mitigate the potential environmental impacts arising from construction of the project.

4.2.2 Planning Permission Obligations

All planning conditions associated with the project's planning permission shall be adhered to. All pre-commencement planning conditions shall be discharged fully by the project owner prior to site start.

4.2.3 Felling Licence

Felling of broadleaf forestry is required within and around the wind farm infrastructure to accommodate the construction of some turbine foundations, hard stands, crane pads, access tracks and substation.

The estimated maximum area of broadleaf tree felling required is ca. 12.6ha, which will be subject to license approval from the Forest Service prior to construction.

Tree felling will be the subject of a Felling Licence from the Forest Service and will be in accordance with the conditions of such a licence. A Limited Felling Licence will be in place prior to any felling works commencing on site. To ensure a tree clearance method that reduces the potential for sediment and nutrient runoff, the construction methodology will follow the specifications set out in the Forest Service Forestry and Water Quality Guidelines (2000) and Forest Harvesting and Environmental Guidelines (2000).

Before any harvesting works commence on site all personnel, particularly machine operators, will be made aware of the following and will have copies of relevant documentation, including:

- The felling plan, surface water management, construction management, emergency plans and any contingency plans;
- Environmental issues relating to the site;
- The outer perimeter of all buffer and exclusion zones;
- All health & safety issues relating to the site.

To increase the diversity of woodland cover within this site some planting of native tree species is proposed. These species will, in time, form areas of low-growing scrubby woodland, which will add to the overall habitat diversity of the site. Planting along the well-drained margins of roads will ensure a relatively high level of soil fertility and better drainage which is most conducive to tree growth.

4.2.4 Other Obligations

The developer and/or contractor for the main construction works will liaise directly with the County Council and An Garda Síochána in relation to securing any necessary permits to allow the works to take place including for example (non-exhaustive list):

1. Commencement notice
2. Special Permits in relation to oversized vehicles on public roads
3. Temporary Road Closures (if required)
4. Road Opening Licence (if required).

The developer will also liaise closely with the local residents, especially homeowners and landowners along the local access routes in relation to works and all reasonable steps will be taken to minimise the impact of the development on such persons.

4.3 Environmental Management Programme

4.3.1 Air Quality

Construction Stage Impacts

The principal source of potential air emissions during the construction of the proposed wind farm will be dust arising from earthworks, tree felling activities, trench excavation along cable routes, the temporary storage of excavated materials, the movement of construction vehicles, loading and unloading of aggregates/materials and the movement of material around the site.

Applying the NRA Assessment Criteria, the overall construction of the proposed wind farm would be considered a major construction site. This would result in soiling effects which have the potential to occur up to 100m from the source, with PM_{10} deposition and vegetation effects occurring up to 25m from the source.

Construction vehicles and plant emissions have the potential to increase concentrations of compounds such as NO_2, Benzene and PM_{10} in the receiving environment. Plant and machinery such as generators, excavators etc. will be required at various stages of the construction works. These will be relatively small units which will be operated on an intermittent basis. Although there will be an emission from these units, given their scale and the length of operation time, the impacts of emissions from these units will be negligible.

Construction Stage Mitigation Measures

Construction stage mitigation measures to minimise dust and emissions are as follows:

- The internal access roads will be constructed prior to the commencement of other major construction activities. These roads will be finished with graded aggregate;
- A water bowser will be available to spray work areas (wind turbine area and grid connection route) and haul roads, especially during periods of excavations works coinciding with dry periods of weather, in order to suppress dust migration from the site;
- All loads which could cause a dust nuisance will be covered to minimise the potential for fugitive emissions during transport;
- Gravel will be used at the site exit point to remove any dirt from tyres and tracks before travelling along public roads;
- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
- The access and egress of construction vehicles will be controlled to designated locations, along defined routes, with all vehicles required to comply with onsite speed limits;
- Construction vehicles and machinery will be serviced and in good working order;
- Wheel washing facilities will be provided at the entrance/exit point of the proposed wind farm site;

- The developer in association with the contractor will be required to implement a dust control plan as part of the CEMP. In the event the Planning Authority decides to grant permission for the proposed wind farm, the CEMP will address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned by the Planning Authority.
- Receptors which receive dusting and soiling from local routes entering the site; and dwellings directly adjacent to the grid connection route construction that experience dust soiling, where appropriate, and with the agreement of the landowner, will have the facades of their dwelling cleaned if required should soiling have taken place;
- Ensure all vehicles switch off engines when stationary – no idling vehicles; and
- Exhaust emissions from vehicles operating within the site, including trucks, excavators, diesel generators or other plant equipment, will be controlled by the contractor by ensuring that emissions from vehicles are minimised through regular servicing of machinery.

4.3.2 Noise and Vibration

Construction Stage Impacts

The construction noise model assessed several tasks with the potential to generate noise. These tasks included: deliveries and/or removal of material to and from site, preparation of access roads, preparation of hardstands and drainage, pouring of foundations, installation of wind turbines and works associated with grid connection.

In relation to site traffic, the noise impact from construction personnel movements to and from the site is expected to be low. During turbine erection and foundation pours, an extension to the working day may be required, i.e. 05:00 to 21:00, but this would be necessary only on a relatively small number of occasions. Late night turbine deliveries are likely to occur and may cause noise impact on local roads.

The preparation of access roads, hardstands and drainage are expected to have a slight impact and be temporary in duration. The construction works associated with the preparation of the turbine foundations are expected to have a slight impact and be temporary in duration. The construction works associated with the installation of the wind turbines are expected to have a slight impact and be temporary in duration. The works associated with the construction of the substation are expected to have a slight impact and be temporary in duration.

The potential for vibration at neighbouring sensitive locations was scoped out due to the low levels of vibration generated and the distant between construction activities and sensitive locations.

A detailed description of the potential construction stage impacts can be found in Chapter 7 of the EIAR.

Construction Stage Mitigation Measures

The predicted noise levels from on-site activity from the proposed project is below the noise limits in BS 5228-1:2009+A1:2014. Nonetheless, several mitigation measures will be employed to minimise any potential impacts from the proposed project.

The noise impact for construction works traffic will be mitigated by generally restricting movements along access routes to the standard working hours and exclude Sundays, unless specifically agreed otherwise.

For example, during turbine erection, an extension to the working day may be required, i.e. 05:00 to 21:00, but this would be necessary only on a relatively small number of occasions. If turbine deliveries are required at night it will be ensured that vehicles on local roads do not wait outside residential properties with their engines idling, and that the local residents will be informed of any activities likely to occur outside of normal working hours.

Consultation with the local community is important in minimising the impacts and therefore construction will be undertaken in consultation with the local authority as well as the residents being informed of construction activities through the Community Liaison Officer.

The construction works on site will be carried out in accordance with the guidance set out in BS 5228:2009+A1:2014. Proper maintenance of plant will be employed to minimise the noise produced by any site operations.

All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the project. Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.

The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 07:00 - 19:00 hours Monday to Friday and 07:00 - 13:00 hours on Saturdays. However, to ensure that optimal use is made of fair-weather windows, or at critical periods within the programme, it could occasionally be necessary to work outside these hours. Any such out of hours working would be agreed in advance with the local planning authority.

The on-site construction and decommissioning noise levels will be below the relevant noise limit of 65 dB $L_{Aeq,1hr}$ for operations exceeding one month, and therefore construction noise impacts are not considered to be significant. However, there is potential for temporary elevated noise levels due to the grid connection works. However, the impact of these works at any particular receptor will be for a short duration (i.e. less than 3 days). Where the works at elevated noise levels are required over an extended period at a given location, a temporary barrier or screen will be used to reduce noise levels below the noise limit where required. The noise impact will also be minimised by limiting the number of plant items operating simultaneously where reasonably practicable.

4.3.3 Biodiversity / Flora and Fauna Management Plan

This Biodiversity / Flora and Fauna Management Plan outlines the measures that will be put in place to protect species and natural and semi-natural habitats at the main wind farm site and describes how these areas will be managed during the lifetime of the project. The management plan shall be finalised in accordance with this plan following the appointment of the contractor for the main construction works. This plan should be read in conjunction with the EIAR.

4.3.3.1 Objectives

The primary objectives of the management plan over the construction, operation and reinstatement phases of the project are as follows:

- Promote the conservation of habitats on site through the establishment of management and/or mitigation;

- Provide management and mitigation for aquatic habitats and water quality;
- Provide management and mitigation for avifauna;
- Provide management and mitigation for bats and terrestrial mammals;
- Monitor the usage of the wind farm site by birds post construction;
- Monitor for any collision by birds at the wind farm site post construction;
- Monitor for any collision by bats at the wind farm site post construction.

4.3.3.2 Current Site Status and Management

Existing ecological conditions are outlined in EIAR Chapter 8 and summarised in Section 2.2.

4.3.3.3 Habitat and Species Mitigation and Management Requirements

The mitigation measures for ecology at the site are listed in Chapter 8 of the EIAR. These include mitigation measures to prevent impacts on watercourses, to prevent disturbance to breeding birds, to limit habitat disturbance and limit impacts on terrestrial mammals and bats.

In addition, monitoring methods proposed to monitor bird and bat usage of the wind farm post construction are described, as well as fatality monitoring.

4.3.3.1 Mitigation by Avoidance and design

The following measures are incorporated into the proposed wind farm design to reduce impacts on designated sites, flora and fauna through avoidance and design:

- The hard-standing area of the wind farm has been kept to the minimum necessary for the maximum turbine envelope proposed, including all site clearance works to minimise land take of habitats and flora.
- Site design and layout deliberately avoided direct impacts on designated sites
- All cabling for the project will be placed underground; this significantly reduces collision risk to birds over the lifetime of the wind farm (Drewitt and Langston, 2006).
- The grid connection routes have been selected to minimise land take of potentially sensitive habitats by following the site access tracks and public roads.
- Care has been taken to ensure that sufficient buffers are in place between wind farm infrastructure and hydrological features such as rivers and streams. Buffers of 50m from natural watercourses have been maintained, excepting where crossing points occur.
- One new stream crossing shall be required within the main wind farm site. A clear-span design has been selected to avoid instream works, and to minimise disturbance of banks and associated indirect effects such as siltation.
- Directional drilling is the proposed installation method where the grid connection crosses the Rathnacally stream. As such, in-stream works will not be required and the potential for contaminant or pollutant input will be greatly reduced as a result.

- The grid cable will be incorporated in the clear span bridge where it crosses the Oakfront stream within the proposed site.
- The design of the grid connection was also carried out with cognisance to ecological features. Cables are to be placed underneath public roads where possible to avoid impact to roadside hedgerows.
- The design of TDR Nodes 5 and 6 was carried out with cognisance of the adjacent Inner Shannon Estuary – South Shore pNHA. The route identified is constrained to the existing public road network and does not overlap or abut any habitats, supporting habitats or features of interest for this site.

4.3.3.2 Mitigation measures during the construction phase of the project

4.3.3.2.1 Introduction

Construction of this project is expected to cause temporary (disturbance) adverse impacts on local ecological receptors, as outlined in the impact appraisal above. The mitigation measures described below will reduce these impacts significantly.

4.3.3.2.2 Project Ecologist

A Project Ecologist/Ecological Clerk of Works (ECoW)) will be employed for the duration of the construction phase to ensure that all the mitigation measures outlined in relation to the environment are implemented. The Project Ecologist/ECoW will advise on environmental effects and communicate with the project owner and contractor to ensure the required actions to implement the mitigation prescribed in this EIAR are carried out.

4.3.3.2.3 Habitats and Flora

The area of the proposed works will be kept to the minimum necessary, including all site clearance works, to minimise disturbance to habitats and flora. In this case, the footprint of the proposed development has been kept to the minimum necessary, including the use of layout design methods including existing roads and stream crossings to minimise excavation works.

No disturbance to habitats or flora outside the proposed development area will occur. Works will be restricted to the immediate footprint of the development. Machinery, and equipment will be stored within the site compound. Designated access points will be established within the site and all construction traffic will be restricted to these locations. Access to the site will be primarily via the existing local road L1322. HGVs shall approach the site via this road from the East. The met mast access route will be via the existing farm track from the south.

<u>Translocation of Wet Grassland Turves</u>

Turves from diverse wet grassland within the footprint of the T02 hard standing area will be translocated to receptor sites in adjacent fields within the site boundary identified in Figure 8-13, in order to preserve the flora and seedbank present within the footprint. The receptor site will be prepared in advance by excavating shallow linear trenches where the existing grassland is retained between trenches. This will reduce the likelihood of translocated turves drying out. The turves will be directly translocated to the receptor sites under the supervision of an ecologist and will not be stockpiled. If required, watering of newly translocated turves will be carried out to prevent drying and aid in establishment.

Hedgerow and Treeline Reinstatement

Hedgerows removed or lowered by TDR Node works will be reinstated using the same native species present in original hedgerows. Semi-mature specimens of native provenance will be used to accelerate rehabilitation of these areas. Native, semi-mature specimen trees will be planted where large trees are felled at TDR Nodes to offset the loss of existing trees.

Meadow Planting

The site compound area will be reinstated following construction by seeding with a native wildflower meadow seed mixture. Wildflower seed mixes are required to be of native provenance; mainstream commercially available mixes are not acceptable.

Where invasive non-native species are present at TDR Nodes, measures will be implemented to ensure spread of these species is prevented, and where feasible eradicated, as described in Appendix 8.7 Invasive Species Management Plan (ISMP).

4.3.3.2.4 Felling of Immature Woodland of Local Importance (Higher Value) at adjacent Inner Shannon Estuary – South Shore pNHA, located outside of its associated SAC

With regards to TDR Node 5, the proposed works are confined to felling of immature Norway Maple trees, preparation of local load bearing surface at the existing roundabout, and removal of street furniture. The following will be implemented:

- Prior to works an invasive species survey will be undertaken in the area to reconfirm the findings of the EIAR.
- The invasive species plan and management plan will be adhered to for works at this area.

4.3.3.2.5 Management of the Spread of Non-native Invasive Species

According to Invasive Species Ireland (ISI) invasive non-native species are the second greatest threat (after habitat destruction) to worldwide biodiversity. Invasive species negatively impact Ireland's native species; changing habitats and ultimately threatening ecosystems which impacts on biodiversity as well as economics as they are costly to eradicate.

Halting the spread of non-native invasive species can be achieved via prevention, containment, treatment and eradication.

Prevention

Main Wind Farm Site

Cherry laurel is present in the hedgerow at the proposed site entrance, while Sycamore is the dominant tree species making up the small area of Mixed broadleaved woodland at the site entrance. As such interaction with proposed works is unavoidable for both of these species and containment measures are required in accordance with the invasive species management plan (ISMP) (Appendix 8.7). Options for eradication are also detailed in the ISMP.

Grid Connection Route

Prior to trimming or vegetation removal along the grid connection an invasive species survey will be undertaken to reconfirm the findings of the EIAR.

Additional Works along the Turbine Delivery Route

Prior to trimming or vegetation removal at turbine delivery work locations, an invasive species survey will be undertaken to reconfirm the findings of the EIAR. As interaction of proposed works with invasive species is likely based on surveys of the existing environment, containment measures are required in accordance with the invasive species management plan (ISMP). Proposed eradication measures are also detailed in the ISMP (Appendix 8.7 of the EIAR).

Containment, Treatment, Eradication

- Cordoning off the area – this shall include a buffer of 5m surrounding the area of infestation to ensure that seeds are not transported to other sections of the site via vehicular traffic, equipment or PPE.
- No machinery or personnel shall be allowed within this restricted area. Similarly, there shall be no storage of materials within or adjacent to this restricted area.
- There shall be no vegetation clearance or trimming within the cordoned area (except where undertaken in accordance with the invasive species management plan) as this can lead to the species recolonising other areas via the wind, water if displaced into drains, or soil and vegetation attached to machinery, vehicles or personnel.
- If schedule III species are present, no soil or vegetation shall be removed from this area unless it is securely contained and is transported under licence to a suitably licenced facility for treatment.
- For non-schedule III species, no soil or vegetation shall be removed from this area unless it is securely contained and is to be disposed of appropriately onsite or transported to a suitably licenced facility for treatment.
- Informing all site staff through toolbox talk as part of site inductions.
- Any new sightings of the species shall by relayed to construction staff and the developer via the project ecologist/ECoW. These areas shall follow the same protocol as described above.
- Reporting sighting(s) to the NPWS and NBDC and liaising with the NPWS.

4.3.3.2.6 Mammals (excluding bats)

An ecologist will supervise areas where vegetation, scrub and hedgerow removal will occur prior to and during construction as appropriate (e.g., an ecologist may be required during some clearance works of areas where vegetation is too dense to check beforehand). This will ensure that any site-specific issues in relation to wildlife not currently present (e.g. Badger setts, Red squirrel dreys) on site will be reconfirmed prior to commencement of works so as to allow appropriate mitigation measures to be put in place.

In the event that an issue arises, the NPWS will be updated, consulted will be undertaken.

Construction operations will take place predominantly during the hours of daylight to minimise disturbances to faunal species at night. Some works along the grid connection route and wind farm site may occur at night but the project ecologist/ECoW shall limit night-time works to sections of the route / site which avoid sensitive features (e.g. mature treelines).

Badgers

A pre-construction mammal survey including a badger survey will be undertaken within the mammal survey study area to reconfirm the existing environment as described in the EIAR and, in the event that a Badger sett should be encountered at any point, then NPWS will be informed and NRA *Guidelines for the Treatment of Badgers Prior To the Construction of National Road Schemes* will be followed.

A number of Badger setts including active setts were present within the site boundary area during surveys, and there are records of Badger in the local area.

Badgers can move between setts regularly and may also excavate new setts within their territory. As such there is potential for the layout and status of the Badger setts onsite to change in the intervening period between planning and construction stages. A derogation/disturbance licence will be required if planning is granted, and as such a derogation report and licence application have been prospectively submitted to NPWS to initiate consultation and to obtain a licence.

Setts within the footprint of proposed infrastructure/felling area will require (following evacuation if active) controlled destruction under ecological supervision. Based on baseline conditions. One sett will require controlled destruction. Setts in close proximity to the development will require temporary hard-blocking and exclusion for the duration of construction works to ensure that Badgers potentially occupying these setts during construction works are not injured.

No hard-blocking or sett exclusions will be undertaken during the Badger breeding season (December-June inclusive).

Construction of an artificial sett will be undertaken in consultation with NPWS due to the presence of a sett close to infrastructure which may be damaged and/or destroyed, and which will be closed with no alternative setts nearby during construction. The artificial sett will be located c. 50m from the existing sett in question..

A report detailing evacuation procedures, sett excavation and destruction, and any other relevant issues will be submitted to the NPWS, in fulfilment of the wildlife licence conditions.

Details on the location of setts, proposed mitigation and location of artificial sett are included in the confidential appendix Badger & Red Squirrel Derogation Application report.

Vegetation clearance

There is the potential for setts to be discovered during vegetation clearance works. Care will need to be taken during this early stage of the development and a competent ecologist will be required on-site for these works. If setts are discovered all works within 30m of the sett shall cease including vegetation clearance. NPWS shall be contacted and a derogation/disturbance licence shall be sought/amended as required. An activity survey shall be carried out to assess the potential for the sett to be used by Badgers.

Measures to prevent the injury of Badgers during proposed mitigation measures

In the event that a Badger is found injured during the proposed mitigation measures, it is important to realise that injured Badgers will be frightened and can be very dangerous. They are strong animals and are not used to being handled, so no attempt will be made to touch an injured Badger, as this could result in workers being bitten.

NPWS shall be contacted along with ISPCA and potentially a vet specified by NPWS capable of treating the species.

Otter

No evidence of otter holts was observed within the study area, and otter signs were limited to a single spraint, indicative of the Oakfront stream being used as a commuting corridor. A pre-construction mammal survey will be undertaken (no later than 12 months prior to construction) within the mammal survey study area to reconfirm the existing environment as described in the EIAR and, if an Otter holt should be encountered at any point, then NPWS will be informed and NRA *Guidelines for the Treatment of Otters Prior To the Construction of National Road Schemes* will be followed.

Red Squirrel

Where possible, any required felling of trees in forestry areas will be limited to time periods outside which Red Squirrel may have young in dreys (peak period January to March).

If this is unavoidable then areas to be clear felled will be surveyed in advance by a suitably qualified ecologist to determine whether any occupied dreys are present. Suitable mitigation measures will be implemented and a derogation/disturbance licence will be sought if dreys are found within the felling footprint or adjacent areas

Irish Stoat

Since stoat dens are difficult to detect, mitigation measures should focus on avoiding impacts during the breeding season. Since stoats are born in April, and reach adult size by September, the implementation of mitigation measures for breeding birds (no vegetation removal between March-August inclusive) will avoid disturbance to stoat during the majority of their breeding season.

If vegetation clearance is unavoidable during this period, then areas to be clear felled will be surveyed in advance by a suitable qualified ecologist to determine whether any stoat are present. A license under the Wildlife Act will be sought as necessary.

Irish Hare, Pygmy Shrew and Hedgehog

These species are mobile and will disperse, however, hibernating Hedgehogs and the young of Irish Hare, Pygmy Shrew or Hedgehog are vulnerable during clearance of vegetation. An ecologist will check for the presence of hibernating hedgehog and or young mammals as appropriate, prior to vegetation clearance works prior to or during construction (as necessary).

Where habitat is too dense the ecologist will supervise vegetation removal and grassland trimming/maintenance during clearance works as appropriate.

- Outside of the bird breeding season (March 1st to August 31st inclusive) attention will be paid to the removal of vegetation, scrub and hedgerow with regards to leverets, October to March for hibernating Hedgehog and September to October for breeding Pygmy Shrew as is appropriate.
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- Within the breeding bird season and outside of it, attention will be paid to the removal and/or maintenance of dense grassland for breeding hare (all year), pygmy shrew (April to October) and Hedgehog (April to July).

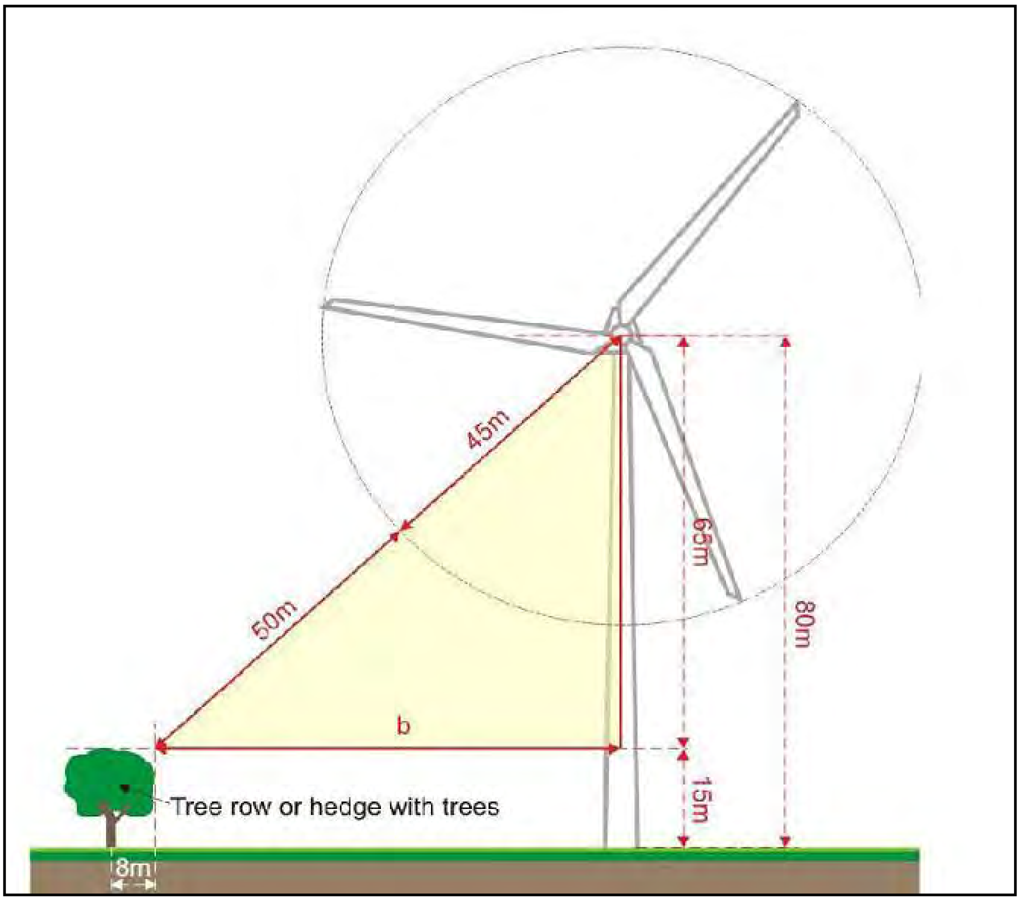
4.3.3.2.7 Bats

According to SNH (2019) guidance:

> *"The Eurobats guidance recommends a 200m buffer around woodland areas. There is, however, currently no scientific evidence to support this distance in the UK and it is recommended that a distance of 50m between turbine blade tip and nearest woodland (or other key habitat features such as wetlands etc.) is adequate mitigation in most, lower risk situations. Exceptionally, larger buffers may be appropriate, e.g. near major swarming and hibernation sites. The longevity of wind farms should also be taken into account and the maximum growth, or management, of woodland and other relevant habitat features considered in their planning.*

These distances were taken into account during the design phase of the proposed Annagh Wind Farm Development.

The following formula was used to calculate the required felling buffer for each turbine (taking into account the height of surrounding woodland/plantations at each turbine location):



$b = \sqrt{(50 + bl)^2 - (hh - fh)^2}$ where: b = the distance on the ground between the edge of the canopy and the turbine (m) bl = blade length (m) hh = hub height (m) fh = feature height (m)
$b = \sqrt{(50 + 75)^2 - (100 - fh)^2}$

Note: fh for each turbine location is given in column 3 of Table 4-1 below

Locations representative of the habitat types and features at turbine locations were surveyed, and the bat survey activity findings recorded informed the application of the 50m blade tip buffer described above at all six proposed turbine locations. Surrounding habitats, height of surrounding trees and felling buffer calculated using the above equation are included in Table 4-1 below. Note that the tree heights have been increased to allow for growth prior to felling, thereby expanding the buffers.

To minimize risk to bat populations, a buffer zone is recommended around any treeline, hedgerow, woodland feature, into which no part of the turbine should intrude. The buffers for each turbine are presented in Table 4-1:

Table 4-1: Assessment of potential turbine/bat conflict zones (based on proposed turbine blade length 75m)

Turbine Number	Habitats Requiring Felling	Surrounding Tree/Hedgerow Height (fh/m)	Felling Buffer Radius (m)	Felling Buffer Radius (m)
1	Mixed broadleaved/conifer woodland	7	9	86
2	Mixed broadleaved/conifer woodland	7	9	86
3	Mixed broadleaved woodland	12	15	92
4	Mixed broadleaved woodland	7	9	86
5	Immature woodland	4.5	6	82
6	Mixed broadleaved woodland	7	9	86

Existing trees will be cleared around all six turbines to provide a vegetation-free buffer zone around each turbine. All buffers will be maintained throughout the lifetime of the wind farm.

The following mitigation measures for bats are proposed:

Supervision of vegetation clearance

An ecologist/ECoW will supervise areas where vegetation, scrub and hedgerow removal will occur prior to and during construction as appropriate (e.g., ecologist may be required during some clearance works of areas where vegetation is too dense to check beforehand). This will ensure that any site-specific issues in relation to wildlife not currently present (e.g., Bat roost locations) on site will be discovered prior to commencement of works to allow appropriate mitigation measures to be put in place. In the event that an issue arises, the NPWS will be informed and the relevant guidelines will be implemented as appropriate (e.g. NRA guidelines).

Retention of trees

Several species of bats roost in trees. Treelines and mature trees within the wind farm site will be avoided and retained intact. Overall impacts on these areas will be reduced through modified design and sensitivity during construction.
Any trees and treelines along approach roads and planned site access tracks will be retained unless felling is unavoidable.

Retained trees should be protected from root damage by an exclusion zone of at least 7 metres or equivalent to canopy height. Such protected trees will be fenced off by adequate temporary fencing prior to other works commencing.

Tree Felling Measures (TDR)

Where mature trees with low bat roosting potential are proposed to be felled, these trees will be left in situ for 24 hours prior to disposal. This will allow any bats present to escape.

It is noted that only low potential trees were identified at TDR Nodes; two trees with heavy Ivy growth (TDR Nodes 8 and 10.3) and three trees with single knot holes (TDR Nodes 10.1, 10.4 and 10.8) are within TDR Node footprints. These trees may have potential for individual/small numbers of bats to roost opportunistically and are classified as having low suitability for roosting bats.

Compensation for loss of commuting routes/Diversion from felling buffers

Linear features such as hedgerows and treelines serve as commuting corridors for bats (and other wildlife). The magnitude of habitat loss is Imperceptible. The total length of hedgerow to be removed is 277m (2.3 % of this habitat type within the study area), although it is noted that a large proportion of this is either within or bounding forestry blocks and as such is better considered as woodland edge in terms of bat habitat. A total of 11m (0.4% of this habitats type in study area) of treelines will be lost. This is made up of two 5.5-metre lengths along the Oakfront stream. Felling around turbines will alter commuting and foraging routes associated with existing woodland edges.

Hedgerow planting using saplings will be undertaken to compensate for the loss of hedgerows currently used by bats and also to provide new routes which guide bats away from turbine buffers. Native species of Irish provenance will be used as they support more insect life than non-native varieties. This will compensate for habitat loss and provide continuity in the landscape.

Habitat retention, replacement and landscaping

Habitat replacement and landscaping could compensate for or add to the wildlife value of the area and also provide areas of aesthetic as well as wildlife interest. In general, landscape design should aim to retain the quality of the landscape and ensure its protection within the landscaping programme. Existing hedgerows and semi-natural scrub or semi-natural grasslands within the study area outside of the footprint of the development will be retained and incorporated into the landscaping. Disturbed areas will be allowed to recolonise naturally.

Lighting restrictions

In general, artificial light creates a barrier to bats so lighting should be avoided where possible. Construction operations within the wind farm site will take place during the hours of daylight where possible to minimise disturbances to faunal species at night. Some works along the cable route and wind farm site may occur at night but the project ecologist/ECoW shall limit night-time works to sections of the route / site which avoid sensitive features (e.g. mature treelines).

Where lighting is required, directional lighting (i.e. lighting which only shines on work areas and not nearby countryside) will be used to prevent overspill.

This can be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvers and shields to direct the light to the intended area only.

Pre-construction Surveys

If three years lapse from between planning-stage surveys in 2020 and installation of the wind turbines, it will be necessary to repeat one season of surveys during the activity period (EUROBATS, 2014). Future survey work will be completed according to best practice guidelines available (Hundt, 2012; Collins, 2016; SNH, 2019, 2021) and includes static detector, activity and roost inspection surveys.

4.3.3.2.8 Avifauna

Subject to other environmental concerns (e.g., run-off), the removal of vegetation and scrub as well as trimming of trees along the TDR will be undertaken outside of the bird breeding season (March 1st to August 31st inclusive). This will help protect nesting birds.

This in line with best practice recommendations for mitigation measures in regard to birds and wind farms (Drewitt, A. L. and Langston, R. H., 2006).

The clearance of vegetation, including forestry plantation, should only be carried out in the period February to September inclusive, i.e. outside the main bird nesting season. Where vegetation removal is required outside this period, vegetation must be inspected for nesting birds by a suitably qualified Ecologist. In the event of birds nesting within areas required to be felled suitable mitigation will be put in place and felling will only proceed upon agreement with NPWS and receipt of a wildlife licence.

Construction operations will take place during the hours of daylight to minimise disturbances to roosting birds, or active nocturnal bird species. This is in line with best practice recommendations for mitigation measures in regard to birds and wind farms (Drewitt and Langston, 2006).

Limited operations such as concrete pours, turbine erection and installation of the grid connection may require night-time operating hours; these works will be supervised by the project ecologist/ECoW.

Toolbox talks will be undertaken with construction staff on disturbance to key species during construction. This will help minimise disturbance. This is in line with best practice recommendations for mitigation measures with regard to birds and wind farms (Drewitt and Langston, 2006).

Re-instated hedgerows will be planted with locally sourced native species. This will result in habitat enhancement for local species of conservation importance such as Greenfinch. This is in line with best practice recommendations for mitigation measures in regard to birds and wind farms (Drewitt and Langston, 2006).

The translocation of wet grassland from the road and hardstanding footprint south of T02 will offset habitat loss for breeding Meadow Pipit and Skylark.

Kingfisher: Implement mitigation measures outlined in Chapter 10 - Hydrology and Water Quality of this EIAR, the CEMP and Aquatic Ecology Mitigation, section 4.3.3.2.9 below, to minimise and prevent the identified indirect impacts to water quality.

A re-confirmatory survey (March/April) will be conducted of the proposed turbine locations, Roads and hard standings to assess any evidence of Buzzard, Kestrel, Sparrowhawk, Snipe and Woodcock activity or taking up of new territories. Should any new nests be recorded, works at these locations will be restricted to outside the breeding season (April-July) or until chicks are deemed to have fledged (following monitoring). A similar survey will be implemented for Barn Owl, focusing on the derelict farmhouse near the proposed met mast access track. Although not currently used by this species, this building could be re-occupied by breeding Barn Owl and as such if present at the time of construction a seasonal restriction to avoid disturbance to breeding birds will be required. Works at this location will be restricted to outside the breeding season (April-July) or until chicks are deemed to have fledged (following monitoring).

4.3.3.2.9 Aquatic Ecology - Water Quality Measures during the Construction Phase

Proposed Mitigation Measures for the Construction Stage of the project

Construction phase mitigation for hydrology will follow that outlined in section 10.7 of Chapter 10, and the mitigation measures outlined will be adhered to in conjunction with those outlined in this section. Construction phase mitigation measures for aquatic ecology predominantly involve the preservation of water quality.

All measures for the protection of water quality within the proposed development site will also protect the aquatic ecology and fisheries value of downstream watercourses.

All measures for the protection of water quality within the proposed development site, as detailed in this CEMP, will also protect the aquatic ecology and fisheries value of downstream watercourses. The measures adopted within this CEMP (including recommendations from Inland Fisheries Ireland) will ensure effective protection of aquatic ecological interests downstream of the proposed development, particularly the habitats supporting sensitive aquatic species and with connectivity to the Blackwater River SAC (002170).

Proposed Mitigation Measures for Tree Felling

Localised tree felling will be required in the vicinity of turbine T1, T2, T3, T4, T5 and T6 hardstand areas, the substation (and associated access track) and along the access tracks to T1 and T6.

It is estimated that 14.5ha of existing coniferous forestry will be felled to facilitate development of the proposed wind farm infrastructure (e.g. turbine hardstands, substation compound and associated access tracks). There are potential source-receptor pathways from felling areas to both the Ardglass River and Oakfront River.

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones (Forestry Service, 2000a, 2000b). This is particularly important adjacent to the Ardglass River and adjoining drainage channel located near turbine T4 (c.130m shortest instream distance) and the Oakfront River and associated drainage channel near turbine T3 (c.160m shortest instream distance). Given the close proximity of felling areas to receiving watercourses and potential source-receptor pathways (i.e. drainage channels), a minimum buffer zone for felling areas of 15-20m will be applied. Check dams/silt fences will be required within the drainage channels adjoining the Ardglass and Oakfront Rivers. Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Brash mats will be used to support vehicles on soft ground and to avoid mineral soils erosion and the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place before they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall.

To ensure tree clearance methodology that reduces the potential for sediment and nutrient run-off, the construction methodology will follow the specifications set out in the following guidance documents:

- DAFM (2019). Standards for Felling and Reforestation;
- Forestry Service (2000a). Forest Service Forestry and Water Quality Guidelines;
- Forestry Service (2000b). Forest Harvesting and Environmental Guidelines;

Additional mitigation measures for the protection of aquatic ecology and receptors during felling activities will follow those outlined in section 10.7.1.2 and 10.7.1.6 of Chapter 10 (e.g. minimum buffer zone widths along watercourses).

Given the sensitivity of aquatic ecological receptors in the Ardglass River, Oakfront River and downstream-connecting Blackwater River SAC (002170) (e.g. salmonids, lamprey species, kingfisher, otter, white-clawed crayfish), it is recommended to undertake felling in the spring period to facilitate the sowing of grass seeds post-harvest to aid sediment filtration and nutrient absorption, using native grass species *Holcus lanatus* and *Agrostris capilaris* (DAFM, 2018). Machine operations must not take place in the 48-hour period before predicated heavy rainfall, during heavy rainfall or in the 48-hour period following heavy rainfall (DAFM, 2018). Removal of branch lop-and-top and other debris (brash) from felling areas within 20m of drainage channels will reduce nutrient seepage immediately post-felling and in the proceeding years after felling has occurred (DAFM, 2019).

Mitigation measures for access track construction

It is proposed to construct approximately 4.5km of new internal access tracks and carry out upgrades to 0.4km of existing agricultural tracks (including bend widening) to facilitate site access and construction activities. All track widening will be undertaken using clean uncrushable stone with a minimum of fines to reduce the risk of suspended solid releases to receiving watercourses.

Still traps will be placed in the new roadside swales. Proposed new tracks will be drained as via roadside swales with stilling ponds at the end of the swale.

These grassed swales will serve to detain flow and reduce the velocities of surface water flows. The swales will be 0.3 m deep with a bottom width of 0.5 m and side slope of 1 in 3. The swales will be constructed in accordance with CIRIA C698 Site Handbook for the Construction of SuDS which will be used in conjunction with CIRIA C753 The SuDS Manual. Where roadside drains are laid at slopes greater than 2%, check dams will be provided.

Mitigation measures to protect site hydrology and water quality are provided in section 10.6 and 10.7.1 of chapter 10. These include measures to reduce or prevent surface water run-off, suspended solids, hydrocarbons, site wastewater, cement and nutrients escaping to receiving surface waters. The mitigation measures proposed will reduce potential direct and indirect impacts from the construction of access tracks. The risk of water quality impacts to receiving watercourses via siltation or nutrient release will be further reduced through siltation management as detailed in section 4.3.6.

The 13 no. surface water drains within the site boundary to be crossed during the construction phase will be via precast box culverts (refer to section 10.6.4 of chapter 10). Silt Protection Controls (SPCs) are proposed at the location of the drain crossings. The SPCs will consist of a minimum of silt traps containing filter stone and filter material staked across the width of the swales and upstream of the outfall to any watercourse.

Mitigation measures for turbine base and met mast construction

The greatest threat to aquatic ecology from turbine base construction (based on site topography and the layout of surface water features) is impacts to water quality identified at turbines T3 and T4 which are located approx. 130m and 170m from the Ardglass River and Oakfront River, respectively (indirect connectivity via drainage ditches). Both the Ardglass and Oakfront Rivers share downstream hydrological connectivity with the Awbeg River and Blackwater River SAC (002170), with the shortest hydrological distances to the European site being 0.7km and 1.4km, respectively (via surface water drains and the rivers).

Please refer to section 10.6 of Chapter 10 for detailed mitigation measures for site drainage and silt attenuation to prevent impacts to the water quality of downstream watercourses during the construction phase. These include measures to prevent run-off erosion from vulnerable areas and consequent sediment release into nearby watercourses to which the proposed development site discharges.

The mitigation measures proposed will reduce potential direct and indirect impacts from the construction of the turbine foundations/hardstands. The risk of water quality impacts to receiving watercourses via siltation or nutrient release will be further reduced through siltation management.

Mitigation measures for site drainage

Permanent roadside drainage will be installed as part of the construction stage. This will include the use of interceptor drains, swales, check dams and stilling ponds. These measures will buffer site run-off during periods of high rainfall by retaining the water until the storm hydrograph has receded. The proposed locations of the stilling ponds are provided in the Surface Water Management Plan (SWMP) contained in Appendix 10.3 and in the Planning Drawings. Silt fencing will be provided at strategic locations (see section 10.7 in chapter 10 of the EIAR) to further protect watercourses during the construction phase.

Site drainage, including silt traps and stilling ponds, will be put in place in parallel with or ahead of construction, such that excavation for new infrastructure will have functional drainage system in place. The stilling ponds will remain in place during construction phase. The stilling ponds will drain diffusely overland, over existing vegetated areas, within the site boundary.

The stilling ponds will be back-filled and the swales that were connected to them will be re-connected to the outfall once construction is completed. Silt Protection Controls (SPCs) are proposed at the location of the 11 no. drain crossings. The SPCs will consist of a minimum of silt traps containing filter stone and filter material staked across the width of the swales and upstream of the outfall to any watercourse.

It is noted that there is little direct connectivity between the development area and the riverine watercourses draining the site (i.e. heavily vegetated drainage channels connecting to the Ardglass River and Oakfront River), so the risk of silt-laden surface water run-off to receiving watercourses is greatly reduced, even in the absence of mitigation. However, detailed mitigation measures to protect water quality (which include but are not limited to sediment run-off control and management of concrete and aquatic buffer zones) in respect of site drainage are outlined in section 4.3.6.

Please refer to section 10.6 of Chapter 10 for detailed mitigation measures for site drainage and silt attenuation to prevent impacts to the water quality of downstream watercourses during the construction phase.

Mitigation measures for GCR installation

In addition to the crossing on 6 no. drainage channels, there will be a requirement for 2 no. riverine watercourse crossings along the GCR in total. These are on the Rathnacally Stream (GCR-WCC1) and Oakfront River (WF-HF5).

The crossing of the Rathnacally Stream on the L1322 will be via horizontal directional drilling (HDD), located approx. 1.5km upstream of the Blackwater River SAC (002170). Mitigation measures relating to water quality preservation are outlined in detail in section 10.7 of chapter 10. These measures will also serve to protect sensitive aquatic ecological receptors and Blackwater River SAC (002170) qualifying interest species and habitats. Although no-instream works are proposed, the drilling works will only be completed during a dry period between July and September (as required by Inland Fisheries Ireland for in-stream works) to avoid the salmonid spawning season and sensitive life stage period. A pre-construction otter survey to reconfirm the findings of the EIAR will be undertaken in the vicinity of the drilling locations to ensure than no breeding or resting areas are located within 150m of the drilling locations (no holts recorded in these locations to date during otter surveys). Should an otter breeding (holt) or resting area (couch) be detected, a derogation licence would need to be obtained from the NPWS to facilitate drilling works.

Excavation of the grid route trench will require excavation of soils/subsoils which has the potential to impact the water quality and aquatic habitat of receiving watercourses. Excavated spoil emanating from the cut trenches, where appropriate (i.e. when trenching within private tracks or the public road) will be used to back-fill the trenches. Any excess will be reused on site or if unsuitable will be disposed of off-site, at an appropriate licenced facility as listed in section 4.3.8. Mitigation measures to prevent the escapement of suspended solids to receiving watercourses (e.g. silt fences, interceptor drains, stilling ponds, drain blocking etc.) are outlined in Section 4.3.6. On the Rathnacally Stream, silt fences will also be constructed in the vicinity of the excavated areas on the stream banks to prevent siltation of the adjacent watercourse. An Ecological Clerk of Works (ECoW) will monitor both turbidity and observe the riverbed during the drilling process to detect any leakage (frac-out) of drilling fluid. Should this leakage be observed, works will cease immediately. If drilling fluids are required, a biodegradable fluid such as CLEARBORE shall be used rather than Bentonite.

The GCR crossing of the Oakfront River (WF-HF5) will be via a single span, pre-cast concrete bridge. This will avoid the requirement for instream works. Nevertheless, installation will only be completed during a dry period between July and September (as required by Inland Fisheries Ireland for in-stream works) to avoid the salmonid spawning season and sensitive life stage period.

Potential releases of sediment-laden surface run-off as a result of bank clearance works to facilitate bridge installation/access will be mitigated against through the water quality mitigation measures applied elsewhere on site (see section 4.3.6).

Mitigation measures for turbine delivery route

The TDR will cross the Rathnacally Stream at a local road crossing on the L1322 (GCR-WCC1). This crossing is located approx. 1.5km upstream (by water) of the Blackwater River SAC (002170).

There are no instream works required at the bridge structure to facilitate turbine delivery, although hedgerow trimming and wall lowering will be required to facilitate oversail. These minor, localised works could in the absence of mitigation cause impacts to the water quality of the receiving Rathnacally Stream and downstream Blackwater River SAC (002170).

Mitigation measures relating to water quality preservation are outlined in detail in section 4.3.6. These measures, which include but are not limited to silt fences, roadside drain blocking, refuelling protocols and spoil disposal, will also serve to protect sensitive aquatic ecological receptors and Blackwater River SAC (002137) qualifying interests such as Atlantic salmon, lamprey species, otter and white-clawed crayfish.

Works within and adjacent to watercourses, as part of HDD and new bridge construction, will adhere the guidelines set out in the best practice documents as listed below:

- CIRIA (2001). Control of water pollution from construction sites - Guidance for consultants and contractors (C532). Construction Industry Research and Information Association, London.
- CIRIA (2006). Control of Pollution from Linear Construction Project; Technical Guidance (C648). Construction Industry Research and Information Association, London.
- CIRIA (2015a). Manual on scour at bridges and other hydraulic structures, second edition (C742). Construction Industry Research and Information Association, London.
- CIRIA (2015b). Environmental Good Practice on Site (4th edition) (C741). Construction Industry Research and Information Association, London.
- CIRIA (2019). Culvert, screen and outfall manual (C786). Construction Industry Research and Information Association, London.
- DHPLG (2019). Draft Revised Wind Energy Development Guidelines. Department of Housing, Planning and Local Government. December 2019
- Enterprise Ireland (unknown). Best Practice Guide (BPGCS005) Oil storage guidelines.
- IFI (2016). Guidelines on Protection of Fisheries during Construction Works in and adjacent to waters. Inland Fisheries Ireland, Dublin.
- IFI (2019) Windfarm scoping document (draft). Inland Fisheries Ireland, Dublin.
- IWEA (2012). Best Practice Guidelines for the Irish Wind Energy Industry. Guidance prepared by Fehily Timoney and Company for the Irish Wind Energy Association.
- Kilfeather, P.K. (2007). Maintenance and protection of the Inland Fisheries resource during road construction and improvement works. Requirements of the Southern Regional Fisheries Board. Southern Regional Fisheries Board, Clonmel, Co. Tipperary
- Murphy, D.F. (2004). Requirements for the Protection of Fisheries Habitat During Construction and Development Works at River Sites. Eastern Regional Fisheries Board, Dublin.

- NRA (2008). Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes. National Roads Authority.
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note);
- SNH (2012). Assessing the cumulative impact of onshore wind energy developments. Scottish Natural Heritage, March 2012.
- SNH (2019b). Good Practice during Wind Farm Construction (4th edition). Scottish Natural Heritage.

4.3.3.2.10 Other Species

In the event that construction is required to proceed during the breeding season of common frog (approximately January – midsummer), a preconstruction amphibian survey will be completed and translocation under licence will be undertaken where active breeding drains are within the development footprint.

Protection of existing hydrological conditions where drains are adjacent to or within the zone of influence (i.e. could be impacted by drainage works elsewhere) are required.

In the event that the hydrology of existing breeding areas within the zone of influence cannot be maintained, translocation to suitable receptor sites will be used.

Amphibian fencing will be erected to prevent re-entry to areas which have been evacuated and any areas which could be occupied by amphibians during the construction period.

4.3.3.3 Mitigation measures during operation

4.3.3.3.1 Designated Nature conservation sites

Implement mitigation measures outlined in section 8.6.3.6 and Chapter 10 - Hydrology and Water Quality of this EIAR, in addition to the NIS to minimise and prevent the identified indirect impacts on water quality as outlined previously.

4.3.3.3.2 Habitats and Flora

Implement mitigation measures outlined in section 8.6.3.6 and Chapter 10 - Hydrology and Water Quality of this EIAR, in addition to the NIS, to ensure that there will be no contamination of water bodies due to siltation or contaminated run-off during the operational phase.

Invasive species will continue to be treated within the project area according to the invasive species management plan for as long as they persist within the site.

Either of the following options are required to be used in maintaining the wildflower meadow: actively managed grazing, or mechanical mowing.

Light annual grazing using sheep or cattle can be used to maintain the planted wildflower meadow. In spring or summer grazing of the site will be avoided to favour early or late flowering species respectively and allow the development of nectar and seeds for ground nesting birds and mammals.

Active management of grazers and regular observation of conditions onsite will be required to determine the correct stocking level at the outset. It is noted that the use of sheep carries a higher risk of overgrazing if too many are present, increasing the need for close observation in the initial stages.

Mechanical mowing can also be used, either in combination with grazing, or alone. If mowing only is used, one cut and lift per year between October – February is required. This can be split into rotational mowing where half is cut late in the year and half is cut early the following year, however all areas should only be cut once per year.

4.3.3.3.2.1 Badgers

Felling/vegetation clearance operations (maintenance of felling buffers) in areas within 50m of badger setts will not take place during the badger breeding season (December-June inclusive). Outside the breeding season, the following buffers apply: no heavy machinery (tracked vehicles) may be used within 30m of badger setts; no machinery (wheeled vehicles) may be used within 20m of badger setts; activities of any description are not permitted within 10m of sett entrances (10m vegetation buffer to be retained around setts).

4.3.3.3.3 Bats

Feathering of Blades

Turbines will operate in a manner which restricts the rotation of the blades as far as is practicably possible below the manufacturer's specified cut-in speed. This is achieved by feathering the blades during low wind speeds; the angle of the blades is rotated to present the slimmest profile possible towards the wind, ensuring they do not rotate or 'idle' when not generating power.

Turbine blades spinning in low wind can kill bats, however bats cannot be killed by feathered blades which are not spinning (Horn *et al*., 2008). The reduction in speed resulting from feathering compared with normal idling may reduce fatality rates by up to 50% (SNH 2021).

As such, the feathering of blades to prevent 'idling' during low wind speeds is proposed for all turbines.

Cut-in Speeds/Curtailment

Increasing the cut-in speed above that set by the manufacturer can reduce the potential for bat/turbine collisions. A study by Arnett *et al*., (2011) showed a 50% decrease in bat fatality can be achieved by increasing the cut-in speed by 1.5 m/s.

Species with elevated risk of collision (Leisler's bat, soprano and common pipistrelle) in particular would benefit from increasing the cut-in speed of turbines, as dictated on a case-by case basis depending on the activity levels recorded at each turbine.

Although the proposed turbine locations are within areas of the Site that will have lower activity levels than the linear features and edge ecology recorded during surveys (open areas and plantation woodland), the locations within the site identified to represent areas post-construction (within plantation woodland) and open space have a moderate to high activity level. Therefore, increased cut-in speeds will be implemented from commencement of operation.

Cut-in speeds will be increased during the bat activity season (April-October) and/or where weather conditions are optimal for bat activity (see below) from 30 minutes prior to sunset and to 30 minutes after sunrise at turbines where surveillance shows high bat activity levels for High Risk species and/or if bat carcasses are recorded.

Cut-in speeds restrictions should be operated according to specific weather conditions:

1. When the air temperature is above approximately 10 to 11°C at nacelle height.
2. Generally, bat activity peaks at a wind speed range of 5.0 to 6.5m/s (at nacelle height).

This strategy is however inefficient and results in considerable unnecessary down time for the turbines concerned. Therefore, a more focused approach is recommended. This will focus on certain times and dates, corresponding with those periods when the highest level of bat activity occur. This includes the use of the SCADA (Supervisory Control and Data Acquisitions) operating system to only pause/feather the blades below a specified wind speed and above a specified temperature within specified time periods.

Post-constructions surveys will be undertaken for the first three years of operation to determine if blanket curtailment restrictions can be amended in line with post-construction activity. The post construction surveys will be used to determine an appropriate curtailment regime designed around the values for the key weather parameters and other factors that are known to influence collision risk which include any or all of the following:

- Wind speed in m/s (measured at nacelle height)
- Time after sunset
- Month of the year
- Temperature (ºC)
- Precipitation (mm/hr)

Post Construction surveys

Monitoring should take place for at least 3 years after construction, providing sufficient data detect any significant change in bat activity relative to pre-construction levels. It should aim to assess changes in bat activity patterns and the efficacy of mitigation to inform any changes to curtailment.

During years one to three of operation (under blanket curtailment restrictions) bat activity will be measured continuously between April and mid-October at each turbine location, in combination with carcass surveys. In addition, wind speed and temperature data will be continuously recorded at the nacelle height of each turbine.

If necessary, over this period the curtailment regime can be refined to "smart curtailment" informed by the weather data and bat activity data determined from the post construction surveys, using software parameters programmed in to the SCADA (or equivalent) system.

Modern remotely-operated wind turbines allow cut-in speeds to be controlled centrally/automatically, facilitating an operation regime designed to minimise harmful impacts to bats.

Curtailment will be monitored in order to determine (a) whether it is working effectively (i.e. the level of bat mortality is considered to be incidental), and (b) whether the curtailment regime can be fine-tuned so that turbine down-time is minimised while ensuring the regime remains effective in preventing casualties (SNH, 2019).

The feathering of turbine blades combined with increased cut-in speeds have been shown to reduce bat fatalities from 30% to 90% (Adams et al., 2021, Arnett et al., 2008, 2011, 2013; Baerwald et al., 2009). The most recent of studies showed a 63% decrease in fatalities (Adams et al., 2021).

Monitoring Curtailment

If, following the initial 3 years of post-construction surveys, bat activity increases above the baseline and/or remains consistently high and carcass searches indicate fatalities are occurring (refer below), increased cut-in speeds will continue. This will subsequently be monitored in years 5, 7, 10, 15, 20, 25 and 30 with further review after each monitoring period.

Alternatively, if it is found that the results of bat activity surveys and fatality searches confirm that the level of bat activity at turbine locations is reduced (to low) then a derogation will be sought from Cork County Council (in consultation with NPWS) for the cessation in the requirement for these cut-in speeds / curtailment measures, or a reduction on the timing restrictions for these measures.

Where post construction acoustic surveys are undertaken, they should utilise full spectrum automatic detectors deployed, as a minimum, for one complete bat activity season.

Acoustic monitoring can be supplemented with thermal imaging cameras etc. as necessary to provide more detailed information on bat activity in the vicinity of turbines.

Due to the level of Leisler's activity within the study area, nacelle-level surveys[1] are also recommended for the post construction surveys. These will be used to identify the level of Leisler's bat activity above the tree canopy and within the height of the rotor-swept area.

An assessment of static data gathered during operational surveillance should be completed using the online analysis tool Ecobat as recommended by SNH (2021) or other equivalent as dictated by up-to date standards and practices.

Lighting

It appears that the lighting on top of wind turbines may affect the likelihood of bats colliding with turbines. Research on this topic, which is reviewed in Powelsland (2009), indicates that intermittent lighting is less likely to cause species to collide with turbines.

Flashing red aviation obstruction lights will be provided on perimeter turbines, subject to approval by the IAA. These will not negatively impact bats (Bennett and Hale 2014).

Buffer zones

The vegetation-free buffer zones around the identified turbines will be managed and maintained during the operational life of the development. These will be kept clear by mechanical means only and maintained on an annual basis in the same condition as during first clearance.

[1] Used to supplement ground-based equipment designed to replicate the survey effort undertaken at the pre-application stage (see Roemer et al., 2017). They are particularly useful at woodland key-holed sites.

Due to mitigation by design, turbines are proposed to be sited at a suitable separation distance from trees and trees or vegetation are to be removed to ensure a woodland-free buffer zone.

The immediate surroundings of individual turbines will be managed and maintained so that they do not attract insects (i.e. the concentration of insects in the wind turbine vicinity should be reduced as much as possible, but not such that insect abundancies affected elsewhere on the site). This will be achieved through physical management of habitats without the use of toxic substances.

The radius of each buffer zone as determined by the height of surrounding vegetation is listed below in Table 4-2 below. Turbine T05 is not located in woodland and therefore does not require a buffer:

Table 4-2: Vegetation Free Buffer Zones for Bats (based on proposed blade length of 75 m)

Turbine number	Felling Buffer Radius (m)
1	86
2	86
3	92
4	86
5	82
6	86

Monitoring of mitigation measures

The success of the implemented mitigation measures for bats on the project shall be monitored for a period of no less than three years post construction and appropriate measures taken to enhance these if and where required.

Bat fatality monitoring

Whilst no significant residual impacts on bats are predicted, the proposed development could provide an opportunity to gain baseline data on bat/turbine interaction and it is recommended that the scheme be monitored for bat fatalities for the first three years of operation (post construction surveys) and subsequently in years 5, 7, 10, 15, 20, 25 and 30 as part of the additional curtailment monitoring schedule. A comprehensive onsite avian fatality monitoring programme is to be undertaken following published best practice. This fatality monitoring programme will be extended and duplicated for bat fauna.

The primary components of the bird mortality programme are outlined below, and an assessment of bat mortality will essentially follow the same methodology.

a) Carcass removal trials to establish levels of predator removal of possible fatalities. This will be done following best recommended practice and with due cognisance of published effects such as predator swamping, whereby excessive placement of carcasses increases predator presence and consequently skews results. No turbines which are used for carcass removal trials will be used for subsequent fatality monitoring.

b) Turbine searches for fatalities will be undertaken following best practice in terms of search area focusing on the hard standing) (SNH, 2019; 2021) while also encompassing the wider search radius defined by bird fatality monitoring requirements, (minimum radius hub height) and at intervals selected to effectively sample fatality rates as determined by carcass removal trials in (a) above.

c) A standardised approach with a possible control group and/or variation in search techniques such as straight line transects/ randomly selected spiral transects/ dog searches will be undertaken. This will provide a means of robustly estimating the post construction collision fatality impact (if any).

d) Recorded fatalities will be calibrated against known predator removal rates to provide an estimate of overall fatality rates.

Table 4-3: Monitoring schedule proposed for bat mitigation measures

Mitigation measure	Monitoring required	Description	Duration
Newly planted hedgerows	Ensure viable growth of planting	Planted material will be checked periodically over the growing season to remove dead material. Any dead material will be replaced within the same season with viable stock according to age/height restrictions already specified in mitigation.	From time of planting to 1 year, and checked again in year 3 post construction to confirm establishment
Mortality study	Fatality monitoring	Corpse searches beneath turbines to assess the impact of operation on bats.	From initial operation conducted during years 1, 2, 3, 5, 10 and 15 post construction.
Bat boxes and tubes	Monitor bat use	Bat boxes and tubes to be placed at locations removed from wind farm as determined by project ecologist/ECoW. These will be examined by a licensed bat specialist according to NPWS recommendations. Records will be submitted to Bat Conservation Ireland for inclusion in its bat distribution database. Re-site if necessary (e.g. if supporting trees are damaged by wind). Annual cleaning required if well used by bats or if used by birds. Replacement if damaged/lost.	From mounting to 3 years post construction.

Table 4-4: Summary of Operational-phase Mitigation Measures for Bats

Moderate-High Level Bat Mitigation Applies to all turbines	**Category**
A buffer zone free of woodland/trees within 50m of turbine blade tips will be created.	Habitat alteration
Operate the wind turbines in a manner that reduces the movement of the blades below the cut-in speed (e.g. by feathering the blades).	Feathering

Moderate-High Level Bat Mitigation Applies to all turbines	**Category**
Implement blanket curtailment during year 1-3 while post construction surveys are undertaken. The curtailment will involve operating the selected wind turbine from 30 minutes prior sunset to 30 minutes after sunrise at a cut-in speed of 5.5 m/s during specified weather conditions and during the active bat season (April to October).	Blanket curtailment
Implement a monitoring programme during years 1 – 3 post construction to detect any large-scale changes in bat activity including carcass surveys. Bat activity will be measured continuously between April and mid-October at each turbine location. In addition, wind speed and temperature data will be continuously recorded at the nacelle height of each turbine.	Post construction monitoring
If, following the initial 3 years of post-construction surveys, bat activity increases above the baseline and/or remains consistently high and carcass searches indicate fatalities are occurring, increased cut-in speeds will continue. This will subsequently be monitored in years 5, 7, 10, 15, 20, 25 and 30 with further review after each monitoring period. Alternatively, if it is found that the results of bat activity surveys and fatality searches confirm that the level of bat activity at turbine locations is reduced (to low) then a derogation will be sought from Cork County Council (in consultation with NPWS) for the cessation in the requirement for these cut-in speeds / curtailment measures, or a reduction on the timing restrictions for these measures through SCADA (or equivalent) operating systems.	Smart curtailment
Undertake a carcass search during years 1-3, and subsequently in years 5, 7, 10, 15, 20, 25 and 30 as part of the additional curtailment monitoring schedule.	Carcass monitoring
Maintain immediate area around the wind turbines in a manner that does not attract insects.	Maintain vegetation free buffer

4.3.3.3.4 Avifauna

A post-construction monitoring programme is to be implemented at the subject site in order to confirm the efficacy of the mitigation measures; the results of this will be submitted annually to the competent authority and NPWS. Published guidance on assessing the impacts of wind farms on birds from English Nature and the Royal Society for the protection of birds recommends the implementation of an agreed post development monitoring programme as a best practice mitigation measure (Drewitt and Langston, 2006).

In addition, published recommendations on swans and wind farms (Rees, 2012) suggests that systematic post construction monitoring; adapted to quantify collision, barrier and displacement, be conducted over a period of sufficient duration to allow for annual variation or in combination effects.

The following individual components are proposed.

1) Fatality Monitoring (to be conducted during years 1, 2, 3, 5, 10 and 15 post construction)- A comprehensive fatality monitoring programme is to be undertaken following published best practice; the primary components are as follows:

    a. Initial carcass removal trials to establish levels of predator removal of possible fatalities. This will be done following best recommended practice and with due cognisance to published effects such as predator swamping, whereby excessive placement of carcasses increases predator presence and consequently skews results (Shawn *et al*., 2010). No turbines which are used for carcass removal trials are to be used for subsequent fatality monitoring. Carcass removal trials shall be continued for the duration of fatality searches.
    b. Turbine searches for fatalities are to be undertaken following best practice (Fijn *et al*., 2012 and Grunkorn, 2011) in terms of search area (minimum radius hub height = 150m around turbine bases) and at intervals selected to effectively sample fatality rates based on carcass removal rates (e.g. 1 per month). To be conducted during years 1, 2, 3, 5, 10 and 15 post construction to allow for annual variation and cumulative effects. Dependant on results further monitoring to be agreed with NPWS.
    c. A standardised approach with a possible control group and/or variation in search techniques such as straight line transects/ randomly selected spiral transects/ dog searches will be undertaken. This will provide a means of robustly estimating the post construction collision fatality impact (if any).
    d. Recorded fatalities to be calibrated against known predator removal rates to provide an estimate of overall fatality rates.

Reports will be submitted to the competent authority and NPWS following each round of surveys.

2) Flight Activity Survey (to be conducted during years 1, 2, 3, 5, 10 and 15 post construction) - A flight activity survey is to be undertaken during the summer and winter months to include both Vantage Point and hinterland surveys as Per SNH (2017) guidance:

    a. Record any barrier effect i.e. the degree of avoidance exhibited by species approaching or within the wind farm (Drewitt and Langston, 2006). Target species to be all raptors and owls, all wild goose and duck species, all swan species and all wader species.
    b. Record changes in flight heights of key receptors post construction.

Reports will be submitted to the competent authority and NPWS following each round of surveys. This survey is to be conducted during years 1, 2, 3, 5, 10 and 15 post construction to allow for annual variation and cumulative effects. Dependant on results further monitoring requirements will be agreed with NPWS.

3) Monthly Wildfowl Census (to be conducted during years 1, 2, 3, 5, 10 and 15 post construction). A monthly wildfowl census, following the methods utilised for the baseline survey, is to be repeated on a monthly basis during the winter period.

This aims to:

    a. Assess displacement levels (if any) of wildfowl such as swans post construction

b. Assess overall habitat usage changes within the vicinity of the Annagh Wind Farm Development post construction.

This survey is to be conducted during years 1, 2, 3, 5, 10 and 15 post construction to allow for annual variation and cumulative effects. Dependant on results further monitoring requirements will be agreed with NPWS. Reports will be submitted to the competent authority and NPWS following each round of surveys.

4) Breeding Bird Survey (to be conducted during years 1, 2, 3, 5, 10 and 15 post construction). A breeding bird survey (moorland breeding bird and Common Bird Census), following methods used in the baseline survey to be repeated yearly between early April to early July. This aims to:

   a. Assess any displacement effects such as those recorded on breeding birds. Overall density of breeding birds to be annually recorded.

5) Breeding Wader Survey (to be conducted during years 1, 2, 3, 5, 10 and 15 post construction). A breeding bird survey, following methods used in the baseline survey to be repeated yearly April-May-June.

Both of the above surveys are to be conducted during years 1, 2, 3, 5, 10 and 15 post construction to allow for annual variation and cumulative effects. Dependant on results further monitoring requirements will be agreed with NPWS.

Barn Owl Nest Box

A barn owl nest box will be installed upstairs in the derelict farmhouse to the south of the wind farm and access via an existing window will be guaranteed. This will provide nesting habitat in continuity as the building deteriorates. This nest box is to be maintained and replaced as required during the lifespan of the wind farm. Any maintenance work may only be carried out from October to February inclusive to ensure the Barn owl nesting season is avoided.

4.3.3.3.5 Aquatic Ecology

The vegetation-free buffer zones around all turbines will be managed and maintained during the operational life of the development. These will be kept clear by mechanical means only; no chemical methods will be used.

The primary impact to aquatic ecology resulting from the operational phase of the proposed wind farm is an increase in surface water run-off from hard-standing areas, access tracks etc. Mitigation for the maintenance regime is outlined in section 10.7.2 of Chapter 10 – Hydrology and Water Quality.

The potential requirement for Eel brushes was considered, however the drainage channels on site are intermittent/non-perennial in terms of flow and of poor fisheries value, including for eel. Brushes are typically only required to facilitate passage on steeper-gradient barriers located on more permanent, flowing surface water features with higher aquatic value. As these conditions are absent from the site, eel brushes on the lower-gradient drainage channel culverts onsite are not required.

The maintenance of the development will incorporate effective maintenance of the drainage system, including visual inspections in accordance with maintenance schedule in CIRIA C753. Therefore, it is not envisaged that maintenance will involve or accrue significant impacts on the hydrological regime of the area.

Quarterly inspections of the erosion and sediment control measures on site (i.e. drains, swales, outfalls to field drains) will be undertaken for the first year following construction and annually thereafter to ensure operational efficiency.

During the operational phase, oils will be required for cooling the transformers giving rise to the potential for oil spills within the site. To mitigate this risk, transformers will be bunded to over 110% of the volume of oil within them.

4.3.3.4 Mitigation Measures during the Decommissioning of the project

4.3.3.4.1 Wind Farm and Grid Connection

The same mitigation measures for the wind farm and GCR will apply for the decommissioning phase as for the construction phase.

In relation to aquatic ecology, the same mitigation measures will apply for the decommissioning phase as for the construction phase. In the event of decommissioning of the Annagh wind farm, the access tracks may be used in the decommissioning process. Mitigation measures applied during decommissioning activities will be similar to those applied during construction but will be of reduced magnitude.

It is proposed that turbine foundations and hardstand areas should be left in place and covered with local soil/topsoil to revegetate at the decommissioning stage. It is considered that leaving the turbine foundations, access tracks and hardstand areas in-situ will cause less environmental damage than removing them. The grid connection ducting and substation will be left in situ as part of the national grid, therefore no potential impacts during decommissioning stage are likely to occur. Hence no mitigation measures are required.

4.3.3.5 Mitigation as set out in the Natura Impact Statement

The following mitigation measures for the protection of European sites are set out in the Natura Impact Statement for the proposed project.

4.3.3.5.1 Mitigation Measures Prior to construction

A Construction and Environment Management Plan (CEMP) setting out the key environmental management measures associated with the construction, operation and decommissioning of the proposed wind farm will be implemented. This will ensure that during the phases of the development, the environment is protected, and any potential impacts are minimised. Upon granted planning permission, the final version of the CEMP will address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned by the consenting authority. The contractor is not permitted to omit or alter mitigation measures set out in the CEMP.

A Project Ecologist/Ecological Clerk of Works (ECoW) with appropriate experience and expertise (in implementing ecological mitigation measures for wind farm developments) will be employed for the duration of the construction and decommissioning phases to ensure that all the mitigation measures outlined in relation to the environment are implemented. The Project Ecologist/ECoW will be awarded the authority to stop construction activity if there is potential for adverse ecological effects to occur. The Project Ecologist/ECoW will ensure successful implementation of all mitigation measures outlined below.

A line of communication with IFI will be established by the ECoW and fisheries officers will be invited to inspect mitigation measures at the site. This will ensure transparency, encourage proactive culture around implementation of measures and facilitate input from key stakeholders if required.

Prior to works commencing an invasive species survey will be undertaken in the areas of the project to reconfirm the extend of the non-native invasive species and to ensure they have not spread to any new areas within the footprint of the proposed project. Measures shall be in accordance with the invasive species management plan (ISMP) and Regulation 49 of the EC (Birds & Natural Habitats) Regulations (2011):

- The invasive species management plan will be adhered to for all works in areas confirmed as containing non-native invasive species.
- The plan is intended to be a working document and will be updated during the construction, operational and decommissioning phases.
- The main objective of the invasive species management strategy are containment, treatment and eradication including:
    - Cordoning off the area – this shall include a buffer of 5m surrounding the area of infection to ensure that seeds are not transported to other sections of the site via vehicular traffic, equipment or PPE.
    - No machinery or personnel shall be allowed within this restricted area. Similarly, there shall be no storage of materials within or adjacent to this restricted area.
    - There shall be no vegetation clearance or trimming within the cordoned area (except where undertaken in accordance with the invasive species management plan) as this can lead to the species recolonising other areas via the wind, water if displaced into drains, or soil and vegetation attached to machinery, vehicles or personnel.
    - No soil or vegetation shall be removed from this area unless it is securely contained and is transported under licence to a suitably licenced facility for treatment.
    - Informing all site staff through toolbox talk as part of site inductions.
    - Any new sightings of the species shall by relayed to construction staff and the contractor via the project ecologist/ECoW. These areas shall follow the same protocol as described above.
    - Reporting sighting(s) to the NPWS and NBDC and liaising with to the NPWS.

A suitably qualified Environmental Manager (competent in the implementation and management of environmental mitigation measures for wind farms) will be appointed to ensure the effective operation and maintenance of drainage and other mitigation measures associated with water control and management during the construction process. The operations management of the proposed project will include regular monitoring of the drainage system and maintenance. The Environmental Manager will be awarded the authority to stop construction activity if there is potential for adverse effects to water control and/or management. The Environmental Manager will ensure successful implementation of all mitigation measures outlined below for water control and management.

4.3.3.5.2 Mitigation Measure During Construction

4.3.3.5.2.1 Habitats and Flora

The area of the proposed works will be kept to the minimum necessary, including all site clearance works, to minimise disturbance to habitats and flora. In this case, the footprint of the proposed development has been kept to the minimum necessary, including the use of layout design methods (e.g. existing roads and stream crossings to minimise excavation works).

No disturbance to habitats or flora outside the proposed development area will occur. All works will be restricted to the immediate footprint associated with the activity, which will be wholly within the development site boundary and kept separate from any key areas for biodiversity. Machinery, and equipment will be stored within the site compound. Designated access points will be established within the site and all construction traffic will be restricted to these locations. Access to the site will be primarily via the existing local road L1322. HGVs shall approach the site via this road from the East. The met mast access route will be via the existing farm track from the south.

4.3.3.5.2.2 Avifauna

The removal of vegetation and scrub as well as trimming of trees along the TDR will be undertaken outside of the bird breeding season (March 1st to August 31st inclusive) in order to protect nesting birds.

4.3.3.5.2.3 Lighting

Construction operations will take place during the hours of daylight to minimise disturbances to roosting birds, or active nocturnal bird species.

Limited operations such as concrete pours, turbine erection and installation of the grid connection may require night-time operating hours; these works will be supervised by the project ecologist/ECoW.

4.3.3.5.2.4 Toolbox Talk

Toolbox talks will be undertaken with construction staff on disturbance to key species during construction. This will help minimise disturbance.

4.3.3.5.2.5 Plant and Vehicles

All site plant will be inspected at the beginning of each day prior to use. Defective plant shall not be used until the defect is satisfactorily fixed.

All major repair and maintenance operations will take place off site.

Vehicles entering the site should be in good working order, free from leakage of fuel or hydraulic fluid.

4.3.3.5.2.6 Felling Schedule (License)

Tree felling will be the subject of a felling license from the Forest Service and to the conditions of such a license. A Felling License will be in place prior to works commencing on site.

To ensure a tree clearance method that reduces the potential for sediment and nutrient run-off, the construction methodology will follow the specifications set out in the following guidance documents:

- DAFM (2019). Standards for Felling and Reforestation;
- Forestry Service (2000a). Forest Service Forestry and Water Quality Guidelines;
- Forestry Service (2000b). Forest Harvesting and Environmental Guidelines;
- DAFM (2018). Draft Plan for Forestry and Freshwater Pearl Mussel in Ireland

4.3.3.5.2.7 Felling schedule (aquatic zone of main wind farm site)

In accordance with the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zone (Forestry Service, 2000a, 2000b). Given the close proximity of felling areas to receiving watercourses and potential source-receptor pathways (i.e. drainage channels), a minimum buffer zone for felling areas of 15-20m will be applied.

Silt fences will be required within the drainage channels. These will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded.

4.3.3.5.2.8 Felling schedule (timber extraction rack)

Where damage or serious rutting has started to occur, timber extraction will be suspended immediately. Relocation of the extraction rack will be used to remedy the situation.
This will avoid timber extraction routes acting as conduits for surface water flows. This in turn will avoid adverse effects on the surrounding water courses via emissions to water.

4.3.3.5.2.9 Felling schedule (felling)

Felling will be undertaken in the spring to facilitate the sowing of grass seeds post-harvest to aid sediment filtration and nutrient absorption, using native grass species e.g. *Holcus lanatus and Agrostris capilaris* (DAFM, 2018).

4.3.3.5.2.10 Felling schedule (machine operations)

Machine operations will not take place in the 48 hour period before predicated heavy rainfall (>10mm/hour), during heavy rainfall or in the 48 hour period following heavy rainfall (DAFM, 2018).

4.3.3.5.2.11 Felling schedule (removal of debris)

Removal of branch lop-and-top and other debris (brash) from felling areas within 20m of forestry drains (i.e. up-slope of active pathways to larger downstream watercourses) will be carried out to reduce nutrient seepage immediately post-felling and in the proceeding years after felling has occurred (DAFM, 2019).
Brash mats will be used to support vehicles on soft ground and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place before they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall.

4.3.3.5.2.12 Wheel wash facilities

Wheel wash facilities will be located at the site entrance to reduce construction traffic fouling public roads. The wheel wash will come with an additional water tank which will be filled regularly. These units will be self-contained and will filter the waste for ease of disposal.

Waste will be removed from each unit and from site by a permitted contractor to a licensed facility. Measures will be in accordance with the invasive species management plan (ISMP) (Appendix 5) and Regulation 49 of the EC (Birds & Natural Habitats) Regulations (2011).

4.3.3.5.2.13 Concrete

Major construction works including concrete pours onsite will be timed to occur outside periods where heavy rainfall would be expected.

A regular review of weather forecasts of heavy rainfall is required, and the site contingency plan will be updated in accordingly before and after such events.

Concrete washout will be carried out in a dedicated area of the temporary compound. Only the washing of chutes will be permitted. Every concrete truck delivering concrete to the site must use the concrete washout facility prior to leaving the site. Chutes will be washed out at the designated area with a settlement lagoon provided to receive all run-off. During construction concrete will be kept out of all watercourses and drains.

4.3.3.5.2.14 Cross-drains

Suitably sized cross-drains will be provided for drainage crossings to convey flows from agricultural drains and forestry drains across the access tracks, to prevent a risk of clogging.

4.3.3.5.2.15 Grid Connection Route

In addition to the crossing on 5 no. drainage channels, there will be a requirement for 2 no. riverine watercourse crossings along the GCR in total. These are on the Rathnacally Stream (GCR-WCC1) and Oakfront River (WF-HF5).

The crossing of the Rathnacally Stream on the L1322 will be via horizontal directional drilling (HDD), Although no-instream works are proposed, the drilling works will only be completed during a dry period between July and September (as required by Inland Fisheries Ireland for in-stream works) to avoid the salmonid spawning season and sensitive life stage period. Mitigation measure 38 will be implemented.

A pre-construction otter survey to reconfirm the findings of the FT surveys undertaken in 2021 will be undertaken to ensure than no breeding or resting areas are located within 150m of the drilling locations. Should an otter breeding (holt) or resting area (couch) be detected, a derogation licence will need to be obtained from the NPWS to facilitate drilling works.

Excavation of the grid route trench will require excavation of soils/subsoils which has the potential to impact the water quality and aquatic habitat of receiving watercourses. Excavated spoil emanating from the cut trenches, where appropriate (i.e. when trenching within private tracks or the public road verge) will be used to back-fill the trenches. Any excess will be disposed of off-site, at an appropriate licenced facility.

All excavated material emanating from trenches within the public road network will be disposed at an appropriate licenced facility. Mitigation measures to prevent the escapement of suspended solids to receiving watercourses (e.g. silt fences, interceptor drains, stilling ponds, drain blocking etc.) are outlined above.

On the Rathnacally Stream, silt curtains and floating booms will also be used where deemed to be appropriate, in consultation with IFI. An Ecological Clerk of Works (ECoW) will monitor both turbidity and observe the riverbed during the drilling process to detect any leakage (frac-out) of drilling fluid. Should this leakage be observed, works will cease immediately.

The GCR crossing of the Oakfront River (WF-HF5) will be via a single span, pre-cast concrete bridge. This will avoid the requirement for instream works. Nevertheless, installation will only be completed during a dry period between July and September (as required by Inland Fisheries Ireland for in-stream works) to avoid the salmonid spawning season and sensitive life stage period. Potential releases of sediment-laden surface run-off as a result of bank clearance works to facilitate bridge installation/access will be mitigated against through the water quality mitigation measures applied elsewhere on site.

4.3.3.5.2.16 Horizontal Directional Drilling

- An Environmental Engineer with a “stop work” authority will be engaged to monitor the construction phase of the development when the water crossing is being undertaken.
- The working area around the bridge/culvert crossings will be fenced off prior to the commencement of works to avoid damage to bankside habitat.
- Watercourses will be visually inspected.
- Should increase levels of siltation be recorded within the watercourses during the course of the construction phase, the environmental auditor will seek to halt construction works until the source of the pressure can be found and remediated.
- Surplus material will be removed from the site to an appropriate facility. There will be no stockpiling of excavated material. A setback distance of at least 20 m from watercourses will be adhered to when storing temporary spoil.
- Prior to any works taking place near water courses the Inland Fisheries Ireland will be consulted.
- Construction works onsite will be timed to occur outside periods where heavy rainfall would be expected

- Silt traps will be regularly maintained during the construction phase. All personnel working onsite will be trained in pollution incident control response.
- Appropriate signage will be placed along the proposed route outlining the spillage response procedure and a contingency plan to contain silt. A regular review of weather forecasts of heavy rainfall is required, and the contractor is required to prepare a contingency plan for before and after such events.
- Visual inspection to take place at all times along the bore path of the alignment.
- Silt fences will be constructed around proposed work areas prior to commencement of works.
- No refuelling will take place within 50m of the stream zone or any sensitive habitats.
- During the drilling process, a mixture of a natural, inert and fully biodegradable drilling fluid will be used.

4.3.3.5.3 Replant Lands Mitigation Measures

4.3.3.5.3.1 Best Practice Measures

To minimise environmental impacts, it is important in the first instance that the following general principles are taken on board:

- Implementation of good forestry work practices on site (e.g. Environmental Requirements for Afforestation and Forestry Standards Manual).
- Working in accordance with relevant legislation, for example, (Wildlife Acts 1976 to 2021 and European Communities (Birds and Natural Habitats) Regulations 2011-2021).
- Contractors shall ensure adequate site supervision and security.

Contract workers shall be briefed to ensure that environmental issues are taken into consideration and that guidelines and codes of practice are followed.

4.3.3.5.3.2 Disturbance to Lapwing and Otter

- No cleaning of vegetation from any section of such watercourses within 20 m of the aquatic zone.
- No woody weed removal within 20 m of an aquatic zone or 10m of a relevant watercourse.
- No works will be carried out at night.

4.3.3.5.3.3 Afforestation

The project will adhere to all water protection measures, set out in the Environmental Requirements for Afforestation, December 2016 (DAFM, 2016) and Forestry Standards Manual (DAFM, 2015), which include:

- Apply a 10-metre wide (minimum) uncultivated and unplanted water setback along aquatic zones and 5 metres at relevant watercourses (as defined in Circular 12/2017) located within or adjoining the site. This setback is to remain undisturbed during establishment and throughout the forest rotation.

- Apply and maintain as per details set out in Tables 5 and 6 of the Environmental Requirements for Afforestation (DAFM, 2016).
- Adhere to all water protection measures relating to cultivation, herbicide application, the location of onsite storage depots and the disposal of waste, set out in the Environmental Requirements for Afforestation (DAFM, 2016).
- There will be no woody weed removal within 50 m of an aquatic zone or 20 m of a relevant watercourse.
- Silt fences will be used along drains.

4.3.3.5.3.4 Fertiliser

- Fertiliser will not be applied within the water setback of an aquatic zone, or within 20 metres of the aquatic zone, whichever is greatest. Manual application only is permitted from this point back to 50 metres from the aquatic zone.
- Fertiliser will not be applied within the water setback of all other water features.
- Fertiliser will not be applied if heavy rainfall is predicted, or during heavy rainfall and / or high winds.

4.3.3.5.3.5 Herbicide

Herbicide will not be applied within the water setback of an aquatic zone, or within 20 metres of the aquatic zone, whichever is greatest.

4.3.3.5.3.6 Water Quality

Exclusion zones for machinery

- Exclusion zones for machinery must ensure that machines do not traverse within 5m of watercourses on site during forestry operations.
- With respect to exclusion zones, measures outlined in Section 3.5 of the Environmental Requirements for Afforestation (December 2016), will be adhered to.
    - Water setbacks
    - Retained habitat setbacks
    - Archaeological setbacks
    - Public road setbacks
    - Utilised building setbacks
    - Landscape setbacks

Silt and sediment control

- Silt traps will be deployed to control movement of silt and sediment, as outlined in Section 4.3 of Environmental Requirements for Afforestation (December 2016). Silt traps will be constructed at end of mound drains at 50 m intervals.
- Silt traps will be maintained throughout all planting works, ensuring that they are clear of sediment build-up.

Drainage and cultivation

- All drains must protect aquatic zones (order 1 – Emlagh Stream 27) from any sediment and nutrients contained in water draining off the site as outlined in section 3.7.1 of Environmental Requirements for Afforestation (December 2016)
- Drains will be maintained throughout all planting works, ensuring that they are clear of sediment build-up and are not severely eroded.
- There will be no vegetation removal within 20 m of a drainage ditch.

Afforestation

- A setback area of 5m will be applied along the relevant watercourses present in the project area (there are three that run west-east into the Emlagh Stream 27), as specified in Section 4.4 of the Environmental Requirements for Afforestation (December 2016)

Setbacks

- A 5-metre-wide (minimum) setback will be applied along relevant watercourses located within or adjoining the site. This setback is to remain undisturbed during establishment and throughout the forest rotation. This will be applied and maintained as per details set out in Tables 5 and 6 of the Environmental Requirements for Afforestation (DAFM, 2016).
- A setback of 10 m from the aquatic zone, Emlagh stream which runs along the eastern boundary of the site for 240 m will be applied.
- There shall be no mounding or machine work within 10m of Aquatic Zone
- There shall be no mounding or machine work within 5 m of Relevant Water Course (RWC).

Chemical use

- Chemical use will be kept to an absolute minimum, depending on site requirements; chemicals will only be applied in dry weather.
- Chemicals shall not be applied within 20m of the aquatic zone or within watercourse setbacks or other sensitive areas.

4.3.3.5.3.7 Aquatic Ecology

4.3.3.5.3.7.1 Construction Stage

Construction phase mitigation measures for aquatic ecology predominantly involve the preservation of water quality.

All measures for the protection of water quality within the site, GCR and TDR as detailed below and within the Surface Water Management Plan, will protect the aquatic ecology and fisheries value of downstream watercourses, in particular the habitats supporting sensitive aquatic species with connectivity to the Blackwater River SAC, Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA.

4.3.3.5.3.7.2 Tree Felling

Recognised tree clearance methodologies that reduce the potential for sediment and nutrient run-off are set out in the following guidance documents:

- DAFM (2019). Standards for Felling and Reforestation;
- Forestry Service (2000a). Forest Service Forestry and Water Quality Guidelines;
- Forestry Service (2000b). Forest Harvesting and Environmental Guidelines;

In accordance with in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zone (Forestry Service, 2000a, 2000b). Given the close proximity of felling areas to receiving watercourses and potential source-receptor pathways (i.e. drainage channels), a minimum buffer zone for felling areas of 15-20m will be applied.

Silt fences will be required within the drainage channels. These will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded.

Brash mats will be used to support vehicles on soft ground and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall.

Felling will take in the spring period to facilitate the sowing of grass seeds post-harvest to aid sediment filtration and nutrient absorption, using native grass species *Holcus lanatus* and *Agrostris capilaris*.

Machine operations must not take place in the 48-hour period before predicated heavy rainfall, during heavy rainfall or in the 48-hour period following heavy rainfall.

Removal of branch lop-and-top and other debris (brash) from felling areas within 20m of drainage channels will reduce nutrient seepage immediately post-felling and in the proceeding years after felling has occurred.

4.3.3.5.3.7.3 Access track construction

It is proposed to construct approximately 3.4km of new internal access tracks and carry out upgrades to 1.4km of existing agricultural tracks (including bend widening) to facilitate site access and construction activities. All track widening will be undertaken using clean uncrushable stone with a minimum of fines to reduce the risk of suspended solid releases to receiving watercourses.

Still traps will be placed in the new roadside swales. Proposed new tracks will be drained as via roadside swales with stilling ponds at the end of the swale. These grassed swales will serve to detain flow and reduce the velocities of surface water flows. The swales will be 0.3 m deep with a bottom width of 0.5 m and side slope of 1 in 3. The swales will be constructed in accordance with CIRIA C698 Site Handbook for the Construction of SuDS which can be used in conjunction with CIRIA C753 The SuDS Manual. Where roadside drains are laid at slopes greater than 2%, check dams will be provided.

Site drainage, including silt traps and settlement ponds, will be put in place in parallel with or ahead of construction, such that excavation for new infrastructure will have functional drainage system in place.

The settlement ponds will remain in place during construction phase. The settlement ponds will drain diffusely overland, over existing vegetated areas, within the site boundary.

Tracks will be capped as soon as practicably possible to cover exposed subsoils and as such reduce the concentration of suspended solids in the run-off.

4.3.3.5.3.7.4 Turbine base and met mast construction

Refer to section 4.3.3.5.2.3.5 below regarding site drainage and silt attenuation to prevent impacts to the water quality of downstream watercourses during the construction phase. These include measures to prevent run-off erosion from vulnerable areas and consequent sediment release into nearby watercourses to which the proposed development site discharges. The mitigation measures proposed will reduce potential direct and indirect impacts from the construction of the turbine foundations/hardstands.

4.3.3.5.3.7.5 Site drainage

The 11 no. surface water drains within the site boundary to be crossed during the construction phase will be via precast box culverts. Silt Protection Controls (SPCs) are proposed at the location of the drain crossings. It is recommended that the SPCs will consist of a minimum of silt traps containing filter stone and filter material staked across the width of the swales and upstream of the outfall to any watercourse.
No interference with natural watercourses will occur.

Drains around hard-standing areas will be shallow to minimise the disturbance to sub-soils.

Permanent roadside drainage will be installed as part of the construction stage. This will include the use of interceptor drains, swales, check dams and stilling ponds. These measures will buffer site run-off during periods of high rainfall by retaining the water until the storm hydrograph has receded.

Site drainage, including silt traps and stilling ponds, will be put in place in parallel with or ahead of construction, such that excavation for new infrastructure will have functional drainage system in place. The stilling ponds will remain in place during construction phase. The stilling ponds will drain diffusely overland, over existing vegetated areas, within the site boundary. The stilling ponds will be back-filled and the swales that were connected to them will be re-connected to the outfall once construction is completed.

Silt Protection Controls (SPCs) are proposed at the location of the 11 no. drain crossings. It is recommended that the SPCs will consist of a minimum of silt traps containing filter stone and filter material staked across the width of the swales and upstream of the outfall to any watercourse.

Site access roads have been laid out to reduce the longitudinal slope of roadside drains and to follow natural flow paths. Where roadside drains are laid at slopes greater than 2%, check dams will be provided.

Where existing tracks will be used to access the site, roadside drains alongside these tracks will be cleared of obstructions only where strictly necessary (i.e. if flooding occurs).

Vegetation and other obstructions provide sediment arrest and flow attenuation functions and as such will not be interfered with unless absolutely necessary.

4.3.3.5.3.7.6 GCR installation

In addition to the crossing on 5 no. drainage channels, there will be a requirement for 2 no. riverine watercourse crossings along the GCR in total. These are on the Rathnacally Stream (GCR-WCC1) and Oakfront River (WF-HF5).

The crossing of the Rathnacally Stream on the L1322 will be via horizontal directional drilling (HDD), located approx. 1.5km upstream of the Blackwater River SAC (002170). Although no-instream works are proposed, the drilling works will only be completed during a dry period between July and September (as required by Inland Fisheries Ireland for in-stream works) to avoid the salmonid spawning season and sensitive life stage period.

A pre-construction otter survey to reconfirm the findings of the FT surveys undertaken in 2021 will be undertaken to ensure than no breeding or resting areas are located within 150m of the drilling locations (no holts recorded in these locations to date during otter surveys). Should an otter breeding (holt) or resting area (couch) be detected, a derogation licence will need to be obtained from the NPWS to facilitate drilling works.

Excavation of the grid route trench will require excavation of soils/subsoils which has the potential to impact the water quality and aquatic habitat of receiving watercourses. Excavated spoil emanating from the cut trenches, where appropriate (i.e. when trenching within private tracks or the public road verge) will be used to back-fill the trenches. Any excess will be disposed of off-site, at an appropriate licenced facility.

All excavated material emanating from trenches within the public road network will be disposed at an appropriate licenced facility.

On the Rathnacally Stream, silt curtains and floating booms will also be used where deemed to be appropriate, in consultation with IFI. An Ecological Clerk of Works (ECoW) will monitor both turbidity and observe the riverbed during the drilling process to detect any leakage (frac-out) of drilling fluid. Should this leakage be observed, works will cease immediately.

The GCR crossing of the Oakfront River (WF-HF5) will be via a single span, pre-cast concrete bridge. This will avoid the requirement for instream works. Nevertheless, installation will only be completed during a dry period between July and September (as required by Inland Fisheries Ireland for in-stream works) to avoid the salmonid spawning season and sensitive life stage period. Potential releases of sediment-laden surface run-off as a result of bank clearance works to facilitate bridge installation/access will be mitigated against through the water quality mitigation measures applied elsewhere on site.

4.3.3.5.3.8 Surface Water

Surface water mitigation in provided in summery hereunder and with the full description provided in section *4.3.6 Surface Water Management Plan* of this CEMP.

4.3.3.5.3.8.1 Measures for Pollution Control to Protect Water Quality in Downstream Receptors

All personnel working on site will be trained in pollution incident control response. An emergency response procedure is prepared herein which will ensure that appropriate information will be available on site outlining the spillage response procedure and a contingency plan to contain silt. Silt Protection Controls (SPCs) are proposed at the location of watercourse crossings and where haul roads pass close to watercourses, silt fencing will be used to protect the streams.

Silt traps will also be provided at outfalls from roadside swales. Silt traps will be kept upstream of outfalls to allow a buffer zone to the outfall. Additional silt fencing will be kept on site in case of an emergency break out of silt laden run-off.

Settlement ponds will be put in place in advance as construction progresses across the site.

The settlement ponds with a diffuse outflow detail will mitigate any increase in runoff and treat suspended solids in the surface water runoff. Erosion control and retention facilities, including settlement ponds will be regularly maintained during the construction phase.

All stockpile material will be bunded adequately and protected from heavy rainfall to reduce silt runoff, where necessary. Adequate security will be provided to prevent spillage as a result of vandalism.

Drains around hardstanding areas will be shallow to minimize the disturbance to sub-soils.

Suitably sized cross-drains will be provided for drainage crossings to convey flows from agricultural drains and forestry drains across the access tracks, to prevent a risk of clogging.

Tracks will be capped as soon as practicably possible to cover exposed subsoils and as such reduce the concentration of suspended solids in the run-off.

All open water bodies adjacent to proposed construction areas will be protected by fencing, including the proposed settlement ponds.

Additional protection will be provided in the form of silt fencing downslope where required and at existing stream crossings during construction, to further ensure that there is no impact from the development to streams and rivers crossing the site.

Where haul roads pass close to watercourses, silt fencing will be used to protect the streams. Silt traps will also be provided at outfalls from roadside swales. Silt traps will be kept upstream of outfalls to allow a buffer zone to the outfall.

Refuelling of plant and fuel bowsers during construction will be carried out at the primary refuelling station which will be located at the main temporary site compound. The station will be fully equipped for a spill response and a specially trained and dedicated environmental and emergency spill response team will be appointed before commencement on site. In addition to the above, onsite re-fuelling of machinery will be carried out 100m from watercourses using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site or at the primary refuelling station at the main site compound and will be towed by a 4x4 jeep to designated re-fuelling areas near to where machinery is located but at distances of greater than 100m from watercourses. Drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site.

Concrete washout will be carried out in a dedicated area of the temporary compound. Only the washing of chutes will be permitted. Every concrete truck delivering concrete to the site must use the concrete washout facility prior to leaving the site. Chutes will be washed out at the designated area with a settlement lagoon provided to receive all run-off. During construction concrete will be kept out of all watercourses and drains.

Any diesel, fuel or hydraulic oils stored at the temporary site compound will be bunded. The bund capacity will be sufficient to contain 110% of the tank’s maximum capacity.

Vehicles entering the site should be in good working order, free from leakage of fuel or hydraulic fluid.

A wheel wash will be provided at the site entrance draining to a silt trap to avoid any silt laden run-off flowing on to the public road and entering roadside drains.

Portaloos and/or containerised toilets and welfare units will be used to provide toilet facilities for site personnel during construction. Sanitary waste will be removed from site via a licenced waste disposal contractor.

Silt fencing will be erected at the location of stream crossings along the cable route.

4.3.3.5.3.8.2 Measures for Flooding

Settlement ponds are to be provided as part of the drainage system for the development. The settlement ponds, together with the swales, will serve to reduce velocities in the surface water runoff draining from the access tracks and hardstanding areas and will provide retention of the flows. This will also mitigate any increase in the risk of flooding.

No construction personnel, operation or maintenance personnel will be permitted on site during extreme flood events.

4.3.3.5.3.8.3 Construction Stage

Long range weather forecasts will be examined, and the construction phases planned taking cognisance of expected weather conditions. Regular meetings will be held to re-assess construction phases with weather conditions as the project progresses.

Regular meetings will be held between the Drainage Engineer appointed by the contractor and the contractor's Project Manager. The planning of traffic routes through the site will be agreed in advance, in order to plan appropriate construction drainage management.

A detailed water quality monitoring programme will be undertaken during the construction phase of the proposed development, in addition to the visual inspections outlined above, so as to ensure the effective implementation of the proposed mitigation measures. A water quality monitoring plan is detailed below.

4.3.3.5.3.8.4 Water Quality Monitoring Plan

A monitoring programme will be established to ensure that the water quality is maintained. This programme will ensure that designed measures are working to ensure water quality is not affected. The details of this programme are outlined below.

Daily visual inspections of drains and outfalls will be performed during the construction period to ensure suspended solids are not entering the streams and rivers of the site, to identify any obstructions to channels, and to allow for appropriate maintenance of the drainage regime. If excessive suspended solids are noted, construction work will be stopped, and remediation measures will be put in place immediately.

Visual inspections will be continued during the operational period until vegetation is established on site at intervals to be agreed with Cork County Council/IFI.

A detailed water quality monitoring programme will be undertaken during the construction phase of the proposed development, in addition to the visual inspections outlined above, so as to ensure the effective implementation of the proposed mitigation measures. Field measurements and grab samples will be taken at suitable locations, which will be decided prior to the construction phase commencing. The field measurements will be recorded at the site and will include measurement of the following parameters, electrical conductivity (µs/cm), pH, temperature (ºC), suspended solids (mg/l) and dissolved oxygen (mg/l). The field measurements will be taken on a weekly basis during the site clearance and earthworks stage of the construction period.

An ECOW will compare the results with the pre work levels and ensure that designed mitigation measures are working. An ECOW will propose new mitigation measures if results exceed pre work levels.

4.3.3.5.4 Mitigation Measures During Operation

4.3.3.5.4.1 Inspections

Quarterly inspections of the erosion and sediment control measures on site (i.e. drains, swales, outfalls to field drains) will be undertaken for the first year following construction and annually thereafter to ensure operational efficiency.

4.3.3.5.4.2 Management of Hydrocarbons

Oil used in transformers (at the substation and within each turbine) and storage of oils in tanks at the substation could leak during the operational phase and impact on groundwater quality. The substation transformer and oil storage tanks will be in a concrete bunded capable of holding 110% of the oil in the transformer and storage tanks. Turbine transformers are located within the turbines, so any leaks will be contained.

4.3.3.5.4.3 Settlement Ponds

Settlement ponds will be left in place during the operational phase to be further utilised during the decommissioning phase. Ponds will be fenced to restrict access.

4.3.3.5.4.4 Invasive Species

Invasive species will continue to be treated within the project area according to the invasive species management plan for as long as they persist within the site.

4.3.3.5.4.5 Lighting on Turbines

Turbines identified during the design process will be illuminated with medium intensity flashing red obstacle lights of 2000 candelas where required by the IAA.

Lighting will be fitted with baffles to ensure that the light is directed skywards and will not be discernible from the ground.

4.3.3.5.4.6 Vegetation-free buffer zones

The vegetation-free buffer zones around all turbines will be managed and maintained during the operational life of the development. These will be kept clear by mechanical means only; no chemical methods will be used.

4.3.3.5.5 Mitigation Measures During Decommissioning Phase

All prior to and construction phase mitigation will be implemented during the decommissioning phase.

4.3.4 Vulnerability to Major Accidents or Disasters

Should a major accident or natural disaster occur, the potential sources of pollution onsite during the construction and operational phases of the Annagh Wind Farm are limited. The primary sources with the potential to cause significant environmental pollution and associated negative impacts on human health and the environment include the bulk storage of hydrocarbons, chemicals and wastes. In the case of the proposed Annagh Wind Farm development site, the storage of chemicals of this kind are strictly limited. For biodiversity, the main possible impacts are considered to be the release of sediment and pollutants into watercourses, which could negatively impact upon aquatic habitats and species.

Potential vulnerabilities relevant to the proposed project are limited to:

- Flooding;
- Fire;
- Major incidents involving dangerous substances;
- Catastrophic events; and
- Landslides.

The risk of flooding is addressed in Chapter 10: Hydrology and Water Quality, which concludes that the wind farm site will have a negligible impact on flood risk in the surrounding area, as a result of the proposed development. Furthermore, there is no expected increase to flood risk along the grid route or TDR.

In the event of extreme weather conditions, the proposed surface water drainage will manage storm water avoiding significant negative impact on the project's infrastructure. Therefore, it is unlikely that the proposed development will result in increased flood risk, and it is unlikely that flood risk would result in effects on human safety (including traffic), water quality, biodiversity, soil stability, material assets and archaeological or architectural heritage, as the increased flood risk is considered negligible.

Mitigation measures are set out in section 4.3.6 to avoid potential negative impacts during the construction stage with respect to flood risk.

The potential for fire at the proposed Annagh Wind Farm is mitigated against by design. Furthermore, the wind farm will be remotely monitored, and potential accidents will be quickly identified and reported, as described in section 6.

In line with IWEA Health and Safety Guidelines for the Onshore Wind Industry (2011), Emergency Response Plans will include emergency response procedures for initial actions in the event of a fire.

Records will be kept for testing of fire alarms and drills and maintenance/inspection of fixed and portable firefighting equipment. Information will be provided to employees on fire safety and fire prevention, including risks of and control measures to prevent fire outbreak, evacuation procedures and those responsible for their implementation, and the use of firefighting equipment, in line with HSA guidance.

During the construction phase of the proposed development, an emergency response plan will be in place as set out in Section 6.

Given the nature of the proposed development, coupled with the lack of proximity to established Seveso sites, there is a negligible potential risk of negative impact to the proposed development and its receiving environment, as set out throughout this EIAR, arising from the occurrence of major incidents involving dangerous substances.

Potential catastrophic events associated with operational wind turbines include:

- Wind turbine toppling (due to foundation or tower failure);
- Wind turbine rotational failure in extreme wind conditions (due to control system or rotor break failure); and
- Fire.

The primary mitigation against a catastrophic event that may endanger the health and safety of the public has been implemented at design stage through adequate siting of wind turbines which provide sufficient set back distances from occupied buildings and other infrastructure to avoid the risk of negative impact in the event of wind turbine collapse.

The proposed tip height for wind turbines at the Annagh Wind Farm is 175m. No wind turbine is located within 500m of a residential dwelling. The most proximate occupied dwelling (involved landowner) is 690m from a proposed turbine location. No turbines have been located within 1.5 x tip height of the proposed on-site substation. A minimum setback distance of 3.5 x rotor diameter has been imposed between wind turbines and existing HV overhead lines in accordance with EirGrid general functional specifications.

Turbines have been sited with consideration for existing ground conditions to minimise the risk of turbine foundation failure, toppling and landslide. Intrusive site investigations have been carried out to confirm ground conditions at turbine locations as well as slope stability analysis throughout the wind farm site. Other design mitigation measures employed for the siting of wind turbines include the following:

- Areas mapped by GSI as having a high susceptibility to landslides have been avoided;
- Turbine locations have been assessed by site investigation and visually by geotechnical engineers prior to confirmation of final siting;
- Care has been taken in design of road and hard standing alignments, cutting and filling and drainage;
- Peat probing has been carried out at turbine locations. No peat was identified within the wind farm site.

See Chapter 9: Land, Soil and Geology for more information on ground conditions.

As detailed in Chapter 9: Land, Soils and Geology, a slope stability assessment was carried out at the Annagh Wind Farm site to investigate the lands for potential slope failure. Susceptibility to slope failure is considered 'low' on the site. Site investigation was conducted which revealed no peat on the site. As such, potential peat stability issues were ruled out at the proposed infrastructure locations.

Mitigation by design has been incorporated into the project to avoid potential effects from landslides. Mitigation measures for potential landslide/slope failure is set out in section 4.3.5. Mitigation measures relating to flood risk which could have a bearing on potential landslides are detailed in section 4.3.6.

Wind turbines are fitted with sophisticated remote monitoring and control systems to manage rotational speed. Turbines also have the capability to shut down in storm conditions through adjustment of blade pitch. Turbines are also fitted with emergency power supply (EPS) units to provide backup power in the event of a loss of mains power supply that could impact the control system.

Wind turbines shall be fitted with fire suppression systems and will have emergency escape procedures in place for operational staff in the event of fire in a wind turbine. An emergency response plan is contained in the CEMP included in Section 6 of this CEMP.

During the construction phase of the proposed development, an emergency response plan will be in place as set out in Section 6 of this CEMP in the unlikely event of a landslide/slope failure.

In relation to potential vulnerability of the project to major accidents and natural disasters it is concluded that the potential susceptibility to natural disaster of the proposed Annagh Wind Farm is negligible.

4.3.5 Soil Management Plan

This Soil Management Plan has been prepared for the development of the proposed Annagh Wind Farm. This plan should be read in conjunction with the EIAR. The Soil Management Plan shall be finalised in accordance with this plan following the appointment of the contractor for the main construction works.

It is intended where possible, to maintain an earthworks balance on site, with all excavated material re-used within the site where possible and minimising the need for removal of any materials for off-site disposal. This will minimise the amount of construction traffic on local roads and reduce the need for off-site disposal. This will in turn lead to the reduction of noise and dust associated with construction traffic.

Site Risk Assessment

The preliminary site-specific hazards have been identified for this site in Table 4-5. The hazards should be re-assessed prior to the commencement of construction on the site and these hazards should be communicated to all personnel entering the site. No site personnel should enter lands outside the scope of the project. The construction areas must be secured from public access at all times.

Table 4-5: Site Specific Ground Hazards - Soil Management

Site Specific Hazards	
Annagh Wind Farm	• Excavations (risk of falling) • Ground stability • Materials storage

Daily Preparation during the Implementation of the Soil Management Plan

The Geotechnical Engineer appointed by the contractor should conduct regular meetings with the Construction Management Team to discuss the phasing of soil management as the work progresses. The focus of these meetings will be on establishing an operational drainage system in advance of the progression of the works.

Particular regard will be taken of daily weather conditions and long-range forecasts. The Drainage Engineer should have the authority to suspend the works if weather conditions are deemed too extreme for the effective protection of receiving watercourses. Mitigation measures identified in Section 4.3.5 to protect receiving watercourses will be put in place as directed by the Drainage Engineer in advance of extreme forecasts.

Personnel Qualifications and Key Contacts

All those carrying out work on site must have a Solas/FÁS Safe Pass Card. All works must be supervised by a competent supervisor. Workers must be adequately trained in the tasks they are required to carry out. The key contact names and contact details should be supplied to all personnel entering the site. All site staff should be informed of the emergency procedures for the site. The Geotechnical Engineer should be contacted if there are any issues with soil/rock stability or other materials management issues.

Construction Stage Impacts

The main characteristics of the proposed Annagh Wind Farm that could impact on land, soils and geology are:

- Construction of wind turbine foundations and hardstanding areas
- Construction of access tracks
- Construction of on-site substation
- Cable trench and grid connection construction
- Soil and rock excavation/reuse
- Temporary Material storage areas
- Drainage
- Vehicular movement
- Construction of temporary site compound

Construction Stage Mitigation Measures

Tree Felling

Potential impacts to the existing environment from the proposed tree felling works have been identified. The works will lead to the exposure of underlying soils to surface water runoff, which could result in soil erosion. This also could lead to an increase in sediment and nutrient concentrations in the surface water run-off which may in turn impact groundwater in the Locally Important Aquifer beneath the proposed project site.

One of the primary mitigation measures to be employed at the construction phase of the development is the management of silt laden runoff.

The potential impact from silt laden surface water runoff from increased erosion of exposed overburden deposits has been assessed, particularly at new and existing drainage locations and where tree felling works are proposed and is included in Chapter 10.

Details of the proposed Surface Water Management System and associated mitigation measures are summarised in Chapter 10 and are also outlined in Section 4.3.5.

Best practices will be employed in the prevention of silt laden run-off from entering watercourses.

The use of plant and machinery during tree felling works will require the storage and use of fuels and oils. Details of oil spill protection measures adjacent to sensitive receptors and emergency spill response procedures are outlined in Section 4.3.5.

Storage tanks, used to store fuel for the various items of machinery, will be self-contained and double-walled. Refuelling of felling plant and equipment will be carried out from these tanks or from delivery vehicles at designated refuelling areas. Specific mitigation measures relating to the management of hydrocarbons are as follows:

- Any diesel, fuel or hydraulic oils stored on site will be stored in bunded storage tanks – the bund area will have a volume of at least 110 % of the volume of such materials stored.
- Refuelling of plant during construction will only be carried out at designated refuelling station locations on site. Onsite re-fuelling of machinery will be carried out 100m from watercourses using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site or at the primary refuelling station at the main site compound and will be towed by a 4x4 jeep to designated re-fuelling areas near to where machinery is located but at distances of greater than 100m from watercourses. Drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site.
- Emergency drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site. The emergency response procedure is provided in Section 1.8 of SWMP.

4.3.5.1 Earthworks

The project will be constructed in a phased manner within a 12-18 month period, as described in Chapter 3, to reduce the potential impacts of the project on the Land, Soils and Geology. Phased construction reduces the amount of open, exposed excavations at any one time. Given that the works comprises a significant proportion of excavation and earthworks, suitably qualified and experienced geotechnical personnel will be required on site to supervise the works.

One of the primary mitigation measures employed at the preliminary design stage was the minimisation of volumes of excavated overburden deposits to be exported off site. All excavated overburden will be retained on-site.

This will include:

- Use of suitable site won material (bedrock) as general fill in the construction of access tracks, hardstands and in reinstatement around turbine foundations.

Surplus overburden deposits excavated during the course of the works will be temporarily stored in a level area adjacent to the construction phase excavations prior to reuse.

Some temporary stockpiles (not exceeding 2m in height) of material will be necessary adjacent to the excavation areas prior to reinstatement, however no long-term stockpiles of material will remain after construction and no surplus/waste soil or rock will be removed from the proposed project site. Temporary stockpiles should be shaped and sealed to prevent the ingress of water from rainfall.

To mitigate against the compaction of soil at the site, prior to the commencement of any earthworks, the work corridor will be pegged, and machinery will stay within this corridor so that soils outside the work area are not damaged. Excavations will then be carried out from access tracks as they are constructed in order to reduce the compaction of soft ground.

To mitigate against erosion of the exposed soil or rock, all excavations will be constructed and backfilled as quickly as possible. Excavations will stop during or prior to heavy rainfall events (>10mm/hour). To mitigate against possible contamination of the exposed soils and bedrock, refuelling of machinery and plant will only occur at designated refuelling areas.

Soil excavated from trenches along the proposed grid connection route will be taken to a licenced facility for disposal or recycling where required. If feasible, the upper layers of tarmac and asphalt will be excavated separately to the lower engineered fill layers. The lower engineered fill layers will be reused, subject to suitability testing. The tarmac/asphalt layers will be taken to a licenced facility for disposal or recycling.

All temporary cuts/excavations will be carried out such that they are stable or adequately supported. Gravel fill will be used to provide additional support to temporary cuts/excavations where appropriate. Unstable temporary cuts/excavations will not be left unsupported. Where appropriate and necessary, temporary cuts and excavations will be protected against the ingress of water or erosion.

Control of Sediment Laden Runoff

The potential impacts from silt laden surface water runoff from increased erosion of exposed overburden deposits has been assessed where earthworks and tree felling are proposed and are described in section 4.3.6.

Details of the proposed Surface Water Management System and mitigation measures are summarised in Section 4.3.6.

To minimise the impact to surface water quality, existing forestry drainage will be maintained outside the immediate site area, and where appropriate, additional site drainage and settlement ponds will be installed as required prior to construction activities.

Silt fencing will be installed in new drainage and monitoring of water quality undertaken during the construction phase.

Measures for spills

Details of oil spill protection measures adjacent to sensitive receptors and emergency spill response procedures are outlined in Section 4.3.6.

Storage tanks, used to store fuel for the various items of machinery, will be self-contained and double-walled. Refuelling of construction vehicles will be carried out from these tanks or from delivery vehicles at designated refuelling areas. Specific mitigation measures relating to the management of hydrocarbons are as follows:

- Fuels, lubricants and hydraulic fluids for equipment used on the construction site will be carefully handled to avoid spillage.
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained, and the contaminated soil removed from the site and properly disposed of;
- Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or re-cycling; and
- Appropriate spill control equipment, such as oil soakage pads, will be kept within the construction area and in each item of plant to deal with any accidental spillage.

4.3.5.2 Slope Stability

With regard to slope stability issues, detailed design and construction phase best practice will be implemented as follows:

- The works will be supervised by a suitably qualified and experienced geotechnical engineer or engineering geologist, and hydrologist or drainage engineer.
- Drainage infrastructure will be put in place in advance of excavations. Drains will divert surface water and groundwater away from excavations into the existing and proposed surface drainage network. Uncontrolled, direct and concentrated discharges of water onto the ground surface will be avoided.
- Loading or stockpiling of materials on the surface of soft ground will be avoided. Loading or stockpiling on other deposits will not be undertaken without first establishing the adequacy of the ground to support loads by an appropriately qualified geotechnical engineer experienced in construction within upland conditions. No stockpiling of material shall take place on steep slopes.
- Excavation will be carried out from access roads or hardstanding areas to avoid tracking of construction plant across areas of soft ground.
- An assessment of the stability at proposed infrastructure locations has been carried out as part of this EIAR based on worst case conditions. A further assessment will be undertaken at detailed design stage by a suitably qualified and experienced geotechnical engineer prior to the commencement of all excavations to confirm the findings of this assessment.
- Blasting of rock will not be permitted.
- Excavations which could have the potential to undermine the up-slope component of an existing slope will be sufficiently supported to resist lateral slippage and careful attention will be given to the existing drainage.
- Earthworks will not be commenced when heavy or sustained rainfall is forecast. A rainfall gauge will be installed on site to provide a record of rainfall intensity. An inspection of site stability and drainage by the Geotechnical Engineer will be carried out on site when a daily rainfall of over 25mm is recorded on site, works will only recommence after heavy rain with the prior approval of the Geotechnical Engineer following inspection.
- An emergency plan is included Section 6 outlining the action plan which would be implemented in the unlikely event of a landslide/slope failure. Should a landslide/slope failure occur or if signs of instability/ground movement are observed, work will cease immediately.

Groundwater

To mitigate against the increased vulnerability of the underlying aquifer to groundwater pollution, all excavations will be constructed and backfilled as quickly as possible. Excavations will stop during or prior to heavy rainfall events. To mitigate against possible contamination of the underlying groundwater, refuelling of machinery and plant will only occur at designated refuelling areas. Details of mitigation measures related to spills and fuel storage are outlined above.

The dewatering of the foundation excavations is not expected to cause interference with domestic wells in the area, due to large offset distances to known wells, relatively shallow depths of excavation and temporary short-term nature of dewatering, if required. To monitor groundwater during the construction phase groundwater monitoring wells will be installed between areas of deeper excavations and sensitive groundwater receptors. The wells will be used to monitor groundwater levels and quality to assess any potential impacts during the construction works.

Grid connection and internal cable trenches could provide preferential pathways for groundwater and contaminant movement. Trenches will be excavated during dry periods where possible in short sections and left open for minimal periods, to avoid acting as a conduit for surface water flows. To further mitigate the risk of cable trenches becoming preferential pathways, clay plugs (or other low permeability material) will be installed at intervals along the trench to stop/inhibit water movement.

4.3.6 Surface Water Management Plan

This Surface Water Management Plan (SWMP) should be read in conjunction with the EIAR. The Surface Water Management Plan shall be finalised in accordance with this plan following the appointment of the contractor for the main construction works.

Existing Environment

The wind farm site is situated within Awbeg (Buttevant)_SC_010 sub-catchment as defined by the WFD and shown on Figure 102 of the EIAR. This sub-catchment is part of the Blackwater Munster (ID 18) catchment.

The main hydrology features within the wind farm site are the Ardglass Stream and Oakfront Stream which drain into the River Awbeg (Buttevant) West approximately 1.3km downstream of the site.

This river is part of the Blackwater River (Cork/Waterford) SAC. The vast majority of the site drains into the Oakfront Stream due to handmade field and forestry drains. During the site visit agricultural and forestry drains were identified.

The average annual rainfall in period 1981-2010 in the area of the wind farm site is 1,002 mm. M5-60 at development location is 16.9 mm according to the Met Éireann rainfall data. This is the predicted rainfall depth in a sixty minute storm with an annual exceedance probability of 20%.

Daily Preparation during the Implementation of the Surface Water Management Plan

The Drainage Engineer appointed by the contractor will conduct regular meetings with the Construction Management Team to discuss the phasing of construction and drainage as the work progresses. The focus of these meetings will be on establishing an operational drainage system in advance of the progression of the works.

Particular regard will be taken of daily weather conditions and long-range forecasts. The Drainage Engineer will have the authority to suspend the works if weather conditions are deemed too extreme for the effective protection of receiving watercourses. Mitigation measures to protect receiving watercourses will be put in place as directed by the Drainage Engineer in response to extreme forecasts.

Personnel Qualifications and Key Contacts

All those carrying out work on site must have a Fás/Solas Safe Pass Card. All works must be supervised by a competent supervisor. Workers must be adequately trained in the tasks they are required to carry out. The key contact names and contact details should be supplied to all personnel entering the site. All site staff should be informed of the emergency procedures for the site.

Potential Impacts

Construction Stage Impacts

During the construction period, the development has the potential to lead to impacts on hydrology and water quality unless appropriate mitigation is applied.

Tree felling, new site access roads, turbine hard-standing areas, the on-site substation and other new, hard surfaces have the potential to contribute to an increase in runoff, release of sediments, hydrocarbons, and pollutants in the watercourses.

During construction, the transport of both dissolved and sediment-bound nutrients from soil to water could deleteriously affect water quality downstream, in the absence of mitigation measures. Nutrient transport from soil to water, may lead to eutrophication in waters receiving drainage from the site.

A detailed description of the potential construction stage impacts on hydrology and water quality can be found in Chapter 10 of the EIAR.

Operational Phase Impacts

The main hydrological impact of the development is the increase in runoff volumes. Due to the insignificance of the increase in runoff from the development, the grassing over of the drainage swales, and the non-intrusive nature of site operations, there is a negligible risk of sediment release to the watercourses during the operational stage.

A detailed description of the potential operational stage impacts on hydrology and water quality can be found in Chapter 10 of the EIAR.

Decommissioning Phase Impacts

The potential impacts associated with decommissioning will be similar in nature to those associated with construction of the wind farm albeit to a lesser extent.

It is proposed that turbine foundations and hardstanding areas are left in place and covered with local topsoil and revegetated. Removal of this infrastructure would result in considerable disruption to the local environment in terms of an increased possibility of sedimentation. It is considered that leaving the turbine foundations and hardstanding areas in-situ will cause less environmental damage than removing them.

Grid connection cables will be left in the ground, therefore no potential impacts during decommissioning stage are likely to occur.

It is proposed that the internal site access tracks will be left in place, subject to agreement with Local Authority and the relevant landowners.

A detailed description of the potential decommissioning stage impacts on hydrology and water quality can be found in Chapter 10 of the EIAR.

Drainage of Wind Farm during the Construction and Operation Phases

Sustainable Drainage Systems (SuDS)

Where possible, sustainable drainage systems, in the form of grassed swales will be used to drain the permitted development. The grassed swales will serve to slow down the velocities of flows draining the hardcore surfaces of the hardstanding areas and the access tracks. The proposed layout of the drainage system is provided in Appendix 1.

The grassed swales will also treat the surface water run-off, removing some of the sediment borne contaminants. These grassed swales will serve to detain flows and reduce the velocities of surface water flows. The swales will be 0.3 m in depth with a bottom width of 0.5 m and side slopes of 1 in 3. A grassed swale is shown on Figure 4-1.

The swales will be constructed in accordance with CIRIA C698 Site Handbook for the Construction of SUDS. Swale draining to settlement pond is shown on Figure 4-2.

Settlement ponds will be put in place in advance as construction progresses across the site. Settlement ponds will have a diffuse stone filled outflow which will encourage the diffuse spread of flows overland and back into natural drains down slope of the settlement ponds. Drainage stone will be placed at the inlet to the ponds to filter the flows before they enter the ponds.

After passing through the settlement ponds, the concentration of suspended solids in the surface water run-off due to the excavations will be reduced to within acceptable levels in accordance with Directive 2006/44/EC – European Communities (Quality of Fresh Waters Needing Protection or Improvement to Support Fish Life).

In the event of an emergency, the settlement ponds will provide a temporary holding area for any accidental spills on site as it will be possible to block off the outflow from these ponds for a limited period.

The settlement ponds will be fenced off for safety. Erosion control and retention facilities, including settlement ponds will be regularly maintained during the construction phase.

Figure 4-1: ***Grassed Swale along access track***

The drainage system will remain operational and will be utilised for the decommissioning phase to treat any surface water from exposed areas as a result of decommissioning at the site. During the decommissioning of the turbine base, hardstanding areas and access tracks shall remain in place and will be covered with local soil/topsoil to minimise disturbance to soils. Removal of this infrastructure would result in considerable disruption to the local environment in terms of increased sedimentation, erosion, dust, noise, traffic and an increased possibility of contamination of the local water table. However, if removal is deemed to be required all infrastructure will be removed with mitigation measures in line to those during construction being employed.

The drainage system outlined below provides for a multi-stage treatment train of the discharges from the development, as recommended in the SUDS manual:

- grassed swales removing some of the sediment borne contaminants,
- settlement ponds providing retention and treatment of discharges,
- diffuse outflow from settlement ponds providing for further retention and settlement of suspended solids by reducing the velocities of flows and increasing the flow path of discharges,
- continuation of flows by natural flow paths over vegetated areas before entering the watercourse, providing further retention and treatment of discharges.

Figure 4-2: ***Swale draining to Settlement pond***

Drainage of Temporary Site Compound

The compound will be set back a minimum of 75m from streams. Drains around the hard-standing areas of the site compound will be in the form of shallow grassed swales to minimise the disturbance to sub-soils.

Filter drains may be used where trafficking by site staff is required to access the temporary site compound. The filter drains/swales will drain to a suitably designed settlement pond. The settlement pond will be backfilled at the temporary compound following the construction period and the vacation of the temporary site compound.

Refuelling of plant and fuel bowsers during construction will be carried out at the primary refuelling station which will be located at the temporary site compound. The station will be fully equipped for a spill response and a specially trained and dedicated environmental and emergency spill response team will be appointed before commencement on site. In addition to the above, onsite refuelling of machinery will be carried out 100m from watercourses using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site or at the primary refuelling station at the site compound and will be towed by a 4x4 jeep to designated refuelling areas near to where machinery is located but at distances of greater than 100m from watercourses. Drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site.

Concrete washout will be carried out in a dedicated area of the temporary compound or at a designated washout pit on site. Only the washing of chutes will be permitted. Every concrete truck delivering concrete to the site must use the concrete washout facility prior to leaving the site. Chutes will be washed out at the designated area with a settlement lagoon provided to receive all run-off.

Any diesel or fuel oils stored at the temporary site compound will be bunded. The bund capacity will be sufficient to contain 110% of the tank's maximum capacity. Where there is more than one tank within the bund, the capacity will be sufficient to accommodate 110% of the largest tank's maximum capacity or 25% of the total maximum capacities of all tanks, whichever is the greater. Design and installation of fuel tanks will be in accordance with best practice guidelines BPGCS005 (Oil Storage Guidelines).

Portaloos and/ or containerised toilets and welfare units with storage tanks will be used to provide toilet facilities for site personnel during construction.

The sanitary waste will be removed from site by a licensed waste disposal contractor. All portaloo units located on site during the construction phase will be operated and maintained in accordance with the manufacturer's instructions, and will be serviced under contract with the supplier. All such units will be removed off-site following completion of the construction phase.

Temporary petrol and oil interceptors will be installed at the site compound and at all locations dedicated for plant repairs/storage of fuel/temporary generator installation. Surface water run-off from the compound will be directed through a Class 1 Full Retention Oil Interceptor before discharge to the surface water drainage system for the site. This surface water drain flows to a settlement pond before final discharge over land. A trained and dedicated environmental and fuel spill emergency response team will be set up on site before commencement of construction on-site.

Drainage of Overland Flows

Existing overland flow channels will be maintained, and cross-drains provided in the access tracks to allow continuity of flow. Where required, on the upslope side of new sections of access track and hardstanding areas, overland flows will be intercepted in channels. The flow will then be discharged diffusely over vegetated areas. Cross-drains will be provided where required at a minimum of 200m intervals. The roadside drains will therefore only carry the site access track runoff. This will ensure that there will be no mixing of 'clean' and 'dirty' water and will avoid a large concentration of flows. Thus, erosion risks will be reduced and the quantity of water requiring treatment will be minimised.

Drainage of Site Access Tracks

The permitted new site access tracks will be drained via roadside grassed swales with settlement ponds at the end of the swale run.

At slopes greater than 2%, check dams will be required in the swales and interceptor drains to slow down the velocities of flows and prevent erosion occurring, as shown in Figure 4-3. These check dams will be in stone of minimum size 37.5 mm and will be laid at a spacing of between 10 and 30 m dependent on the slope.

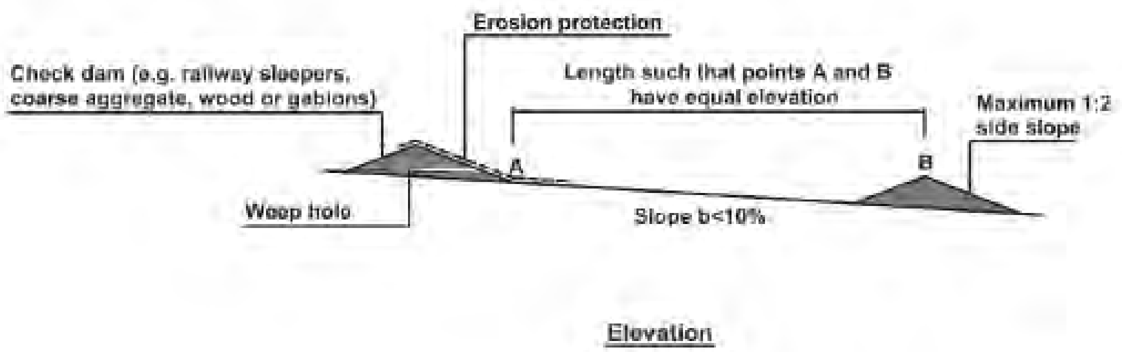


Figure 4-3: ***Check Dam Details***

The roadside swales will drain to settlement ponds before discharging diffusely overland. The settlement ponds will remain in place following the construction period.

Silt traps will be provided in swales which will consist of geotextile staked across the swale at regular intervals. The geotextile will be weighed down on the upstream side with clean filter stone to provide further filtration and stability to the silt trap, as shown in
Figure 4-4 to Figure 4-6.

Silt fencing will be kept on site and erected as required during construction to provide further protection to prevent the ingress of silt into the watercourses. The silt fencing will be kept in place until the natural vegetation has been re-established.

Site drainage, including silt traps and settlement ponds, will be put in place in parallel with or ahead of construction, such that excavation for new infrastructure will have a functioning drainage system in place.

Figure 4-4: ***Silt Trap across Grassed Swale***

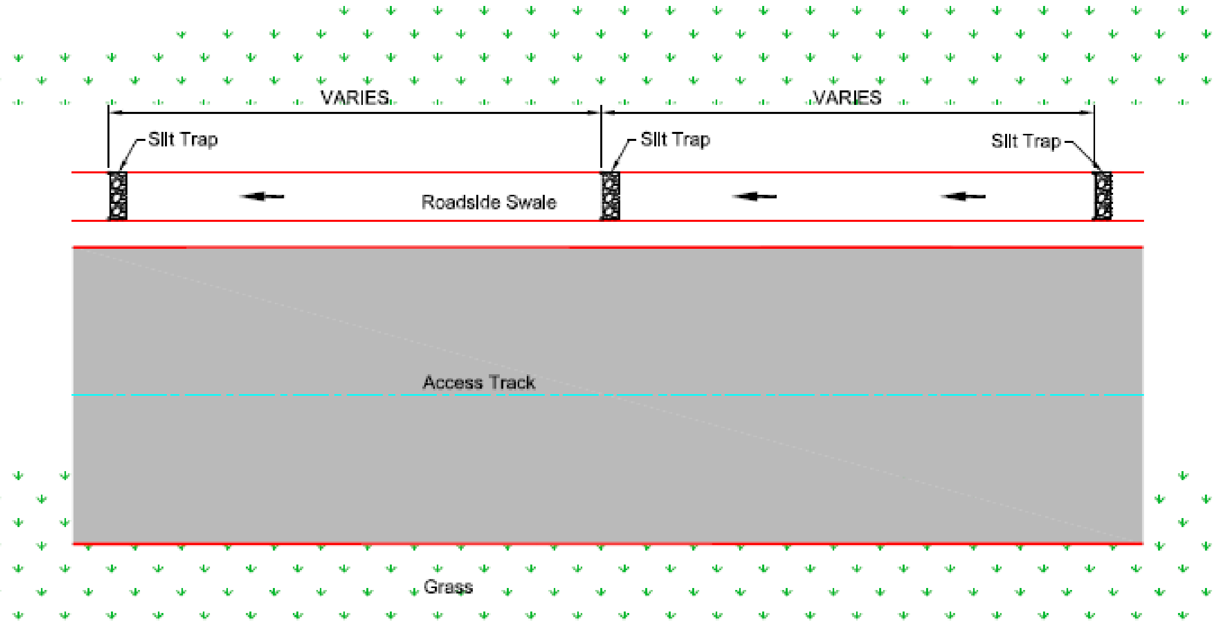


Figure 4-5: ***Plan of Silt Trap in Swale***

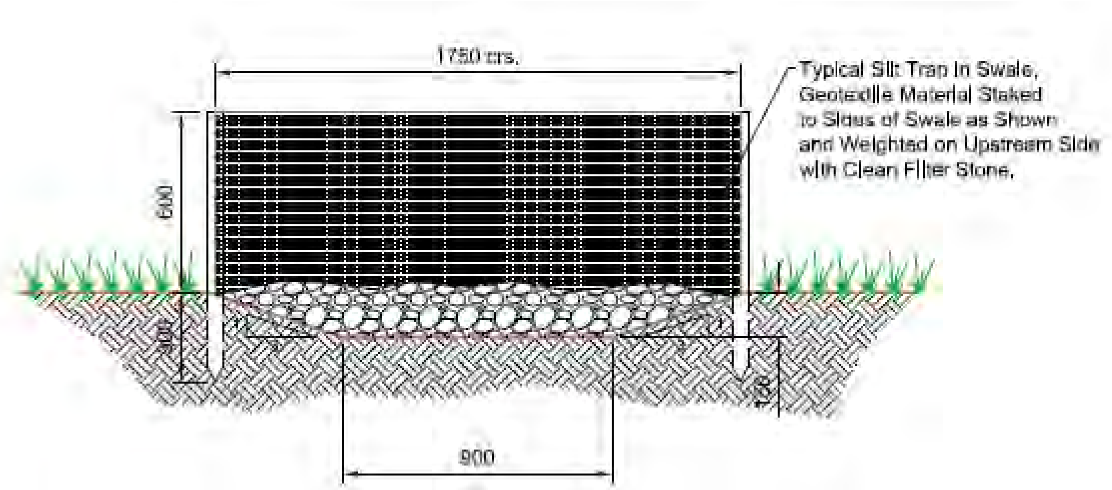


Figure 4-6: ***Silt Trap Details***

Drainage of Turbine Bases and Hardstanding

The excavations for turbines will be pumped into the site drainage system (including settlement ponds), which will be constructed at site clearance stage, in advance of excavations for the turbine bases.

As discussed above, the new turbine hard-standing areas will be drained via shallow swales with suitably designed settlement ponds. The settlement ponds will remain in place following the construction period.

If cross-drains are required to convey the drainage across the hardstanding area, the diameters will be suitably designed in advance.

Drainage of Cable Trenches

Cables running throughout the wind farm site will be installed in trenches adjacent to site access tracks, where possible. Cable trenches will be excavated using a mechanical excavator and the excavated materials placed in small bunds adjacent to the trenches for back filling, as shown in
Figure 4-7.

The seed bank is to be retained for placing back as the top layer of backfill to the trench, to aid successful restoration of vegetation in disturbed areas.

Cable trenches will be excavated during dry periods where possible, in short sections and left open for minimal periods, to avoid acting as a conduit for surface water flows. Clay bunds will be constructed at up to 10m intervals within the cable trench.

Figure 4-7: ***Backfill over Cable Trench***

Procedure for Dewatering of Excavations

Standing water, which could arise in excavations, has the potential to contain an increased concentration of suspended solids as a result of the disturbance to soils. Water in the excavations for turbines will be pumped into the site drainage system which will be constructed at site clearance stage, in advance of excavations for the turbine bases.

Drainage of Substation

The on-site substation will be drained using shallow swales, with a suitably designed settlement pond. The settlement pond will remain in place following the construction period. At the upslope side of the sub-station overland flows will be intercepted in channels and discharged diffusely over vegetated areas.

The substation drainage will consist of an underground surface water pipe system. This system will include a number of surface water manholes, rain water pipes for the compound building roof, Class 1 Full Retention Oil Separator, an oil sensitive bund dewatering system and ACO drains. The system will discharge overland.

In accordance with SuDs best practice, it is proposed to include rainwater harvesting tanks within the surface water system which will comprise of a filter, an underground tank and a pump. The system allows rainwater to run down the roof and into the guttering and downpipes in the normal way before passing through the filter, which removes any leaves and debris. Rainwater is then stored in the underground tank for reuse.

Permanent sanitary facilities will be provided at the substation.

A foul system is proposed within the station to cater for the wastewater generated in the welfare facilities of the control building. The foul system will consist of an underground pipe network, foul manholes and an 18m3 full retention foul effluent storage tank. The tank will have an associated high level alarm which will be connected to the control building. A foul holding tank to be maintained and emptied bi-annually is the most preferable means of treating and disposing of foul waste from the site. The licensed contractor charged to empty and dispose of the waste will be the holder of a valid waste collection permit.

Drainage of Stockpiled Material

During the construction period, the excavated material will be used to reinstate the turbine bases.

All excavations shall be constructed and backfilled as quickly as possible. Excavation will stop during or immediately after heavy rainfall.

Excavation will precede the turbine base construction, cable trench and access track construction. Soil will be excavated and replaced with granular fill where required. Excavation will be carried out from access tracks where possible in order to reduce the compaction of topsoil.

During the construction period, spoil heaps from the excavations for the turbine bases will be stored temporarily. These temporary spoil heaps will be covered if required and surrounded by silt fences to filter sediment from the surface water run-off from excavated material. The silt fences will be inspected regularly and after rainfall events by Environmental Clerk of Works (ECOW).

Surplus soil or rock excavated during the course of the works will be used on site in the form of landscaping including low berms, where appropriate. No spoil stockpiles will be left on site after construction is completed.

Any stockpiling will be short-term and temporary and will occur only within the site boundary as the construction proceeds. The site drainage system will be put in place prior to excavation, therefore the discharge routes from any temporary stockpiling will be via the site drainage system. A minimum buffer of 50m will be provided between temporary stockpiles and the nearest watercourse.

Watercourse Crossings

Existing stream crossings will be protected using silt fencing.

Minor drains such as manmade agricultural and bog drains will be crossed using suitably designed pipe culverts.

Turbine delivery will not take place during extreme weather conditions.

Climate Change

To accommodate the effect of future climate change in Ireland, the 100-year peak flow values for stream crossing designs should be multiplied by 1.2 to obtain the design 100-year flood value for the crossing.

Wash Down from Concrete Trucks and Cement Mixers

Concrete washout will be carried out in a dedicated area of the temporary compound. Only the washing of chutes will be permitted. Every concrete truck delivering concrete to the site must use the concrete washout facility prior to leaving the site. Chutes will be washed out at the designated area with a settlement lagoon provided to receive all run-off.

An adequately designed settlement lagoon will be provided to receive all runoff from the concrete wash down area, similar to that shown in
Figure 4-8. Regular inspections of the wash down areas and associated settlement lagoons shall be carried out and adequate records kept.

The settlement lagoon shall be lined using a 1mm LLDPE impermeable liner. A sump will be provided at this location which will collect the wash water from the concrete trucks. The excavated material will be kept on site for reinstatement following the construction period.

Figure 4-8: ***Lined Settlement Lagoon for Concrete Washout Facility***

During construction, wash water and any solids in the sump will be removed periodically to an appropriate licensed facility. The sump can be emptied daily if required. Following construction, any solids, the liner, and any remaining wash water in the sump will all be removed to an appropriate licensed facility for disposal. The sump will then be reinstated.

Mitigation Measures for Pollution Control to Protect Water Quality in Downstream Receptors

All personnel working on site will be trained in pollution incident control response. An emergency response procedure is prepared herein which will ensure that appropriate information will be available on site outlining the spillage response procedure and a contingency plan to contain silt.

Silt Protection Controls (SPCs) are proposed at the location of watercourse crossings and where haul roads pass close to watercourses, silt fencing will be used to protect the streams.

Silt traps will also be provided at outfalls from roadside swales. Silt traps will be kept upstream of outfalls to allow a buffer zone to the outfall. Additional silt fencing will be kept on site in case of an emergency break out of silt laden run-off.

Settlement ponds will be put in place in advance as construction progresses across the site. The settlement ponds with a diffuse outflow detail will mitigate any increase in runoff and treat suspended solids in the surface water runoff. Erosion control and retention facilities, including settlement ponds will be regularly maintained during the construction phase.

All stockpile material will be bunded adequately and protected from heavy rainfall to reduce silt runoff, where necessary. Adequate security will be provided to prevent spillage as a result of vandalism.

Drains around hardstanding areas will be shallow to minimize the disturbance to sub-soils.

Suitably sized cross-drains will be provided for drainage crossings to convey flows from agricultural drains and forestry drains across the access tracks, to prevent a risk of clogging.

Tracks will be capped as soon as practicably possible to cover exposed subsoils and as such reduce the concentration of suspended solids in the run-off.

All open water bodies adjacent to proposed construction areas will be protected by fencing, including the proposed settlement ponds.

Additional protection will be provided in the form of silt fencing downslope where required and at existing stream crossings during construction, to further ensure that there is no impact from the development to streams and rivers crossing the site.

Where haul roads pass close to watercourses, silt fencing will be used to protect the streams. Silt traps will also be provided at outfalls from roadside swales. Silt traps will be kept upstream of outfalls to allow a buffer zone to the outfall.

Refuelling of plant during construction will be carried out at the temporary compounds, which will be located a minimum of 50m from any watercourse. The station will be fully equipped for a spill response and a specially trained and dedicated environmental and emergency spill response team will be appointed before commencement on site. In addition to the above, onsite re-fuelling of machinery will be carried out 100m from watercourses using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site or at the designated refuelling area and will be towed by a 4x4 jeep to designated re-fuelling areas near to where machinery is located but at distances of greater than 100m from watercourses. Drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site.

Concrete washout will be carried out in a dedicated area of the temporary compounds. Only the washing of chutes will be permitted. Every concrete truck delivering concrete to the site must use the concrete washout facility prior to leaving the site. Chutes will be washed out at the designated area with a settlement lagoon provided to receive all run-off. During construction concrete will be kept out of all watercourses and drains.

Any diesel, fuel or hydraulic oils stored at the temporary site compounds will be bunded. The bund capacity will be sufficient to contain 110% of the tank's maximum capacity.

Vehicles entering the site shall be in good working order, free from leakage of fuel or hydraulic fluid.

A wheel wash will be provided at the site entrance draining to a silt trap to avoid any silt laden run-off flowing on to the public road and entering roadside drains.

Portaloos and/or containerised toilets and welfare units will be used to provide toilet facilities for site personnel during construction. Sanitary waste will be removed from site via a licenced waste disposal contractor.

Silt fencing will be erected at the location of stream crossings along the cable route.

Construction Stage Mitigation Measures

Long range weather forecasts shall be examined, and the construction phases planned taking cognisance of expected weather conditions. Regular meetings shall be held to re-assess construction phases with weather conditions as the project progresses.

Regular meetings shall be held between the Drainage Engineer appointed by the contractor and the contractor's Project Manager.

The proposed mitigation measures are listed below:

4.3.6.1 Proposed Mitigation Measures During Construction

4.3.6.1.1 Increase in Surface Runoff

Permanent roadside drainage will be installed as part of the construction stage. This will include the use of interceptor drains, swales and check dams. The proposed drainage system will increase time of concentration. Time of concentration (Tc) is time required for an entire catchment to contribute to runoff at the point of interest.
These measures will buffer site runoff during periods of high rainfall by retaining the water until the hyetograph has receded. A hyetograph is a graphical representation of the distribution of rainfall intensity over time.

4.3.6.1.2 Suspended Solids

The key mitigation measure during the construction phase is locating the proposed turbines 50m from the watercourse. No construction activities or drainage will be within 50m of the watercourses, with an exception for watercourse crossings, access road leading to the proposed substation and turbine T4.

The proposed buffer zones will:

- Avoid physical damage to watercourses, and associated release of sediment.
- Avoid excavations within close proximity to surface water courses.
- Minimise the potential for the entry of suspended sediment from earthworks into watercourses.
- Minimise the potential for the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

The following measures shall be implemented during the construction phase:

- settlement ponds with a diffuse outflow detail will be put in place in advance as construction progresses across the site. Erosion control and retention facilities, including settlement ponds will be regularly maintained during the construction phase. The three-stage treatment train (swale – settlement pond – diffuse outflow) proposed to retain and treat the discharges from hard surface areas as a result of the development will reduce any risk of flooding downstream.
- A water quality monitoring programme will be established to ensure that water quality is maintained throughout the construction phase. The details of this programme are outlined below. This programme will ensure that designed measures including settlement ponds are working, and existing water quality is maintained.
- It is proposed to divert an existing field drain as stated in Section 10.6.7. The diversion of the field drain will take place during a dry period. It is proposed to put double silt fences in the drain just upstream and downstream of the diversion area. Prior to construction is it proposed to build a small stone dam within a ditch to prevent water ingress. Clean water accumulated upstream of a dam will be pumped downstream of the construction area.
- Where haul roads pass close to watercourses, silt fencing will be used to protect the streams.
- Silt traps will also be provided at outfalls from roadside swales to settlement ponds.
- Interceptor cut-off drains will be provided on the upslope side of the access roads to prevent the mixing of overland flows with the drainage for the proposed development. These interceptor drains will discharge diffusely over land to avoid concentration of runoff.

  The roadside drains will therefore only carry the site access road runoff and so avoid carrying large volumes of water and concentrating flows.
- Where new cross-drains are proposed on this site to convey surface water from roadside swales to settlement ponds, these will be sized at a minimum of 300 mm diameter to avoid blockages.
- Cross drains of 450 mm will be provided to prevent a risk of clogging for drainage crossings and conveying flow from agricultural drains and forestry drains under access track roads.
- Standing water, which could arise in excavations, has the potential to contain an increased concentration of suspended solids as a result of the disturbance to soils. The excavations for turbines will be pumped into the site drainage system (including settlement ponds), which will be constructed at site clearance stage, in advance of excavations for the turbine bases.
- All open water bodies adjacent to proposed construction areas will be protected by fencing including the proposed settlement ponds.
- Excavated subsoil material not required for in-site reinstatement will be removed to the designated material storage areas.

- Silt fencing will be erected at the locations of the drain crossings for the duration of the construction period.
- Site access tracks have been laid out to reduce longitudinal slope of roadside drains where possible. Where roadside drains are laid at slopes greater than 2%, check damns will be provided. This will reduce effective slope and runoff velocities and any consequent potential for erosion.
- Silt fencing will be erected at the location of stream crossings along the cable route.
- The temporary storage of excavated material on site will be put at least 50 m from watercourses.
- An Environmental Clerk of Works (ECOW) will be appointed by the developer to ensure the effective operation and maintenance of drainage and other mitigation measures during the construction process. The operations management of the Site will include regular monitoring of the drainage system and maintenance as required.
- Additional protection will be provided in the form of silt fencing downslope during construction of new watercourse crossings, to further ensure that there is no impact from the development to streams and rivers downslope of the site. All open water bodies adjacent to proposed construction areas will be protected by fencing.
- Daily visual inspections of drains and streams will be performed during the construction period of the new crossing structures to ensure suspended solids are not entering the streams and rivers alongside the work area, to identify any obstructions to channels, and to allow for appropriate maintenance of the existing roadside drainage regime.
- Weather warnings will be monitored, and no construction will take place during extreme events. Large excavations and movements of subsoil or vegetation stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast. Works will be suspended by an ECOW if forecasting suggests either of the following is likely to occur:
    - >10 mm/hr (high intensity local rainfall events).
    - >25 mm in a 24 hour period (heavy frontal rainfall lasting most of the day).
    - >half monthly average rainfall in any 7 days.
- Prior to works being suspended the following control measures will be completed:
    - Secure all open excavations.
    - Provide temporary or emergency drainage to prevent back-up of surface runoff.
    - Avoid working during heavy rainfall and for up to 24 hours after heavy rainfall events to ensure drainage systems are not overloaded.
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded.
- Brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall.

Water Quality Monitoring Programme

A monitoring programme will be established to ensure that water quality is maintained. The details of this programme are outlined below. This programme will ensure that designed measures are working, and water quality is not affected.

An Environmental Clerk of Works (ECOW) will be on-site during construction to monitor water quality. Turbidity meters will be installed prior to construction downstream of the site.

Levels of turbidity will be monitored pre-construction to confirm existing levels in the waterbodies. Should the turbidity levels measured during construction be higher than the existing levels, construction will be stopped, and remediation measures will be put in place immediately, to include silt fencing.

Water samples will be taken weekly during ground disturbance works and will include measurement of the parameters provided in Table 4.6 below:

Table 4-6: Surface Water Quality Monitoring Parameters

Parameter	Maximum Value	Regulation
Turbidity	-	-
pH	6.0 < pH < 9.0	Surface Water Regulations 2009
BOD	High Status < 1.3 (mean) or <2.2 (95%ile) Good Status <1.5 (mean) or < 2.6 (95%ile)	Surface Water Regulations 2009
Total Suspended Solids (mg/l)	<25	Salmonid Water Regulations 1988
Total Ammonia (mg/l N)	High Status < 0.04 (mean) or <0.09 (95%ile) Good Status <0.14 (mean) or < 0.065 (95%ile)	Surface Water Regulations 2009
Nitrite (NO_2) (mg/l)	<0.05	Salmonid Water Regulations 1988
Molybdate Reactive Phosphorus (mg/l P)	High Status < 0.025 (mean) or <0.045 (95%ile) Good Status <0.035 (mean) or < 0.075 (95%ile)	Surface Water Regulations 2009

Post-mitigation Impact (residual impact): Direct, Negative, Low, Short Term, Unlikely.

Given the level of protection provided by the hydrological buffer zones and the proposed measures, **not significant** residual effects are anticipated.

4.3.6.1.3 Release of Hydrocarbons

- Refuelling of plant during construction will only be carried out at designated refuelling station locations on site.
- Storage of fuels, lubricants and hydraulic fluids will occur at the contractor's compound, which will be fenced and have a lockable gate, thereby ensuring that the area in which fuels, lubricants and hydraulic fluids are stored will be properly secured against unauthorized access or vandalism.

- Emergency drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site. The emergency response procedure is provided in the SWMP provided in Appendix 10.3.
- Designated contractors' personnel will be trained and certified in oil spill control and clean up procedures, and in the proper and safe disposal of any waste generated through such an event.
- Any diesel, fuel or hydraulic oils stored on site will be stored in bunded storage tanks – the bund area will have a volume of at least 110 % of the volume of such materials stored.

4.3.6.1.4 Contamination from Wastewater and Pollutants

- Portaloos and/or containerised toilets and welfare units will be used to provide toilet facilities for site personnel. Sanitary waste will be removed from site via a licenced waste disposal contractor.
- To reduce the risk of invasive species and pathogen introduction (e.g. Crayfish plague), all equipment will be thoroughly checked, cleaned and dried in accordance with best practice as specified in the CIRIA guidelines below. Furthermore, plant machinery which has worked within riparian corridors or come in to contact with water will be steam-cleaned and dried in advance of works commencement in the Blackwater catchment. Crayfish plague is known from the Suir, Deel and Maigue Catchments to the north since 2017 but has not been detected to date in the Blackwater catchment. The potential introduction of Crayfish plague is of particular concern at watercourse crossings given the potential for White-clawed Crayfish populations downstream.

    - CIRIA (2001). Control of water pollution from construction sites - Guidance for consultants and contractors (C532). Construction Industry Research and Information Association, London.
    - CIRIA (2006). Control of Pollution from Linear Construction Project; Technical Guidance (C648). Construction Industry Research and Information Association, London.
    - CIRIA (2015a). Manual on scour at bridges and other hydraulic structures, second edition (C742). Construction Industry Research and Information Association, London.
    - CIRIA (2015b). Environmental Good Practice on Site (4th edition) (C741). Construction Industry Research and Information Association, London.
    - CIRIA (2019). Culvert, screen and outfall manual (C786). Construction Industry Research and Information Association, London.

4.3.6.1.5 Release of Cement-Based Products

- Prior to leaving the site, every truck delivering concrete to the site must wash the chute only to a lined pit provided at each turbine location and substation compound.
- There will be no on-site batching of concrete and no storage of cement will be permitted within 50 m of the crossing construction areas, except at turbine T4.
- During all concrete works pH will be measured daily upstream and downstream of works areas. A change in 0.5 pH units will trigger cessation of works and investigation of possible concrete source.
- Where possible, pre-cast elements will be used to minimise the need for wet concrete works within the site.
- Weather forecasting will be used to plan dry days for pouring concrete.

- It will be ensured that the concrete pour site is free of standing water prior to concreting and plastic covers will be available in case of a sudden rainfall event.

4.3.6.1.6 Proposed Mitigation Measures for Tree Felling

Tree felling will be permitted under limited felling license(s) from the Forest Service and to the conditions of such a license. A Limited Felling License will be in place prior to works commencing on site. To ensure a tree clearance method that reduces the potential for sediment and nutrient runoff, the construction methodology will follow the specifications set out in:

- Felling and Reforestation Policy, Forest Service, Department of Agriculture, Food and the Marine, Dublin. May 2017
- Standards for Felling and Reforestation, Forest Service, Department of Agriculture, Food and the Marine, Dublin. October 2019
- Forestry Standards Manual (Agricultural, Food and the Marine, 2015)
- Forestry Act 2014 and the Forestry Regulations 2017 (SI No 191 of 2017) and SI 31 of 2020 - Forestry (Amdmt) Regs 2020 re reg 19AA procedures (pdf 99Kb)
- Forest Service. 2000a. Forestry and Water Quality Guidelines. Forest Service, Department of the Marine and Natural Resources, Dublin.
- Forest Service. 2000b. Code of Best Forest Practice – Ireland. Irish National Forest Standard. Forest Service, Department of the Marine and Natural Resources, Dublin.
- Forest Service. 2000c. Forest Harvesting and the Environment Guidelines. Forest Service, Department of the Marine and Natural Resources, Dublin.

The following mitigation measures are proposed:

- Before operation commence, identify a 10m wide exclusion zone along the edge of all aquatic zones
- Ensure all operators are aware of exclusion zone
- Machine traffic and timber stacking are not permitted within these zones
- Trees within the reach of the harvester arm will be felled by harvester, and snedded and bunched outside the exclusion zone.
- Trees outside machine reach to be felled manually by chainsaw operators. Felled trees to be winched out of the exclusion zone where appropriate and safe to do so, or removed by extended harvester arm, for subsequent snedding and processing outside the exclusion zone.
- In all cases, fell trees away from the water feature.
- Regarding aquatic zones, ensure banks remain undisturbed. No branches or debris are to enter the aquatic zone during operations. Immediately and with care, remove any branches that do fall in.
- Minimise the crossing of drains during felling and extraction, and restrict machine activity to brashed extraction racks and haulage routes.
- Where necessary, deploy a heavy-duty plastic culvert lengthways into the channel and cover with brash material. The culvert must be of a diameter approximating the depth of the drain, to avoid any unnecessary undulation along the extraction route.

- Where required, a solution for smaller drains is to temporarily lay log sections lengthways into the channel and overlay with brash. Again, select logs that approximate the depth of the channel to be crossed.
- When installing and removing the temporary crossing, ensure that no work is carried out within the aquatic zone, and that the stream bed and bankside remain undisturbed.
- Carefully remove temporary crossings as they become no longer needed. Any brash padding used must be peeled back carefully away from the water feature, to avoid dislodging collected sediment.
- Direct crossing over the stream bed is not permitted.
- Ensure the feature is crossed at a right angle to the flow of water.
- Where needed, any necessary crossing shall be via an appropriate structure that spans proud of the flow of water and prevents the breakdown and erosion of the banks.
- Solutions include the laying down of a bridge comprising logs overlaid with geotextile and brash to intercept soil falling off wheels.
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed.
- Timber will be stacked in dry areas, and outside a local 50m watercourse buffer. Straw bales and check dams will be emplaced on the down gradient side of timber storage sites.
- Brash mats will be used to support vehicles on soft ground (e.g. during trenching and drainage construction), reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall.
- Prior to the commencement of operations, silt traps will be installed within existing forest drains that connect with aquatic zones, either directly or indirectly through other relevant watercourses.
- Silt traps will be staggered along the length of the drain, and not only at the lower reaches towards its outflow.
- Silt trap design can vary, from depressions added to the drain bed, to log sections laid lengthways into the drain, to the use of geotextile barriers
- Silt fences will be utilized where necessary, to block pathway for silt in areas where overland flow is possible.
- Once silt traps and silt fences become functional, they will be regularly checked and maintained as necessary, in order to ensure continued effectiveness throughout operations.
- Felling and extraction and other machine operations onsite (or redirect to more stable areas of the site) will cease during and after periods of rainfall which result in the possibility of the surface mobilisation of silt.
- Silt traps and silt fences will be checked weekly, and maintained as required, to ensure their continued effectiveness throughout works. All excess silts will be removed and disposed of appropriately.
- Daily visual checks will be undertaken of relevant watercourses (primarily at their outflow from the site) and adjoining aquatic zones, to confirm (or otherwise) that no sediment or silt discharge will be arising from site works.
- A record will be kept of the above monitoring and will be retained for possible inspection.

A detailed water quality monitoring programme will be undertaken during the construction phase of the proposed development, in addition to the visual inspections outlined above, so as to ensure the effective implementation of the proposed mitigation measures. A water quality monitoring plan is detailed below.

Operational Phase Mitigation Measures

It is not envisaged that the operation of the wind farm will result in significant impacts on the hydrological regime or water quality of the area, as there will be no further disturbance of soils post-construction, and only a minimum of traffic movement.

Oil used in transformers (at the substation and within each turbine) and storage of oils in tanks at the substation could leak during the operational phase and impact on groundwater quality. The substation transformer and oil storage tanks will be in a concrete bund capable of holding 110% of the oil in the transformer and storage tanks. Turbine transformers are located within the turbines, so any leaks will be contained.

Visual inspections will be continued during the operational period until satisfactory vegetation is established on site at bi-annual intervals to be agreed with Local Authority/IFI.

It is not envisaged that the maintenance period will involve any significant impacts on the hydrological regime of the area. The maintenance of the development will incorporate effective maintenance of the drainage system. Visual inspections will be undertaken during the maintenance period in accordance with maintenance schedule in CIRIA C753. The maintenance regime will include inspecting the following:

- Drains, cross-drains and culverts for any blockages,
- Outfalls to existing field drains and watercourses,
- Existing roadside swales for any obstructions,
- Swales,
- Progress of the re-establishment of vegetation.

The maintenance regime will also include implementing appropriate remedial measures as required after the above inspections and testing the water quality at the outfalls at appropriate intervals.

Decommissioning Stage and Mitigation Measures

As in the construction phase silt protection controls would again be put in place. The drainage system will remain operational during the decommissioning phase and will serve to treat any sediment laden surface water runoff due to a renewed disturbance of soils. Revegetation following the backfilling of hardstanding areas will be monitored. Erosion control matting will be used to assist in the re-establishment of vegetation.

Mitigation Measure for Flooding

Settlement ponds are to be provided as part of the drainage system for the development. The settlement ponds, together with the swales, will serve to reduce velocities in the surface water runoff draining from the access tracks and hardstanding areas and will provide retention of the flows. This will also mitigate any increase in the risk of flooding.

No construction personnel, operation or maintenance personnel will be permitted on site during extreme flood events.

Water Quality Monitoring Plan

A monitoring programme will be established to ensure that the water quality is maintained. This programme will ensure that designed measures are working to ensure water quality is not affected. The details of this programme are outlined below.

Daily visual inspections of drains and outfalls will be performed during the construction period to ensure suspended solids are not entering the streams and rivers of the site, to identify any obstructions to channels, and to allow for appropriate maintenance of the drainage regime. If excessive suspended solids are noted, construction work will be stopped, and remediation measures will be put in place immediately, as described in section 4.3.6.1.2.

Visual inspections will be continued during the operational period until vegetation is established on site at biannual intervals to be agreed with Local Authority/IFI.

A detailed water quality monitoring programme will be undertaken during the construction phase of the proposed development, in addition to the visual inspections outlined above, so as to ensure the effective implementation of the proposed mitigation measures. Field measurements and grab samples will be taken at suitable locations, downstream of the proposed infrastructure. The field measurements will be recorded at the site and will include measurement of the following parameters, electrical conductivity (µs/cm), pH, temperature (ºC), suspended solids (mg/l) and dissolved oxygen (mg/l). The field measurements will be taken on a weekly basis during the site clearance and earthworks stage of the construction period. An ECOW will compare the results with the pre work levels and ensure that designed mitigation measures are working.

Emergency Silt Control and Spillage Response Procedures

All personnel working on site will be trained in pollution incident control response. An emergency response plan will be prepared which will ensure that appropriate information will be available on site outlining the spillage response procedure and a contingency plan to contain silt. A regular review of forecasts of heavy rainfall is required and a contingency plan will be prepared for before and after such events. A record will be kept of daily visual examinations of watercourses which receive flows from the permitted development, during and for an agreed period after the construction phase. Procedures for particular accidental spillages, from leaking or damaged fuel lines or a break-out of silt are outlined below.

Oils, Fuels and Site Vehicles

Refuelling of plant during construction will be carried out at the temporary compounds. The station will be fully equipped for a spill response and a specially trained and dedicated environmental and emergency spill response team will be appointed before commencement on site. In addition to the above, onsite re-fuelling of machinery will be carried out 75m from watercourses using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site or at the designated refuelling area and will be towed by a 4x4 jeep to designated re-fuelling areas near to where machinery is located but at distances of greater than 75m from watercourses.

Details of tests to be carried out on Storage tanks to a recognized standard together with a secondary containment system to provide at least 110% of the maximum tank capacity are as follows:

All tank and drum storage areas shall, as a minimum, be bunded, either locally or remotely, to a volume not less than the greater of the following:

a. 110% of the capacity of the largest tank or drum within the bunded area; or
b. 25% of the total volume of substance which could be stored within the bunded area.

Accidental spillage from leaking or damaged fuel lines

Emergency drip trays and spill kits will be kept available on site for use in emergencies to ensure that any spills from vehicles are contained and removed off site. Each refuelling station will be fully equipped for a spill response and a specially trained and dedicated environmental and emergency spill response team will be appointed before commencement on site.

In the case of water pollution in addition to the Local Authority, Inland Fisheries Ireland will also be informed immediately.

In the event of an accidental spillage from leaking or damaged fuel lines, the spillage will be cleaned up with absorbent material e.g. sand or turf mould and placed in a designated bunded location while awaiting removal offsite to a licensed facility.

In the event of an emergency, the settlement ponds will provide a temporary holding area for any accidental spills on site as it will be possible to block off the outflow from these ponds for a limited period.

Accidental break out of silt

Following an accidental break out of silt, emergency measures will be put in place. During the construction period an emergency facility will be provided with sand bags to block off the outlet in the sedimentation ponds to prevent discharge from the sedimentation ponds in the event of a break out of the silt.

Additional silt fencing will be available on site for use in emergencies.

The drainage engineer shall be contacted if there is an accidental spillage or break out of silt on the site.

Maintenance of Site Drainage Systems

The drainage system for the development shall be maintained regularly to keep it operating effectively. The maintenance shall include the following:

- inspection and maintenance of swales,
- inspecting cross-drains for any blockages,
- inspecting settlement ponds and outfalls,
- inspecting the stream crossings and piped crossings for obstructions,
- inspecting the progress of the re-establishment of vegetation,
- implementing appropriate remedial measures as required after the above inspections.

4.3.7 Archaeological Management Plan

This plan details archaeological requirements. For information on architectural heritage, please refer to Chapter 14 of the EIAR and Section 2.

Construction and Operational Stage Mitigation Measures

Wind Farm

The forestry plantation, including the presence of tree stumps and root systems in felled areas within the main wind farm site, will preclude advance archaeological site investigations such as geophysical survey and test trenching.

A systematic advance programme of archaeological site inspections will be undertaken within all development areas following pre-construction tree felling to assess whether there are any visible surface traces of any potential unrecorded archaeological or architectural heritage sites. Archaeological monitoring of ground excavation works during the construction phase will then be carried out under license by the National Monument Service. In the event that any sub-surface archaeological features are identified during these site investigations they will be recorded and cordoned off while the National Monuments Service are consulted to determine further appropriate mitigation measures, which may include preservation *in situ* (by avoidance) or preservation by record (archaeological excavation).

The locations of all recorded archaeological sites within the fields in the environs of construction areas will be cordoned off and the outer edges of their Zones of Notification clearly signed as 'No Entry: Archaeological Areas' for the duration of the construction phase. These onsite constraints comprise Ringfort CO007-072001-, Enclosures CO007-072002- and CO007-074----, Fulacht Fia CO007-175---- and Mound CO007-073----. The locations of the two derelict, late 19th century farmyards will also be clearly marked as no entry areas. Onsite work crews will be notified of these locations during onsite inductions. Their locations will be subject to inspections by the appointed archaeologist at regular biannual intervals during the construction phase to ensure that the protective measures are being successfully implemented.

Grid Connection

A programme of licensed archaeological monitoring of all ground excavation works within the sections of road that extend within the Zones of Notification (ZON) around all known archaeological sites identified in the EIAR will be undertaken during the construction phase. Archaeological monitoring of all excavation works within green field areas will also be carried out and this will include advance inspections of all dry minor watercourses that may be crossed by the 'dry-trench scenario' and subsequent monitoring of these works.

The programme of archaeological supervision of the construction phase of the Development will also include monitoring ground excavation works and vegetation clearance within the section of the L1322 road in the environs of known archaeological sites located in adjacent fields (i.e., Ringfort CO007-048----, Vernacular House CO007-049001- and Church site CO007-122----). Any required localised ground works within greenfield areas to facilitate the grid connection and turbine delivery will also be subject to archaeological monitoring (e.g., joint bays, site entrance upgrades). An archaeological watching brief of cable trench excavation works in other areas of roadways will be maintained and the extent of this supervision will be agreed in advance with the National Monuments Service as part of the licence application process.

Turbine Delivery Route

The delivery of the turbines to the proposed wind farm will not require the construction of any new sections of diversion roads or bridges. The delivery will require localised widening works, to mainly include vegetation trimming, within localised sections of the L1322 road margin which are within the wider environs of three recorded archaeological sites located within private properties on both sides of the road. (i.e., Ringfort CO007-048----, Vernacular House CO007-049001- and Church site CO007-122----). The proposed work locations to facilitate the delivery route within the environs of Ringfort CO007-048---- and Church CO007-122---- will not result in any direct impacts on their recorded locations. In addition, no interventions to the derelict ruins of the vernacular house CO007-049001- will be required. While the works will not result in predicted direct impacts on any of these recorded archaeological sites, any localised reduction of existing ground surfaces will have the potential to result in direct impacts of indeterminable significance on any unrecorded, sub-surface archaeological remains that may exist in such locations.

Monitoring of mitigation measures

There are a number of obligatory processes to be undertaken as part of archaeological licence applications to the NMS and these will allow for monitoring of the successful implementation of the archaeological mitigation measures. Method statements detailing the proposed strategy for all site investigations will submitted for approval to the National Monuments Service as part of the licence application in advance of the construction phase. These will clearly outline the extent of all ground works and outline the onsite and consultation processes to be enacted in the event that any unrecorded archaeological sites or features are identified. A report will be compiled on all site investigations which will clearly present the results in written, drawn and photographic formats and copies will be submitted to the National Monuments Service, the Planning Authority and the National Museum of Ireland.

4.3.8 Waste Management Plan

It will be the objective of the Developer in conjunction with appointed contractor to prevent, reduce, reuse and recover as much of the waste generated on site as practicable and to ensure the appropriate transport and disposal of residual waste off site. This is in line with the relevant National Waste Management Guidelines and the European Waste Management Hierarchy, as enshrined in the Waste Management Act 1996, as amended.

Any waste generated during the development construction phase will be collected, source separated and stored in dedicated receptacles at the temporary compound during construction.

This Construction Waste Management Plan has been prepared for the proposed Annagh Wind Farm in line with the ”Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects” (2006) as published by the Department of the Environment, Community and Local Government and supported by the Eastern-Midlands Region Waste Management Plan 2015-2021.

The Waste Management Plan shall be finalised in accordance with this plan following the appointment of the contractor for the main construction works. This plan should be read in conjunction with the EIAR.

Assignment of Responsible Personnel

It will be the responsibility of the contractor for the main construction works (when appointed) to nominate a suitable site representative such as a Project Manager, Site Manager or Site Engineer as Waste Manager who will have overall responsibility for the management of waste.

The waste manager will have overall responsibility to instruct all site personnel including sub-contractors to comply with on-site requirements. They will ensure that at an operational level that each crew foreman is assigned direct responsibility.

Waste Generated

It is envisaged that the following categories of waste will be generated during the construction of the project:

- municipal solid waste (MSW) from the office and canteen
- construction and demolition waste
- waste oil/hydrocarbons
- paper/cardboard
- timber
- steel.

A fully authorised waste management contractor will be appointed prior to construction works commencing. This contractor will provide appropriate receptacles for the collection of the various waste streams and will ensure the regular emptying/and or collection of these receptacles.

Waste Minimisation/Reduction

All efforts will be made by site management to minimise the creation of waste throughout the project.

This will be done by:

- material ordering will be optimised to ensure only the necessary quantities of materials are delivered to site
- material storage areas will be of a suitable design and construction to adequately protect all sorted materials to ensure no unnecessary spoilage of materials occurs which would generate additional waste
- all plant will be serviced before arriving on site. This will reduce the risk of breakdown and the possible generation of waste oil/hydrocarbons on site
- all operators will be instructed in measures to cut back on the amount of wastage for trimming of materials etc. for example cutting of plywood, built into the amount ordered
- educating foremen and others to cut/use materials such as ply wisely for shutters etc.
- prefabrication of design elements will be used where suitable to eliminate waste generation on site
- where materials such as concrete are being ordered, great care will be practiced in the calculation of quantities to reduce wastage.

Waste Reuse

When possible, materials shall be re used onsite for other suitable purposes e.g.

- re-use of shuttering etc. where it is safe to do so
- re-use of rebar cut-offs where suitable
- re-use of excavate materials for screening, berms etc.
- re-use of excavated material etc. – where possible will be used as suitable fill elsewhere on site for the new site tracks, the hardstanding areas and embankments where possible.

Waste Recycling & Recovery

In accordance with national waste policy, source separation of recyclable material will take place. This will include the provision of receptacles for the separation and collection of dry recyclables (paper, cardboard, plastics etc.), biological waste (canteen waste) and residual waste.

Receptacles will be clearly labelled, signposted and stored in dedicated areas.

The following sourced segregated materials container will be made available on site at a suitable location:

- timber
- ferrous metals
- aluminium
- dry mixed recyclables
- packaging waste
- food waste.

The materials will be transported off-site by a licensed contractor to a proposed recovery centre and these materials will be processed through various recovery operations. A list of nearby licensed waste management facilities is shown in Table 4-7.

Table 4-7: Nearby Waste Management Facilities

Facility	Type of Waste Accepted
Kanturk Civic Amenity Site	Plastic, metals, oil, paper, cardboard, glass, electrical goods
Mallow Civic Amenity Centre	Plastic, metals, oil, paper, cardboard, glass, electrical goods, timber, green waste
Munster waste management	Domestic, commercial, industrial, agricultural

Waste Disposal

Residual waste generated on-site may require disposal. This waste will be deposited in dedicated receptacles and collected by the licensed waste management contractor and transported to an appropriate facility. All waste movements will be recorded, of which records will be held by the waste manager on-site.

Contaminated Material

Any contaminated soils will be handled, removed and disposed of in accordance with statutory requirements for the handling, transportation and disposal of waste. In particular, the following measures will be implemented:

- Contaminated material will be left in-situ and covered, where possible until such time as WAC (Waste Acceptance Criteria) testing is undertaken in accordance with recommended standards and in-line with the acceptance criteria at a suitably licenced landfill or treatment facility. This will determine firstly the nature of the contamination and secondly the materials classification i.e. inert, non-hazardous or hazardous,
- If the material is deemed to be contaminated, consultation will take place with the respective local authority and/or EPA on the most appropriate measures. Such materials will be excavated, transported by a contractor with a valid waste collection permit and recovered/disposed of at an appropriate facility.

Training

Copies of the project waste management plan will be made available to all relevant personnel on site. All site personnel and sub-contractors will be instructed about the objectives of the Plan and informed of the responsibilities that fall upon them as a consequence of its provisions.

It will be the responsibility of the contractors appointed (Waste Manager) to ensure that all personnel are made aware of their responsibilities under the plan via a toolbox talk or otherwise.

4.3.9 Traffic Management Plan

This document is the Construction Traffic Management Plan (TMP) for the proposed Annagh Wind Farm, Co. Cork. The Construction Traffic Management Plan shall be finalised in accordance with this plan following the appointment of the contractor for the main construction works and the turbine supply contract.

Please note that some items in this plan can only be finalised with appropriate input from the contractor who will actually carry out and schedule the works. Furthermore, it is appropriate that the Project Supervisor Construction Stage (PSCS), when appointed, should have an active role in the preparation/review of the Traffic Management Plan.

This plan should be read in conjunction with Chapter 13 of the EIAR.

The contractor is required to prepare the necessary Site-Specific Traffic Management Plans prior to the construction works commencing in accordance with Chapter 8 of the Traffic Signs Manual and subject to load permits.

The contractor will be responsible for the implementation of all agreements between the developer and the County Council with the objective that the transportation needs for the proposed project will have a minimal impact on the road network and local communities.

As with any construction development project, the transport of materials onto the site will give rise to increased traffic and associated impacts. However due to the very nature of construction these impacts will be temporary.

Construction traffic will require regular access to the site at varying times throughout the construction phase. The aim of this TMP is to put in place procedures to manage traffic effectively on site and in the immediate vicinity of the proposed project, to ensure the continued movement of traffic on the public roads and to minimise disturbance during transportation of materials particularly oversize loads. The correct implementation of this TMP will ensure that appropriate procedures are in place to minimise any effects on the safety and movement of the general public.

Prior to the commencement of construction, the TMP will be reviewed by the main contractor (and any sub-contractors) and will be updated as necessary.

General Traffic Management Measures

The Traffic Management Plan (TMP) consists of the following measures:

Traffic Management Co-Ordinator – A dedicated Traffic Management Coordinator will be appointed for the duration of the project and this person will be the main point of contact for all matters relating to traffic management on the project.

Roads and Routes: The final TMP will clearly identify roads that will be used to access the project site and roads that are not to be used. In some cases, the roads authority may wish that certain roads are not used for HGVs but can be used by LGV traffic.

One-way Systems: as the L1322 is narrow at points, the roads authority may want to introduce a system of one-way construction traffic movements during the construction of the development. Any such one-way systems will be identified in the construction stage TMP in agreement with the roads authority.

Road Closures: with the use of the local roads network for the grid connection route, the narrow carriageway width of the L1322 may require full road closures. Any such road closures will be agreed with the roads authority in advance of construction and diversions will be incorporated into the traffic management plan.

Road Condition Survey: a pre-condition survey will be carried out on all public roads that will be used in connection with the development to record the condition of the public roads in advance of construction commencing. A post-construction survey will also be carried out after the works are completed. The specification and timing of the surveys will be agreed with the roads authority. Joint surveys shall be completed if the roads authority requests.

Road Reinstatement: All roads will be reinstated expeditiously on completion of the construction works. Roads will be reinstated to their pre-works condition or better and to the satisfaction of the roads authority.

Site Inductions: All workers will receive a comprehensive site induction which will include a section on traffic management and clear guidance on the routes to be used/not used to access the site.

24-Hour Emergency Contact: a 24-hour emergency phone number will be maintained for the duration of the construction works and the number will be noted on temporary signage at each works area (for grid connection) and the site entrance for the wind farm site.

Traffic Management Guidance: all necessary temporary traffic management will be planned and executed in accordance with best practice, including Chapter 8 of the Traffic Signs Manual published by the Department of Transport.

Letter Drops: a letter drop will be carried out to notify members of the public living near the proposed site and cable route to advise them of any particular upcoming traffic related matters e.g. temporary lane/road closure or delivery of turbine components.

Signage: Clear signage relating to the development, both temporary and permanent, will be provided for accessing the site.

Road Sweeper: Appropriate steps, as described in sections 4.3.5 and 4.3.10, will be taken to prevent soil/dirt generated during the works from being transported on the public road. If necessary, a road sweeper will be used to maintain the public roads in a clean condition during the construction activities of the project.

Site Entrances: The entrances to the site will be secured when the site is not in use. When necessary a flagman will be used to assist traffic movements at the site entrances

Abnormal Load Deliveries: Abnormal loads will require an abnormal load permit prior to delivery and will be delivered at times and frequencies directed by An Garda Siochána.

Mitigation measures proposed for the grid connection works include:

Road Opening Licence: The road works associated with the grid connection cabling will be completed in line with the requirements of a road opening license as agreed with the local authority.

Route Proofing: In advance of the main grid connection works an assessment will be carried out to define the precise alignment of the cable route within the corridor which has been assessed. This will include slit trenching with the aim of minimising the construction impacts and avoiding existing services in the road.

Maintaining Local Access: reasonable access to local houses, farms and businesses will be maintained at all times during any road closures associated with the grid connection works. The details of this will be agreed with the roads authority in advance of the grid connection works commencing.

Road Cleanliness: Appropriate steps will be taken to prevent soil/dirt generated during the works from being transported on the public road. Road sweeping vehicles will be used when necessary, to ensure that the public road network remains clean.

Temporary Trench Reinstatement: Trenches on public roads, once backfilled, will be temporarily reinstated to the satisfaction of the roads authority.

Haul Route Interface: Aggregates and other materials imported to the wind farm site will be managed to ensure they do not conflict with the grid connection works. Grid connection works will be planned to avoid conflicts with other major activities on the main construction site such as concrete foundation pours and large component deliveries.

Turbine Delivery Route Interface: the delivery of turbine components to the site will be managed to ensure there is no overlap with the grid connection works. Grid Connection works are to be scheduled so as not to conflict with turbine deliveries.

Mitigation measures proposed for the turbine delivery route include:

- **Programme of Deliveries**: a programme of deliveries will be submitted to the roads authority in advance of deliveries of turbine components to the site. The programme will include details of the dates and times of each component delivery along with the route to be taken. Turbine component deliveries will be carried out at night during off-peak times and will be done using a convoy and a specialist heavy haulage company.
- **Garda Escort**: Turbine deliveries will be escorted by An Garda Siochána. This will ensure the impacts of the turbine deliveries on the existing road network are minimised.
- **Reinstatement**: Any area affected by the works to facilitate turbine delivery will be fully reinstated to its original condition unless agreed otherwise.
- **Consultation**: Consultation with the local residents and Cork County Council are included in the traffic management plan to manage turbine component deliveries.

Met Mast Construction

The southern site entrance will be used only for construction of a new section of track to access the met mast location, and for installation of the met mast. Sightlines are not achievable here so the following mitigation measures are proposed:

Banksman: During the construction phase a banksmen will control traffic at the southern entrance to maintain traffic safety on the local road during construction activities relating to the installation of the proposed 100m met mast. The southern access will not be used for any other elements of the proposed development during the construction phase.

Note: the southern entrance will only be used during the operation phase for maintenance of the met mast (likely to be one or two vehicles periodically). Agricultural activity will continue on this laneway.

Similarly, a banksman will be required for decommissioning at the southern entrance for removal of the met mast.

Mitigation Measures – Operational Phase

Site entrances at the wind farm site shall be maintained continually to ensure conditions at these entrances do not deteriorate. Hedgerow maintenance will be required to ensure continued visibility at the entrances.

Mitigation Measures – Decommissioning

The traffic impact associated with the decommissioning phase will be significantly less than the construction phase.

All decommissioning works are to be carried out in accordance with a decommissioning plan to be agreed with the planning authority. Traffic management measures identified will be included in the decommissioning plan for the wind farm.

Infrastructure associated with the grid connection will form part of the national grid and will be left in-situ. Therefore, no impacts are envisaged upon decommissioning of the windfarm development and no mitigation is required.

Similar to the construction phase, a banksman will be required at the southern site entrance for the decommissioning (removal from site) of the proposed 100m met mast.

Mitigation measures adopted for project decommissioning shall be in line with those identified for the construction phase of the proposed development.

Traffic Management Measures for Potential Cumulative Impacts

All known existing and proposed projects within the study area that could potentially generate a cumulative impact with the project in relation to traffic and transportation during construction, operation and decommissioning were identified and examined as part of this assessment. Table 4-8 provides details of the projects within the study area that were considered for cumulative impacts.

Further details on existing and proposed projects assessed in the EIAR for cumulative impacts are contained in Chapter 1.

Table 4-8: Existing and Proposed Projects Assessed for Cumulative Impacts

Project/Operation	Description
Replanting Works	Replant lands have been identified in the townland of Emlagh, near Kilkee, County Clare and are considered cumulatively with the project in this EIAR.
Solar Farm at Fiddane, Ballyhea, Co. Cork, Co. Cork	Consented 67.8 hectare solar farm bordering site to the north. Separate planning application for grid connection.
Solar Farm at Ballyroe, Dromin, Ballynadrideen, Ardnageehy, Rathnacally, and Clashganniv in Ballyhea, Charleville, Co. Cork	Consented 102.76 hectare solar farm and 3.4 km grid connection approximately 1km from the proposed wind farm site.
N/M20 Cork to Limerick scheme	the planned M20 project located east of the site

Construction Staging

The construction programming and staging shall be carried out as described in Section 3.2.

Construction Plant and Vehicles

The typical construction plant and vehicles used as part of the construction of a wind farm are as follows (non-exhaustive):

- Hydraulic Excavators
- Dump Trucks
- General construction delivery vehicles (e.g. steel reinforcement bar, electrical components etc.)

- Concrete trucks and pumps
- Cranes of various lifting capacities (up to 1000 tonnes)
- Oversized articulated delivery vehicles (for turbine component transport)
- Site Jeeps (off-road 4x4 all purpose vehicles)
- Private vehicles of those employed on site for the construction phase.

It should be noted however that final selection of construction plant and vehicles may vary depending on suitability, availability, contractor's choice, etc.

Plant operators will be responsible for the upkeep and maintenance of construction plant and vehicles, ensuring good working order prior to use. Should emergency maintenance need to be carried out on site, this will be carried out at a designated area away from sensitive receptors and will ensure that a spill kit is nearby.

The hours of construction activity will be limited to avoid unsociable hours as per Section 8.5 (d) of the code of practice for BS 5228: Part 1: 1997. Construction operations shall generally be restricted to between 08:00 hours and 19:00 hours Monday to Saturday. It should be noted that it may be necessary to commence turbine base concrete pours earlier due to time constraints incurred by the concrete curing process. Work on Sundays or public holidays will only be conducted in exceptional circumstances or in an emergency. Additional emergency works may also be required outside of normal working hours as quoted above.

Construction commencement dates are yet to be confirmed at this stage; these will be made known to the Planning Authority by way of formal Commencement Notice.

Construction Compound

The locations of the construction compounds are shown on the site layout, Figure 1-2.

Consultation and Notification

An Garda Síochána

Following the appointment of the successful contractor for this project, this Transport Management Plan shall be finalised following the appointment of the contractor for the main construction works.

The contractor will liaise directly with An Garda Síochána in relation to the plan and any concerns/requirements they have will be incorporated in to the plan. This may include details in relation to the escorting of oversized loads.

The necessary permits (including approved route permits) will be applied for and obtained from An Garda Síochána.

Cork County Council

The contractor will liaise directly with the County Council in relation to the plan and any concerns/requirements they have will be incorporated into the plan. The contractor will also liaise with other local authorities, as necessary, along the final turbine delivery route.

The necessary permits (including standard permits) will be applied for and obtained from the relevant local authorities.

Local Residents

The following measures will be used to communicate the necessary information to the households along the local road to be used as a haul road:

(a) Information signs will be erected in advance of the construction/transportation works.
(b) A flyer drop will be carried out to advise households along the local road leading to the site in relation to the programme of construction works and especially in relation to oversized load movements.
(c) Contact details for a Liaison Officer will be provided so that any concerns can be easily channelled to the Developer.

Complaints will be entered into the site complaints log and the relevant site environmental officer will arrange to meet with those affected. The situation will be acted upon immediately and reviewed by the Project Manager.

Key Personnel and Responsibility

Once prepared and agreed with the local County Council and An Garda Síochána the contractor will implement the project specific Traffic Management Plan (TMP).

Please note that some items in this plan can only be finalised with appropriate input from the contractor who will carry out and schedule the works. Furthermore, it is appropriate that the Project Supervisor Construction Stage (PSCS), when appointed, should have an active role in the preparation/review of the Traffic Management Plan.

Typically, the following members of the contractors' staff will have responsibility for adherence to the TMP as follows:

Traffic Management Coordinator

The Traffic Management Coordinator will be responsible for maintaining regular contact with An Garda Síochána, The local County Council, the statutory bodies and the client concerning traffic control, interference with services and co-ordination of crossings at roads, rivers and railways.

The Transport Officer will contact the relevant bodies in relation to method statements prior to the work taking place. The Transport Officer will be responsible for instructing the Construction Manager, Foreman and all other personnel on the information in the agreed method statement prior to the work commencing and ensuring that the method statement is adhered to.

The Transport Officer will be responsible for ensuring that the Traffic Management Plan will be implemented in full.

Safety Officer The Safety Officer will be responsible for implementing all safety requirements detailed in the Project Safety Plan. Ensure that all operatives receive site safety induction prior to commencing work on site. He will ensure that all plant, particularly lifting equipment, on site has the relevant certification and are checked regularly by a competent person. The Safety Officer will carry out safety audits and checks on a regular basis and amend procedures where necessary.

Construction Manager The Construction Manager will be responsible for overall supervision of the operations to ensure they are constructed in a safe and efficient manner. He will ensure that sufficient resources are available to meet the programme and that the necessary information is provided to the appropriate staff.

Foreman The Foreman is responsible for ensuring that the crew carry out the work in accordance with the method statement and contract specifications and drawings using good working practices in a safe manner. He will supervise construction personnel ensuring their competence. He will check all plant and equipment on a regular basis ensuring it is maintained and in good working order.

Wind Turbine Generator Deliveries

A detailed turbine delivery route assessment has been carried out for the project which can be found in Appendix 1 of this document.

The components of up to 7 no. Wind Turbine Generators (WTG's) will be transported by road to the main wind farm site for on-site assembly, using the access route outlined in the above Turbine Delivery Route Assessment Report.

Wind turbine component deliveries, cranes and all large plant associated with turbine installations will use the turbine delivery route.

Restricted Public Road Use by Construction Traffic

The local authority may impose restrictions on the use of some local roads. These will be agreed in liaison with Cork County Council prior to construction and will be outlined in this section, as well as specific signage requirements for construction works.

Some of the existing local roads are narrow, and to this effect, one-way delivery and access route systems may be employed to mitigate against unsuitable two-way construction traffic.

Using local roads is unavoidable, however, introducing a one-way system where necessary and restricting construction traffic access to a small number of roads will minimise disruption to the local community.

Materials will be delivered to site via the indicative haul routes shown in Figure 3-2.

Road Closures, Diversions and Safety Measures for Road Crossings

It is envisaged that road closures will be necessary for the carrying out portions of the cable trenching, with the majority of the proposed cable trenching taking place on existing local roads. The consent of Cork County Council will be required and the necessary road diversions together with the appropriate signage will be put in place. As there is a good network of local roads, it is anticipated that there are a number of options available for diverting traffic which will allow flexibility during this process of construction and maintain local access at all times during this element of the works.

It is proposed to maintain local access at all times during this element of the works. It is proposed that all access points (domestic, business, farm) are considered when finalising the temporary road closures and diversions. Diversion signage will also be included.

Safety measures for road users adjacent to deep excavations, such as temporary concrete barriers will be detailed for Trenchless Road Crossings in advance of construction and agreed with Cork County Council.

Road Cleaning

Public roads shall be kept free of mud, dust, spillages and debris from the construction site, construction plant or haulage vehicles. Any necessary measures shall be put in place at the site entry/exit points.

Carriageway/ Road Reinstatement

It is anticipated that the proposed haul routes will be capable of accommodating the construction traffic associated with the project. After the main contractor is appointed and the haul routes are agreed with Cork County Council. In the event that there are concerns around the structural capacity of a road on a proposed haul route, a structural survey shall be carried out to determine suitability of the existing roads to carry the loading. Where the structural survey indicates that a proposed haul route is not in a suitable condition, details of any upgrading works required shall be submitted to Cork County Council for approval. The developer shall upgrade the road or junction in advance of haulage operations.

A pre-condition survey of haul routes, consisting of a video survey and photographs shall be carried out and a copy submitted to Cork County Council. Any damage caused to the road shall be repaired to its previous condition, to the satisfaction of Cork County Council. Any defects that appear during the haulage period shall be rectified by the project owner.

4.3.10 Dust Management Plan

4.3.10.1 Introduction

This Dust Management Plan (DMP) for the construction and decommissioning works at the proposed Annagh Wind Farm outlines the sources of dust during the works, identifies measures to minimise dust during the works and the complaints procedure for dust.

4.3.10.2 Dust generation and control

4.3.10.2.1 Dust generation

The amount of dust generated and emitted from a working site and the potential impact on the surrounding areas varies according to:

- The type and quantity of material and working methods
- Distance between site activities and sensitive receptors
- Climate/local meteorology and topography.

Dust and particulate matter arising from construction works can affect nearby residents, land uses, soils and flora.

Dust emission is when dust and particulate matter become airborne mostly via windblow. Once dust becomes airborne, the air currents disperse it.

The prevailing wind in Ireland is from the south-west and so dust will most frequently disperse towards the north-east.

The proposed works associated with the proposed project that have the potential to cause dust include:

- Site clearance activities including felling of forestry
- Soil excavations
- Movement of dump trucks containing soils/subsoils within the site (use of berms)
- Stockpiling of soils.

The decommissioning works would have lower potential to generate dust, as the tracks are likely to remain in situ, upon agreement with landowners and Cork County Council. The turbines will be dismantled; however, the foundations will remain in place and will be infilled and seeded.

During construction, the vegetation will be cleared from the site. For agricultural lands, this will include the removal of grasses and topsoil prior to the construction of the hardstanding for the turbines. Excavations will be required for the construction of the internal access tracks and hard standings which are expected to be founded. Excavations will be required also for the cabling within the site.

In areas of forestry, tree felling will be required. In total, 14.7ha of forestry will require felling. This activity also has the potential to release dust. However, the remaining forestry within the area will screen most of the dust and prevent fugitive dust from impacting on receptors.

Excavations for the 6 no. turbine bases and hardstands also has the potential for the release of dust.

Soils being moved within the site on dumper trucks also has the potential to release dust as the travel across the site. Much of the soils excavated within the site will be used to form berms around the turbine hardstands and along access tracks.

Where soils are stockpiled for later use, the surfaces of the piles have the potential to release dust.

4.3.10.2.2 Dust control

The following dust control measures will be put in place during construction and decommissioning works:

- The internal access roads will be constructed prior to the commencement of other major construction activities. These roads will be finished with graded aggregate;
- A water bowser will be available to spray work areas and haul roads, especially during periods of excavations works coinciding with dry periods of weather, in order to suppress dust migration from the site;
- All loads which could cause a dust nuisance will be covered to minimise the potential for fugitive emissions during transport;
- Gravel surface will be used on the construction road at the site exit point to remove any dirt from tyres and tracks before travelling along public roads;
- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable;
- The access and egress of construction vehicles will be controlled to designated locations, along defined routes, with all vehicles required to comply with onsite speed limits, which shall be reduced in periods of dry, windy weather;
- Wheel washing facilities will be provided at the entrance/exit point of the proposed project site.

4.3.10.3 Complaints Procedure

At the main site entrance, the contact details for the site will be available so that local residents are encouraged to contact the site in the event of an off-site dust impact.

The contractor on site will need to be immediately informed of the incident so that fugitive dust complaints can be substantiated.

In all instances, a complaint will be logged by the environmental manager and each complaint should be assigned a discrete complaint number in the Environmental Log.

The environmental manager will maintain the complaints register and any complaints received will be investigated and the dust suppression methods employed will be reviewed. Suitable remedial action will be undertaken as necessary.

4.4 Environmental Management Team - Structure and Responsibility

A preliminary organisation chart is included in Figure 4-9. Revisions to the project organisation chart shall be controlled independently of this plan following the appointment of the Contractor for the main construction works.

The Contractor’s Project Manager will be responsible for the delivery of all elements of the Environmental Management Plan.

The Contractor's Project Manager will retain all responsibility for issuing, changing and monitoring the Environmental Management Plan throughout.

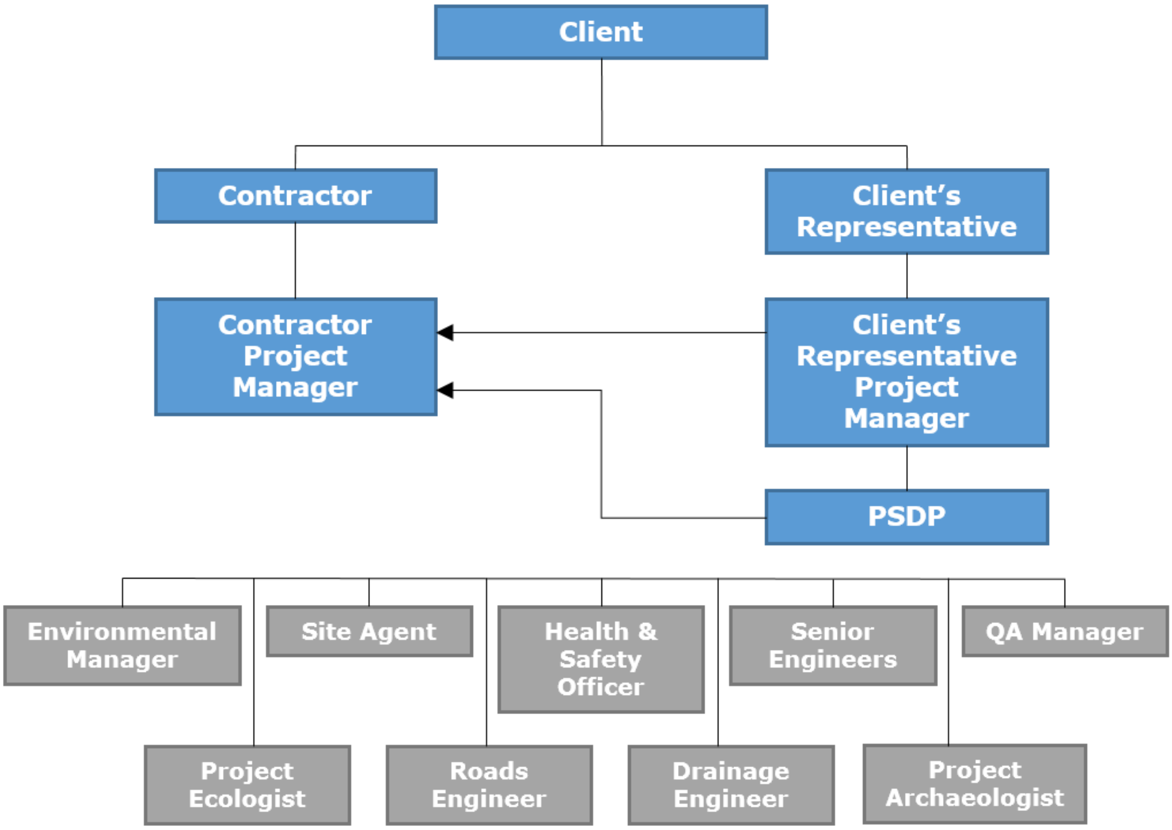


Figure 4-9: Project Management Team Organogram

4.5 Training, Awareness and Competence

All site personnel will receive environmental awareness information as part of their initial site briefing. The detail of the information should be tailored to the scope of their work on site.

The contractor for the main construction works may decide to conduct the environmental awareness training at the same time as Health and Safety Training (often referred to as Site Inductions).

This will ensure that personnel are familiar with the environmental aspects and impacts associated with their activities, the procedures in place to control these impacts and the consequences of departure from these procedures.

The CEMP will be posted on the main site notice board during the project. The environmental performance at the site is on the agenda of the monthly project management meetings for the project.

Elements of the CEMP will be discussed at these meetings including objectives and targets, the effectiveness of environmental procedures etc. Two-way communication will be encouraged by inviting all personnel to offer their comments on environmental performance at the site.

4.6 Environmental Policy

The contractor is responsible for preparing and maintaining an Environmental Policy for the site. The policy should be appropriate to the project, commit to continuous improvement and compliance with legal requirements and provide a framework for objectives and targets. This will be communicated to all site personnel and will be available on site notice boards.

4.7 Register of Environmental Aspects

The contractor is responsible for preparing and maintaining a *Register of Environmental Aspects* pertaining to the site. This register will identify the environmental aspects associated with activities onsite and determine which aspects have or can have a significant impact on the environment.

4.8 Register of Legislation

The contractor is responsible for preparing and maintaining a register of key environmental legislation pertaining to the site. This register will reference all current environmental legislation and will be inspected, reviewed and updated regularly to ensure compliance.

4.9 Objectives and Targets

Objectives and targets are required to be set to ensure that the project can be constructed and operated in full accordance with the EIAR, planning conditions and legislative requirements, with minimal impact on the environment.

Environmental objectives are the broad goals that the contractor must set in order to improve environmental performance. Environmental targets are set performance measurements (key performance indicators or KPI's) that must be met in order to realise a given objective.

The contractor will set objectives based on each significant environmental impact. Key objectives will include the following:

- To ensure that the rivers and streams are not negatively impacted by construction works.
- To ensure that humans are not negatively impacted by dust generated by construction works.
- To ensure that humans are not negatively impacted by noise or vibration generated by construction works.
- To ensure that impacts to habitats and wildlife are minimised during works.
- To ensure that a waste management plan for this site will be fully implemented.
- To ensure that the visual impact during the construction work is minimised.
- To ensure Annagh Wind Farm is constructed in compliance with the EIAR.

Performance in relation to each of these objectives will be reviewed on a regular basis by means of inspections, audits, monitoring programmes, etc.

4.10 Non-Conformance, Corrective and Preventative Action

Non-Conformance Notices will be issued where there is a situation where limits associated with activities on the project are exceeded, or there is an internal/external complaint associated with environmental performance.

Non-Conformance is the situation where essential components of the EMS are absent or dysfunctional, or where there is insufficient control of the activities and processes to the extent that the functionality of the EMS in terms of the policy, objectives and management programmes, is compromised. A Non-Conformance register should be controlled by the contractor.

The EMS and all its components must conform to the EMP, objectives and targets and the requirements of the ISO 14001 management standard.

In the event of non-conformance with any of the above, the following must be undertaken:

- Cause of the non-compliance;
- Develop a plan for correction of the non-compliance;
- Determine preventive measures and ensure they are effective;
- Verify the effectiveness of the correction of the non-compliance;
- Ensure that any procedures affected by the corrective action taken are revised accordingly.

Responsibility must be designated for the investigation, correction, mitigation and prevention of non-conformance.

4.11 EMS Documentation

The Contractor is required to keep the following documentation in relation to the environmental management of the project (as a minimum):

- Construction Environmental Management Plan for Annagh Wind Farm
- Register of Environmental Impacts
- Register of Planning Conditions
- Monitoring Records
- Minutes of Meetings
- Training Records
- Audit and Review Records.

All these documents and records are to be available for inspection in the site office. The documentation shall be to date and shall be reviewed on a regular basis with revisions controlled in accordance with the site quality plan.

4.12 Control of Documents

The Contractor will establish, implement and maintain a procedure to control CEMP documents and records so they are clearly identifiable, organised, current, easily located and revised when necessary.

5. SAFETY & HEALTH MANAGEMENT PLAN

5.1 Introduction

This Safety and Health Management Plan (SHMP) defines the work practices, procedures and management responsibilities relating to the management of health and safety during the design, construction and operation of the Annagh Wind Farm and shall be read in conjunction with the Preliminary Safety & Health Plan prepared for the project by the Project Supervisor for the Design Process. The Safety and Health Management Plan shall be finalised in accordance with this plan following the appointment of the contractor for the main construction works.

This SHMP describes how the contractor for the main construction works will implement a site safety management system (SMS) on this project to meet the specified contractual, regulatory and statutory requirements, environmental impact statement mitigation measures and planning conditions. It is the contractor's responsibility to implement an effective safety management system to ensure that the developer's safety requirements for the construction of this project are met.

All site personnel will be required to be familiar with the requirements of the safety management plan as related to their role on site. The plan describes the project organisation and sets out the health and safety procedures that will be adopted on site.

- The Safety and Health Plan is a controlled document and will be reviewed and revised as necessary.
- A copy of the Safety and Health Plan will be located on/near the site H&S notice board.
- All employees, suppliers and contractors whose work activities cause/could cause impacts on the environment will be made aware of the SHMP and its contents.

5.2 Project Obligations

The construction of Annagh Wind Farm the will impose numerous safety management obligations on the developer, designer and contractor. As well as statutory obligations, there are several specific obligations set out in the EIAR and in the planning conditions for the proposed wind farm. These obligations are set out below. The contractor for the main construction works and all its sub-contractors are to ensure that they are fully aware of and in compliance with these safety obligations.

5.2.1 EIA Obligations

EIAR obligations are described in Section 4.2.1.

5.2.2 Planning Permission Obligations

Planning permission obligations will be fully outlined in the Contractor's CEMP.

5.2.3 Statutory Obligations

The Safety, Health and Welfare at Work Act 2005 and the Safety, Health and Welfare at Work (Construction) Regulations 2013 place a responsibility on the Developer as the "Client", the Designer, the Project Supervisors and the Contractor.

The Client must:

- Appoint a competent and adequately resourced Project Supervisor for the Design Phase (PSDP)
- Appoint a competent and adequately resourced Supervisor for the Construction Stage (PSCS)
- Be satisfied that each designer and contractor appointed has adequate training, knowledge, experience and resources for the work to be performed
- Co-operate with the project supervisor and supply necessary information
- Keep and make available the safety file for the completed structure
- Provide a copy of the safety and health plan prepared by the PSDP to every person tendering for the project
- Notify the Authority of the appointment of the PSDP.

Designers must:

- Identify any hazards that their design may present during construction and subsequent maintenance
- Eliminate the hazards or reduce the risk
- Communicate necessary control measures, design assumptions or remaining risks to the PSDP so they can be dealt with in the safety and health plan
- Co-operate with other designers and the PSDP or PSCP
- Take account of any existing safety and health plan or safety file
- Comply with directions issued by the PSDP or PSCS.

The PSDP must:

- Identify hazards arising from the design or from the technical, organisational, planning or time related aspects of the project
- Where possible, eliminate the hazards or reduce the risks
- Communicate necessary control measure, design assumptions or remaining risks to the PSCS so they can be dealt with in the safety and health plan
- Ensure that the work of designers is coordinated to ensure safety
- Organise co-operation between designers
- Prepare a written safety and health plan for any project and deliver it to the client prior to tender
- Prepare a safety file for the completed structure and give it to the client.

The PSCS must:

- Co-ordinate the identification of hazards, the elimination of the hazards or the reduction of risks during construction
- Develop the Safety and Health Plan initially prepared by the PSDP before construction commences
- Co-ordinate the implementation of the construction regulations by contractors
- Organise cooperation between contractors and the provision of information
- Co-ordinate the reporting of accidents to the Authority
- Notify the Authority before construction commences
- Provide information to the site safety representative
- Co-ordinate the checking of sage working procedures
- Co-ordinate measures to restrict entry on to the site
- Co-ordinate the provision and maintenance of welfare facilities
- Co-ordinate arrangements to ensure that craft, general construction workers and security workers have a Safety Awareness card, e.g. Safe Pass and a Construction Skills card where required
- Co-ordinate the appointment of a site safety representative where there are more than 20 persons on site
- Appoint a safety adviser where there are more than 100 on site
- Provide all necessary safety file information to the PSDP
- Monitor the compliance of contractors and others and take corrective action where necessary;
- Notify the Authority and the client of non-compliance with any written directions issued.

The Contractor must:

- Co-operate with the PSCS
- Promptly provide the PSCS with information required for the safety file
- Comply with directions of the project supervisors
- Report accidents to the Authority and to the PSCS where an employee cannot perform their normal work for more than 3 days
- Comply with site rules and the safety and health plan and ensure that your employees comply
- Identify hazards, eliminate the hazards or reduce risks during construction
- Facilitate the site safety representative
- Ensure that relevant workers have a safety awareness card and a construction skills card where required
- Provide workers with site specific induction
- Appoint a safety officer where there are more than 20 on site or 30 employed
- Consult workers with site specific induction
- Monitor compliance and take corrective action.

Consequently, at all stages of the project there are statutory requirements for the management of safety, health and welfare of all involved in or affected by the development. As previously outlined this CEMP and specifically the Safety and Health Management Plan addresses key construction management issues associated with the proposed wind farm. This plan will be developed further at the construction stage, on the appointment of the Contractor for the main construction works.

5.2.4 The Management of Health and Safety during the Design Process

Fehily Timoney & Company (FT) has been appointed Project Supervisor for the Design Process (to prepare the Environmental Impact Assessment Report and planning application for the proposed Annagh Wind Farm development) and is competent to fulfil this role in accordance with the Safety, Health and Welfare at Work (Construction) Regulations, 2013. Health and safety are a major priority for FT and FT adopts health and safety practices that are an inherent part of a safe and sustainable business. FT's objective is to provide a safe and healthy work environment for all and to meet our duties to clients, contractors and members of the public.

It is FT's policy to comply fully with all health and safety legislation, in particular the Safety, Health and Welfare at Work Act, 2005, Safety, Health and Welfare at Work (General Application) Regulations 2007, and the Safety, Health and Welfare at Work (Construction) Regulations 2013.

FT has developed in-house procedures to ensure, so far as is reasonably practicable, that all projects:

- are designed to be capable of being constructed to be safe/ without risk to health;
- can be operated and maintained safely and without risk to health during use; and
- comply in all respects, as appropriate, with the relevant statutory enactments and instruments.

These procedures include effective risk management procedures involving the identification and evaluation of risks and the development of mitigation measures to eliminate (where possible) or reduce those risks during the life-cycle of the project. The FT team is committed to health and safety and shares responsibility for managing risk at all stages of a project.

All work by FT is undertaken in a competent and efficient manner taking account of the general principles of prevention to safeguard the safety, health and welfare of construction & maintenance workers and other third parties.

The FT procedures for the management of safety during the design process are outlined in the in-house procedure PP09 "Health and Safety Requirements in Design Projects" and is adhered to on all design projects.

The purpose of this procedure is to define the requirements for the management of health & safety during design projects, to ensure compliance with The Safety, Health and Welfare at Work (Construction) Regulations 2013.

The procedure includes standard forms which are used to communicate health and safety considerations within the design team and also guidelines which develop the company's health and safety procedure and outline the company's responsibilities for health and safety during the design process.

The procedure addresses health and safety issues at all stages of a project, from the preliminary design through to commissioning and operation. By establishing a chain of responsibility each party is clear on their role and obligations from a health and safety perspective.

Risk assessments are carried out, at preliminary and detailed design stages by every discipline involved in the design. Each risk assessment is prepared by the designers and reviewed by the Health and Safety Facilitator for the project.

Risk assessments are used to identify hazards and assess risk at all stages during the life of the project including the construction & maintenance stages.

A Health and Safety Facilitator for the Design Process (HSF) is appointed on all projects where FT are the Project Supervisor for the Design Process (PSDP).

Health & Safety Facilitators are selected from the senior ranks of FT design staff to ensure they have the required knowledge, experience and training to carry out the role.

Meetings will be held between the HSF and relevant design personnel to collate all the risk assessments and other pertinent information and to discuss any issues relating to health and safety and ensure the constructability of the designs. The minutes of these meetings are circulated to the entire design team complete with actions allocated to the designers as appropriate. At such a meeting a "Construction Risk Analysis" form is completed which forms the basis for the Preliminary Safety & Health Plan. This document outlines the particular, significant and residual risks and in addition specific construction methods or sequences assumed during the design. Special requirements for maintenance envisaged at design stage are also included.

A Designers Safety File shall be kept and maintained during the design. All design criteria adopted, and safety & health information required for the Safety File shall be kept in this file which is maintained by the HSF and is the pre-cursor to the Safety File. The information required from the Contractor/ PSCS for inclusion in the Safety File is specified at tender stage in the Preliminary Safety and Health Plan.

This information from the PSCS & Contractor(s) and the Designers Safety File is used to compile the Safety File in the latter stages of a contract and formally issued to the Client on completion of the contract.

FT promotes a collaborative approach to health and safety on site where the Client, PSDP, Designers, Contractors and PSCS co-operate with each other and share information. Joint site safety audits and/or walk-downs are carried out as part of this collaboration and safety is monitored and addressed on site on an ongoing basis. The regular safety meetings are held to document this ongoing co-operation, get an over-view of works currently in hand onsite and about to commence and share information.

5.2.5 The Preliminary Safety and Health Plan

In accordance with the requirements of the Safety, Health & Welfare at Work (Construction) Regulations 2013 a Preliminary Safety & Health Plan will be required as part of the design process. This plan will be further developed by the PSCS on appointment and maintained as a live document during construction and commissioning of the development.

The safety and health plan is required to include the following information:

- a general description of the project;
- details of other work activities taking place on site;
- works involving particular risks;
- the timescale for the project and the basis on which the time frame was established;

- conclusions drawn by designers and the PSDP having taken into account the General Principles of Prevention and any relevant Safety and Health Plan or Safety File;
- the location of electricity water and sewage connections so as to facilitate early establishment of welfare facilities.

In accordance with the PSDP's procedures the Preliminary Safety & Health Plan for the proposed Annagh Wind Farm development should include the following sections and subsections to ensure the PSCS is aware of the health and safety issues at tender stage and enable them to price accordingly:

Preamble:

1 General Project Information:
- 1.1 Title
- 1.2 Description of Project
- 1.3 Employer
- 1.4 Designers / Other Consultants
- 1.5 Project Supervisor Design Process
- 1.6 Drawings, Specifications and Other Documents
- 1.7 Intended Contract Commencement Date
- 1.8 Intended Contract Completion Date
- 1.9 Basis for Contract Duration
- 1.10 Restrictions on Working Hours
- 1.11 Notification of Project
- 1.12 Termination of the PSCS Appointment

2 The Existing Environment:
- 2.1 Site Location
- 2.2 Relevant Adjoining Land Uses
- 2.3 Site Restrictions
- 2.4 Restrictions on Access
- 2.5 Hazardous Area Classification
- 2.6 Existing Services
- 2.7 Ground Conditions
- 2.8 Existing Hazards
- 2.9 Liaison with Statutory Bodies

3 Other Work Activities:
- 3.1 Other Contracts Which May Affect Work
- 3.2 Occupation of Site
- 3.3 Building Activities
- 3.4 Other Work Activities
- 3.5 Emergency Procedures in Place on Site

4 Particular and Residual Risks:

- 4.1 Works Which Puts Persons at Work at risk
- 4.2 Work Which Puts Persons at Risk from Chemical or Biological Substances
- 4.3 Work with Ionising Radiation
- 4.4 Work near High Voltage Power Lines
- 4.5 Work Exposing Persons at Work to the Risk of Drowning
- 4.6 Work on Wells, Underground Earthworks and Tunnels
- 4.7 Work Carried Out by Divers at Work Having a System of Air Supply
- 4.8 Work Carried Out in a Caisson with a Compressed Air Atmosphere
- 4.9 Work Involving the Use of Explosives
- 4.10 Work Involving the Assembly or Dismantling of Heavy Prefabricated Components
- 4.11 Work Involving Hazardous Material
- 4.12 Residual Risks

5 Additional Information:

- 5.1 Existing Documents
- 5.2 Site Possession
- 5.3 Site Rules
- 5.4 Site Specific Safety Objectives
- 5.5 Phasing of Works
- 5.6 Permits / Authorisation Required
- 5.7 Maintenance
- 5.8 Continuing Liaison
- 5.9 Specific Recommendations

6 Information Required for Safety File:

- 6.1 Information Required for Safety File from PSCS

5.2.6 The Management of Health and Safety during the Construction Phase

The selection criteria for the Contractor for the works will be based on the ability to construct the works in a manner that will not endanger the safety, health and welfare of any parties and competence to fulfil the role of PSCS.

The contract will be awarded on the basis of assessment of the candidates against relevant health and safety criteria including experience of similar projects, knowledge of the construction processes involved and training of their management and staff who will be involved in carrying out the works.

5.2.7 The Construction Stage Safety and Health Plan

In accordance with the requirements of the Safety, Health & Welfare at Work (Construction) Regulations 2013 the preliminary Safety & Health Plan prepared by the PSDP will be further developed by the PSCS before the commencement of the construction work and updated on a regular basis during the construction phase of the project.

The document will include the following sections and subsections to ensure the management of health and safety during the construction phase of the project:

1. Description of Project:
    - project description and programme details
    - details of client, PSDP and PSCS, designers
    - main contractor and other consultants
    - extent and location of existing records and plans
    - arrangements for communicating with Contractors, PSDP and others as appropriate

2. Communication and Management of the Work:
    - management structure and responsibilities
    - safety and health goals for the project and arrangements for monitoring and review of safety and health performance
    - arrangements for:
        - regular liaison between parties on site
        - consultation with the workforce
        - the exchange of design information between the Client, Designers, Project Supervisor for the Design Process, Project Supervisor Construction Stage and Contractors on site
        - handling design changes during the project
        - the selection and control of contractors
        - the exchange of safety and health information between contractors
        - security, site induction, and on-site training
        - welfare facilities and first aid
        - the production and approval of risk assessments and method statements
        - the reporting and investigation of accidents and other incidents (including near misses)
    - site rules
    - fire and emergency procedures

3. Arrangements for Controlling Significant Site Risks:
    - safety risks
        - services, including temporary electrical installations
        - preventing falls
        - work with or near fragile materials
        - control of lifting operations
        - dealing with services (water, electricity and gas)
        - the maintenance of plant and equipment
        - poor ground conditions
        - traffic routes and segregation of vehicles and pedestrians
        - storage of hazardous materials
        - dealing with existing unstable structures
        - accommodating adjacent land use
        - other significant safety risks

- Health risks:
  - removal of asbestos
  - dealing with contaminated land
  - manual handling
  - use of hazardous substances
  - reducing noise and vibration
  - other significant health risks

The construction stage safety and health plan will be maintained on site by the PSCS and will be communicated to all relevant parties on an ongoing basis through inductions, site safety meetings and tool box talks etc. as required.

6. EMERGENCY RESPONSE PLAN

6.1 Introduction

This chapter of the CEMP presents an Emergency Response Plan for the proposed project. The Emergency Response Plan shall be finalised in accordance with this plan following the appointment of the contractor for the main construction works and following detailed design development.

This Emergency Response Plan contains predetermined guidelines and procedures to ensure the safety, health and welfare of everybody involved in the project and to protect the environment during the construction phase of Annagh Wind Farm. This outlines the immediate response to an emergency or disaster situation and will be developed by the main construction works contractor and PSCS as part of their construction stage Safety and Health Plan.

An emergency is any disruptive or harmful event that endangers people, environment, property or assets. Emergencies can be small, as in a fire contained by employees using firefighting equipment or large, as in a disaster resulting from a storm.

In the context of the Annagh Wind Farm, examples of Emergency Response Plan emergency events are:

- medical emergency
- explosion
- overheated equipment
- chemical and fuel spill
- fire
- loss of power
- vehicle incidents

Example sources of emergency or disaster events are:

- unstable/inappropriate stockpiles on site
- faulty or incorrect use of equipment
- falls from height
- smoking
- storm/adverse weather
- power failure
- fuel spill
- road failure
- serious vehicle collisions or overturning

6.2 Emergency Response Plan

An emergency response plan deals with the immediate physical effects of a disaster and outlines the initial response.

6.2.1 Emergency Response Liaison

The contractor/PSCS will designate an individual to serve as the Emergency Response Liaison for this project. The emergency response liaison will coordinate the emergency response for the duration of any emergency at or nearby the project site.

The local County Council, An Garda Síochána and the HSE Ambulance Co-ordinator will be provided with the construction programme and the onsite contact information from the Emergency Response Liaison prior to construction.

The Emergency Response Liaison will be immediately reachable at all times during project construction. The Liaison will coordinate with the above agencies to establish emergency procedures for access to and within the site in the event of an emergency.

6.2.2 Reporting Emergencies

In the event of fire, storm, flood, serious injury or other emergency, contact:

ALL ON SITE EMERGENCIES DIAL 999

6.2.3 Designated Responder

A map depicting tower locations with the emergency meeting point will be furnished to the local County Council Fire Department and HSE ambulance co-ordinators.

Upon arrival on the scene, the senior EMS Officer will set up the incident command structure. The Emergency Response Liaison and all contractor's personnel will cooperate with directions of the incident commander and assist as directed.

The nearest emergency services, ambulance and Accident & Emergency (A&E) facilities are:

Service:	Contact Details:	
Accident & Emergency (A&E)	Mallow General Hospital	(022) 21251
Accident & Emergency (A&E)	Cork University Hospital	(021) 292 2000
Ambulance Service	Dial 112 or 999	
Fire Services	Dial 112 or 999	

Service:	Contact Details:	
Garda Station	Charleville Garda Station	063 21770
District HQ:	Mallow Garda Station	022 31457
Divisional HQ:	Fermoy Garda Station	025 82111

Each member of the contractor's site team who are First-Aid and Cardiopulmonary Resuscitation (CPR) trained personnel will be identifiable with a hard hat sticker indicating their training.

6.2.4 Emergency Alarm

The emergency alarm will be raised on site as soon as an emergency situation is detected, the alarm will be identified (contractor to check those that apply):

	Air Horn		**Radio**		**Voice**		**Hand Signals**		**Siren**

6.2.5 Emergency Reporting

In the event of an emergency the nearest supervisor with radio equipment/mobile phone will be notified. The degree of emergency will be reported to the Emergency Response Liaison who will contact the Emergency Services and request the appropriate emergency service.

6.2.6 Medical Protocol

In the event of a major medical emergency, the emergency centre (999) will be notified and an ambulance and emergency medical team will respond to the scene. All major medical cases require professional (ambulance) transportation. In the event of a minor medical case, the affected employee can be transported via company vehicle in the escort of a foreman or site engineer (with first aid training).

6.2.7 Emergency Response

Upon notification, the Emergency Response Liaison will respond to the emergency scene and manage emergency operations:

1. Assess hazards and make the area safe – If you cannot enter the area without risking your safety, don't do it, call the Emergency Services immediately and wait for them. If you think you can safety enter the area, look around the emergency scene for anything that can be dangerous or hazardous to you, the casualty, or anyone else at the scene. Bystanders can help with making the area safe. First aid kits will be available on site. Operators that have been first aid/CPR/AED trained will be listed on site and easily identifiable by a hard hat sticker.

2. Take charge of the situation – if you are the first-aid provider on the scene act fast. If someone is already in charge, briefly introduce yourself and see if that person needs any help. If there is any chance the casualty could have a head or spinal injury, tell them not to move.

3. Get Consent – always identify yourself as a first-aid provider and offer to help. Always ask for consent before touching a conscious adult casualty and always ask for consent from a parent or guardian before touching an unconscious or conscious child or infant. With an unconscious adult casualty consent is implied as it is generally accepted that most people want to live. Remember to protect yourself first by wearing gloves and eye protection.

4. Assess Responsiveness – is the casualty conscious or unconscious? Note their response while you are asking them for their consent. If they respond, continue with the primary survey, and if they don't respond, be aware that an unconscious casualty is or has the potential of being a breathing emergency.

5. Call out for help – this will attract bystanders. Help is always useful in an emergency situation. Someone can be called over to phone for medical help. Others can bring blankets if needed, get water, etc. a bystander can help with any of the following:

- Make the area safe.
- Find all the casualties.
- Find the first aid kit, or any useful medical supplies.
- Control the crowd.
- Call for medical help.
- Help give first aid, under your direction.
- Gather and protect the casualty's belongings.
- Take notes, gather information, be a witness.
- Reassure the casualty's relatives.
- Lead the ambulance attendants to the scene of the emergency.
- Notify Emergency Services as soon as you can. Either send a bystander or call yourself.

In the event of a major medical emergency the Emergency Response Liaison, as the person-in-charge of the emergency scene, will dispatch someone to the site access point nearest the emergency scene to direct and lead arriving outside responders to the emergency scene. The designated meeting point will be agreed prior to the commencement of construction. Emergency personnel will be met at this meeting point communicated by management during the 999 call. The emergency personnel escort will use the hazard lights on their vehicle, so they are easily identified.

6.2.8 Escape and Evacuation Procedure

Dependent upon the degree of the emergency and if safe to do so, employees will evacuate to the designated assembly area where the designated wardens shall account for all employees and determine if anyone still remains within the emergency scene.

Should a wild land fire occur, the designated assembly area is compromised other locations will be designated as secondary assembly areas.

6.2.9 Tower Rescue Procedure

In the event personnel are trapped or injured in an elevated tower position the following protocol will be initiated:

1. The Emergency protocol will be initiated
2. Emergency Response Liaison will be notified
3. Tower Rescue Team will be activated and respond to the scene
4. Outside medical and Rescue Teams will be notified and respond to the scene.

Tower Rescue Procedure:

1. Upon learning of an emergency, the on-scene foreman shall assess the emergency and ascertain its degree, location and the extent of any injuries.
2. Upon confirming that an emergency exists the on-scene foreman notifies the Emergency Response Liaison and the project Office.
3. Upon notification of the emergency the Emergency Response Liaison shall notify senior project supervision and the local emergency centre (999) of the emergency.
4. The Emergency Response Liaison shall inform the dispatcher of the location, tower number, the degree of the emergency and the extent of injuries.

6.2.10 Prevention of Illness/Injury Due to Weather/Elements

1. All employees will have access to shelter and heat in the event of inclement weather.
2. Employees will have access to at least a litre of water at all times.
3. High wind warnings and weather forecast will be discussed every morning with the crews. Weather conditions and forecast will be monitored regularly by management.
4. No Employee will work alone. A buddy system will be used so employees can contact a supervisor in case of an emergency.

6.2.11 Environmental Emergency Procedure

An emergency preparedness and response procedure is required to prevent environmental pollution incidents. Emergency Silt Control and Spillage Response Procedures are included in Section 4.3.3 of this CEMP.

Suitable spill kits and absorbent material for dealing with oil spills will be maintained on site. In the event of pollution or potential risk of pollution the Local Authority should be informed immediately.

In the case of water pollution in addition to the Local Authority, Inland Fisheries Ireland should also be informed immediately.

6.2.12 Emergency Response Plan – Haul Routes

Emergency Response Procedure relating to transportation of plant, equipment and materials to site to be developed by the main contractor during the construction phase of the wind farm.

6.2.13 Catastrophic Events – Wind Turbines

According to the Health and Safety Authority (HAS), operation wind farms are still considered a workplace (albeit not permanently occupied). All persons who have control to any extent over the wind-farm have duties to ensure, so far as reasonably practicable, that the wind-farm does not pose a risk to those working there or to anyone not employed there but who may be affected by activities on the wind-farm.

Each wind-turbine, incorporating the tower, blades, gearbox and ancillary equipment in the tower and nacelle are considered to be machines under the European Machinery Directive [2006/42/EC]. The duties on designers and manufacturers of machinery are set out in the Machinery Directive, which has been transposed into national law by the 2008 European Communities (Machinery) Regulations [S.I.No.407/2008]. All wind turbines should be CE marked, which is in effect, a mark of assurance that the wind-turbine complies with the essential health and safety requirements (EHSRs) of EU supply law. In all cases, the manufacturer or the manufacturer's authorised representative must compile information in a technical file confirming how the machine complies with these requirements. The maintenance of turbines and ancillaries must only be carried out by competent, trained and qualified personnel. The system of work for operation and maintenance must be planned, organised, maintained and revised to ensure safety of personnel.

Potential catastrophic events associated with operational wind turbines include:

- Wind turbine toppling (due to foundation or tower failure);
- Wind turbine rotational failure in extreme wind conditions (due to control system or rotor break failure);
- Fire.

The primary mitigation against a catastrophic event that may endanger the health and safety of the public is implemented at design stage through adequate siting of wind turbines which provide sufficient set back distances from occupied buildings and significant electrical infrastructure to avoid the risk of impact in the event of wind turbine collapse.

The maximum tip height for wind turbines at this site 175m. No wind turbine is located within 700m of a residential dwelling No turbines have been located within 600m of the proposed on-site substation. No turbines are located within proximity of existing MV/HV overhead lines

Turbines have been sited with consideration for existing ground conditions to minimise the risk of turbine foundation failure, toppling and landslide. Intrusive site investigations have been carried out to confirm ground conditions at turbine locations as well as slope stability analysis for turbines located on sloped ground. Other design mitigation measures employed for the siting of wind turbines include the following:

- Areas mapped by GSI as having a high susceptibility to landslides have been avoided;
- Turbine locations have been assessed by site investigation and visually by geotechnical engineers prior to confirmation of final siting;

- If turbines are located on sloped ground, particular care has been taken in design of road and hard standing alignments, cutting and filling and drainage;
- Peat probing has been carried out at turbine locations. No peat has been found on site.

Mode details with respect to consideration of ground conditions and site investigations carried out on site can be found in Chapter 9 of the EIAR.

Wind turbines shall be fitted with fire suppression systems and will have emergency escape procedures in place for operational staff in the event of fire in a wind turbine.

The proposed wind farm shall include the following minimum safety measures as part of its operation and maintenance (O&M) plan:

- Regular visual inspections and testing of all wind turbine and substation equipment shall be incorporated into the project's operation and maintenance schedule as per manufacturers requirements;
- Fire safety measures and equipment in the facility must be kept in effective working order. This includes all fixtures and fittings such as fire doors, staircases, corridors, fire detection and alarm systems, fire-fighting equipment, notices and emergency lighting. Regular checks, periodic servicing and maintenance must be carried out, whatever the size of the workplace. Any defects should be put right as quickly as possible;
- A nominated competent person shall carry out checks and routine maintenance work to ensure the reliability and safe operation of fire-fighting equipment and installed systems such as fire alarms and emergency lighting. A record of the work carried out on such equipment and systems will kept on site at all times;
- The system shall include an abort switch that can be operated at any time with overriding manual abort system.

Emergencies as a result of catastrophic events described here shall be dealt with in accordance with emergency response measures as set out in this emergency response plan.

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX 1

Turbine Delivery Route Report

Annagh Windfarm

Route Survey Report

February 2021

Exceptional Load Services Ltd, Ballymoyle, Arklow, Co Wicklow, Ireland

T: +353-402-31229. E. permits@wide-loads.com

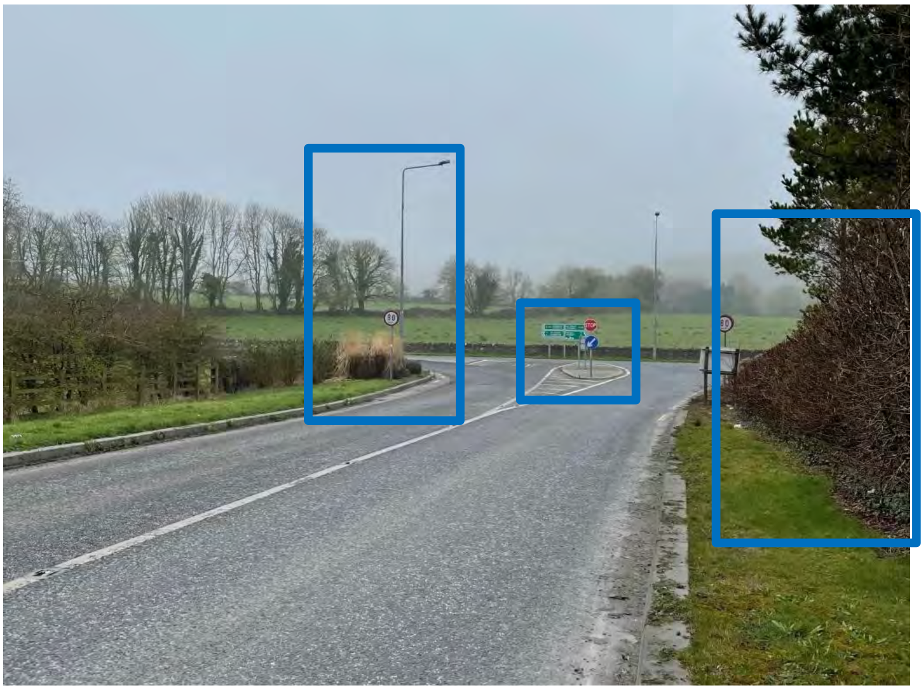
Customer	Fehily Timony & Company
Site Address	Annagh Windfarm Charleville Co cork
Survey Date	03/03/2021
Survey Personnel	Edwin Sunderland, ELS John Webb, ELS
Survey Criteria	To select most suitable route from Port of Foynes to site entrance. For the purpose of the survey the following route options were considered: N69 – Mungret – N18 – Rossbrien – M20 – Patrickswell – N20 – Charleville – N20 – Ballyhea – L1322 – to site
Surveyed Dimensions	For this survey the following components were considered Blade: 73.6m It is assumed tower sections would be delivered on tower adaptors Areas marked **ORANGE** are load bearing Areas marked **BLUE** are oversail only.

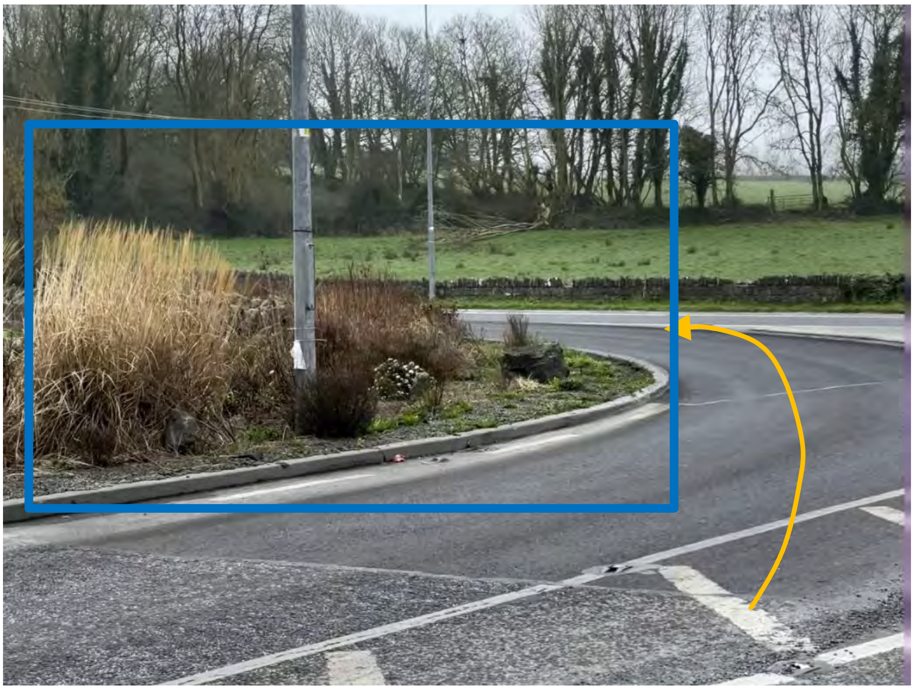
Revision Record

Revision/Version	Date	Author	Description
Issue R.0	15/03/21	Edwin Sunderland	Report.

Location Map	

Proposed Route	
Node 1. Port Exit. There is sufficient room on left or on right via bypass gate for standard all turbine components.	

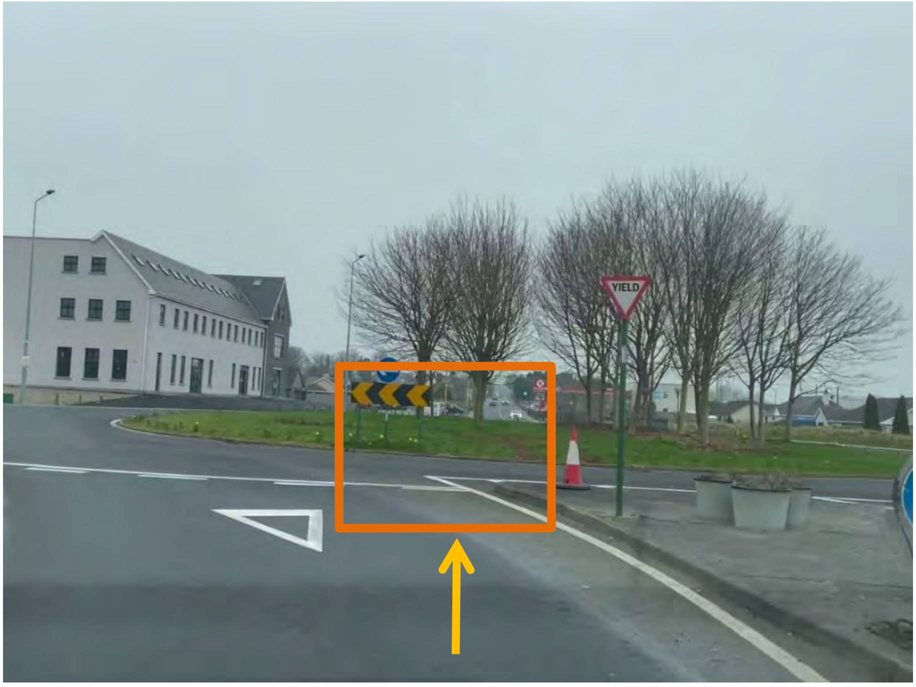
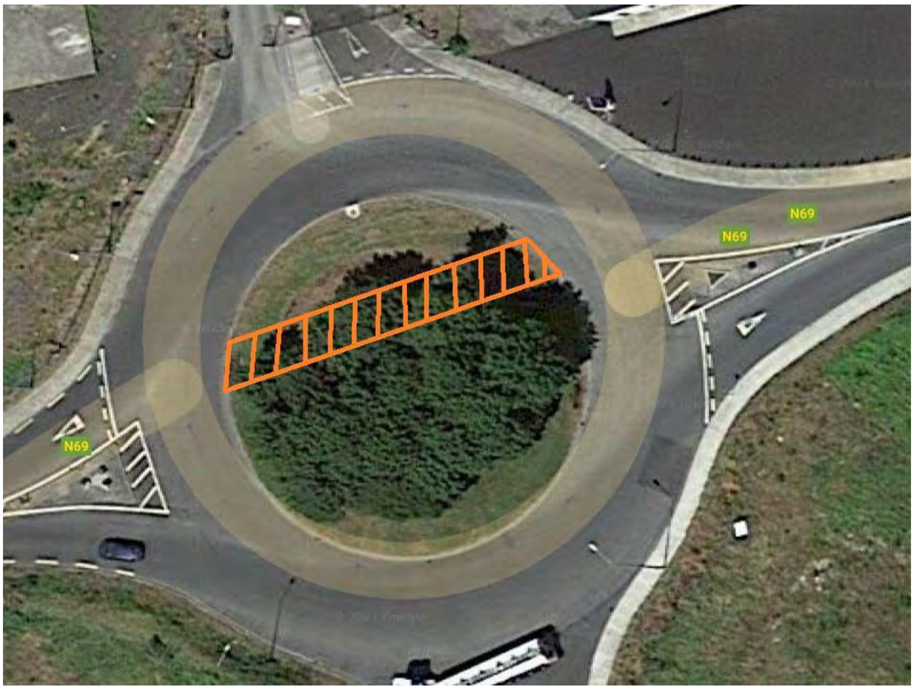
Node 2.0. Port Access Road – N69 Enabling works required at this junction for mid and rear oversail	
Node 2.1. Port Access Road – N69 Vegetation on right will require trimming to 2.5m over road level to boundary fence. The right side only could be used but would require third party land take for load bearing and rear oversail.	

Node 2.2 Port Access Road – N69 Road signs are in sleeves and will need to be remover for each transport.	
Node 2.3 Port Access Road – N69 This area needs to be cleared of all obstruction over 1m height for mid oversail	

Node 2.3 Port Access Road – N69 Top 40cm of wall should be removed to allow for mid oversail. Exact amount will be defined by trailer type. Third party agreement needed.	

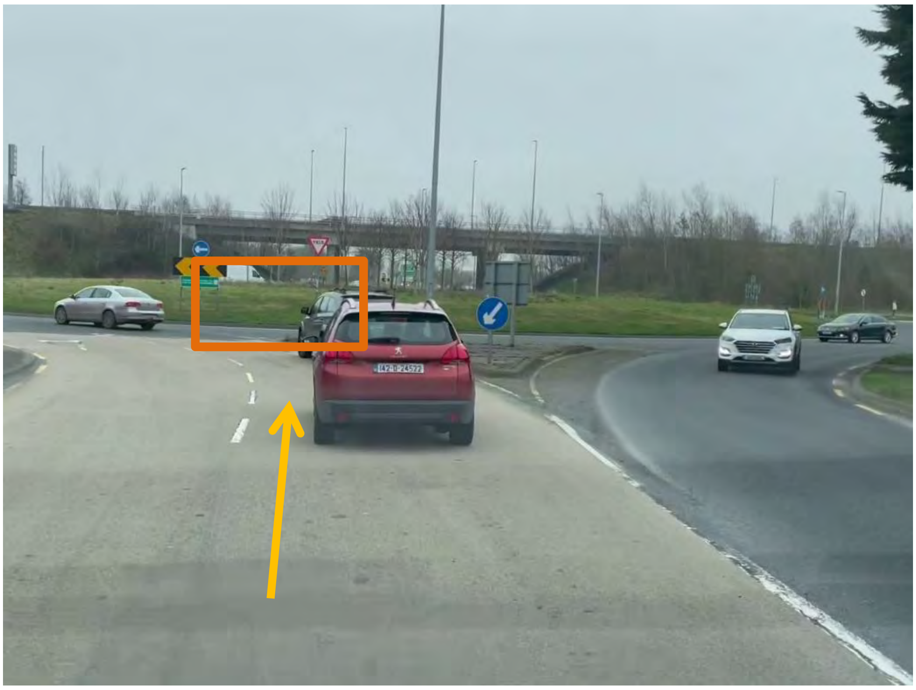
Node 3 Ferrybridge

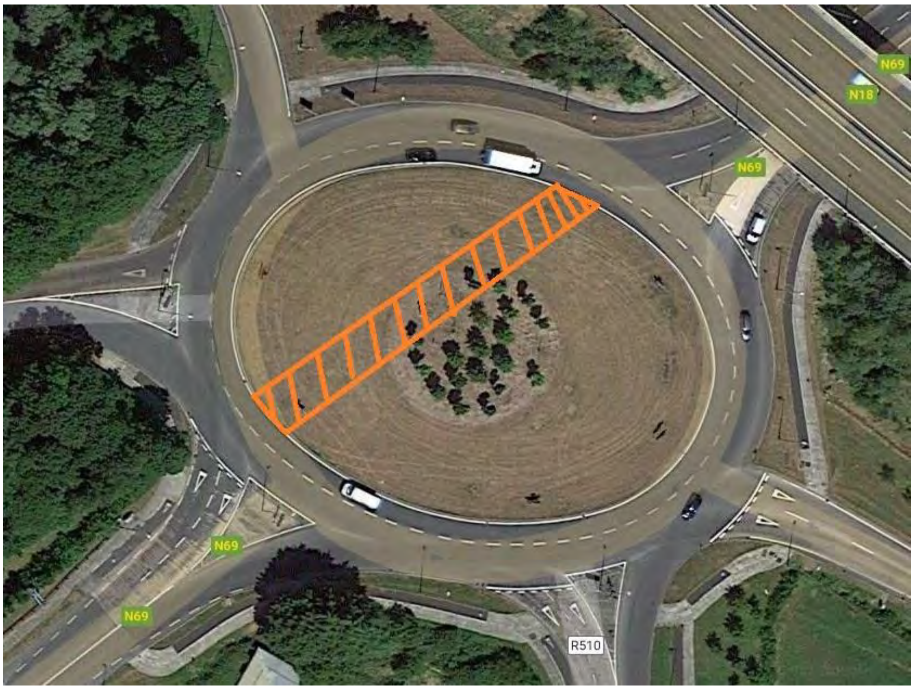
This bridge has restrictions both lateral and verticle. Lateral alignment should be ok with correct trailer selection but vertical alignment will be affected by trailer length/rear overrhang and may need some works to avoid grounding.

Node 4. Clarina Roundabout. The best and correct option for this roundabout is a 'cut-through' track through the centre island. The roundabout does not have the necessary dimensions to drive around even with oversail.	 

Node 5. Mungret Interchange – West Roundabout.

The best option for this roundabout is a 'cut-through' track through the centre island either on north or south side. Again here it aleviates the need to remove critical road signs and street lighting.





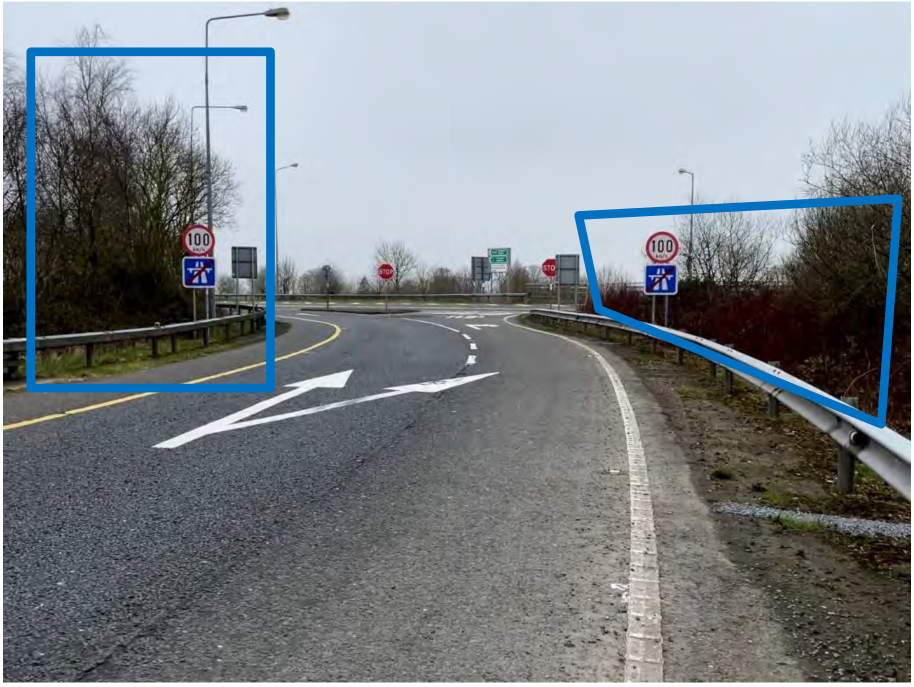
Node 6. Mungret Interchange – East Roundabout.

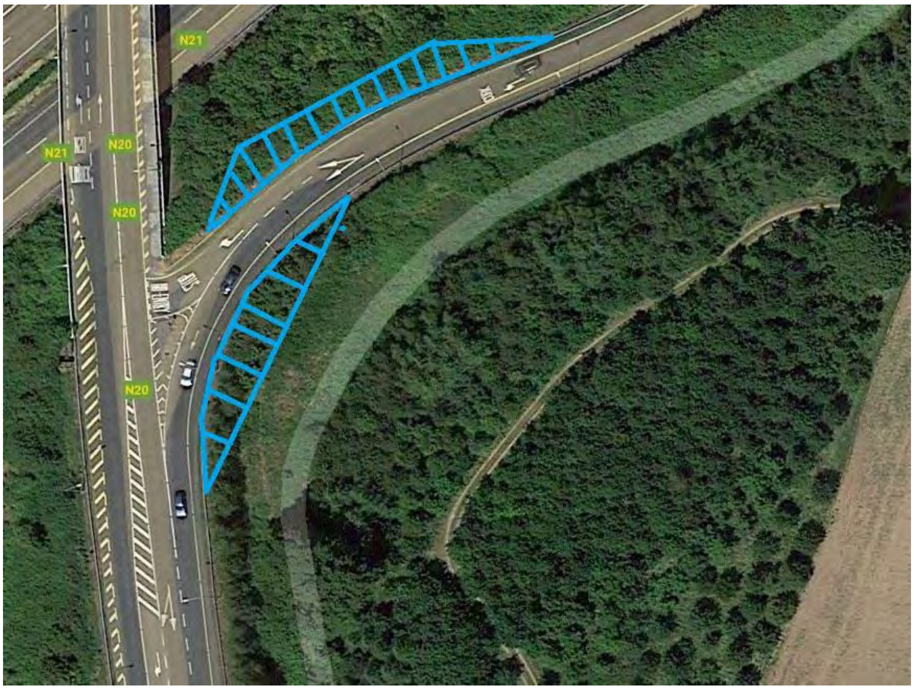
The roundabout has sufficient dimension but will require substantial enabling works for blade transport.

The required area could be made up of load bearing and oversail but such determination can only be made when trailer type and overhang are decided.

Node 7. M20- N20 off ramp southbound

The junction does not have sufficient clearances and will require removal of signs and street lamp on left side and scrub clearance on left and right for mid and rear oversails.

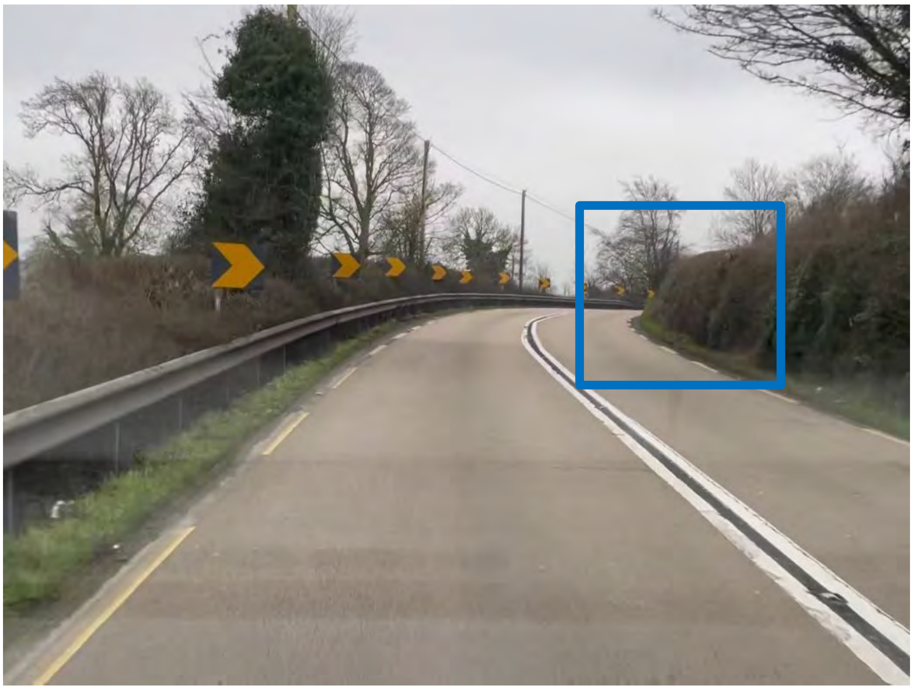




Node 8. N20 Right Curve. Ballymacrory

52.496368 -8.706154

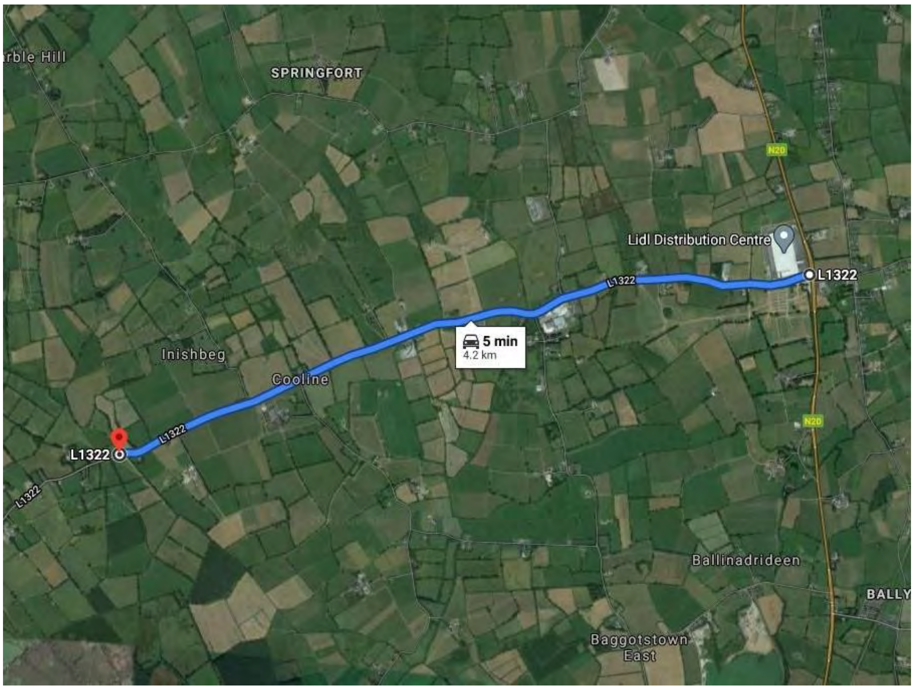
This right curve does not have sufficient dimension for 73m blade length. Enabling works on lerf or right or both for oversail only will be required.



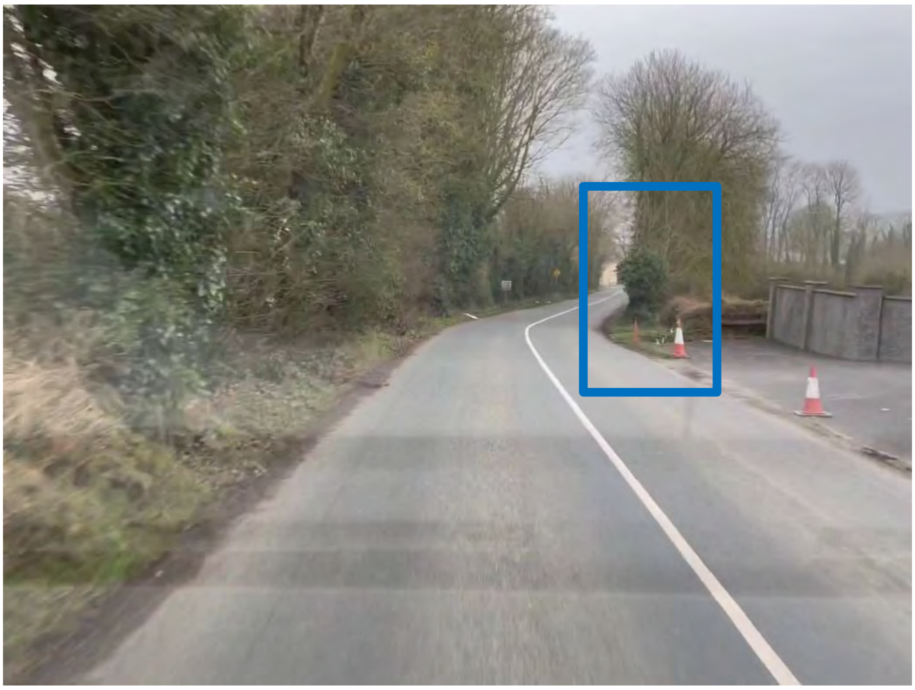
Node 9. N20 – L1322 Junction, Ballyhea This junction will require load bearing enabling works on the L1322 Road sign to be removed.	
	


Ard na Gaoithe
ARDNAGEEHY
L1324
STOP


N20
L1322
L1322
L1322
N20
L1322
N20

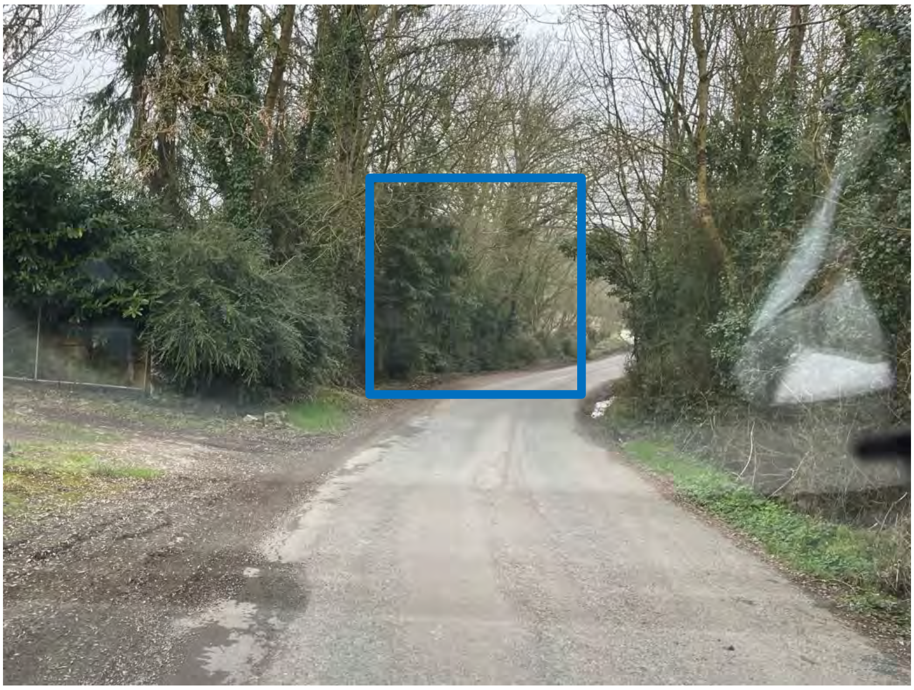
Node 10. L1322 The L1322 from the N20 junction to site entrance will require upgrading and widening. Third party land take will be required at various points to facilitate blade transport. A number of areas have weak verges with poor drainage and will need to be upgraded during widening process.	
Node 10.1. L1322 Enabling works on right for mid oversail. Possible third party land take.	

Node 10.2. L1322 Enabling works on left for mid oversail. Third party land take required. Possible additional option for rear oversail on right.	
Node 10.3. L1322 Enabling works on left for mid oversail. Third party land take required	

Node 10.4. L1322 Enabling works on right for mid oversail. Possible third party land take.	
Node 10.5. L1322 Enabling works on right for mid oversail. Walls of water pump enclosure should be reduced.	

Node 10.6. L1322 Enabling works on right for mid oversail. Possible third party land take.	
Node 10.7. L1322 Enabling works on left for mid oversail with option for rear oversail on right. Third party land take required.	

Node 10.8. L1322 Enabling works on right for mid oversail. Possible third party land take.	
Node 10.9. L1322 Enabling works on right, left or both for mid and rear oversail. Possible third party land take.	

Node 10.10. L1322 Enabling works on right for mid oversail.	
Node 10.11. L1322 Enabling works at site entrance.	

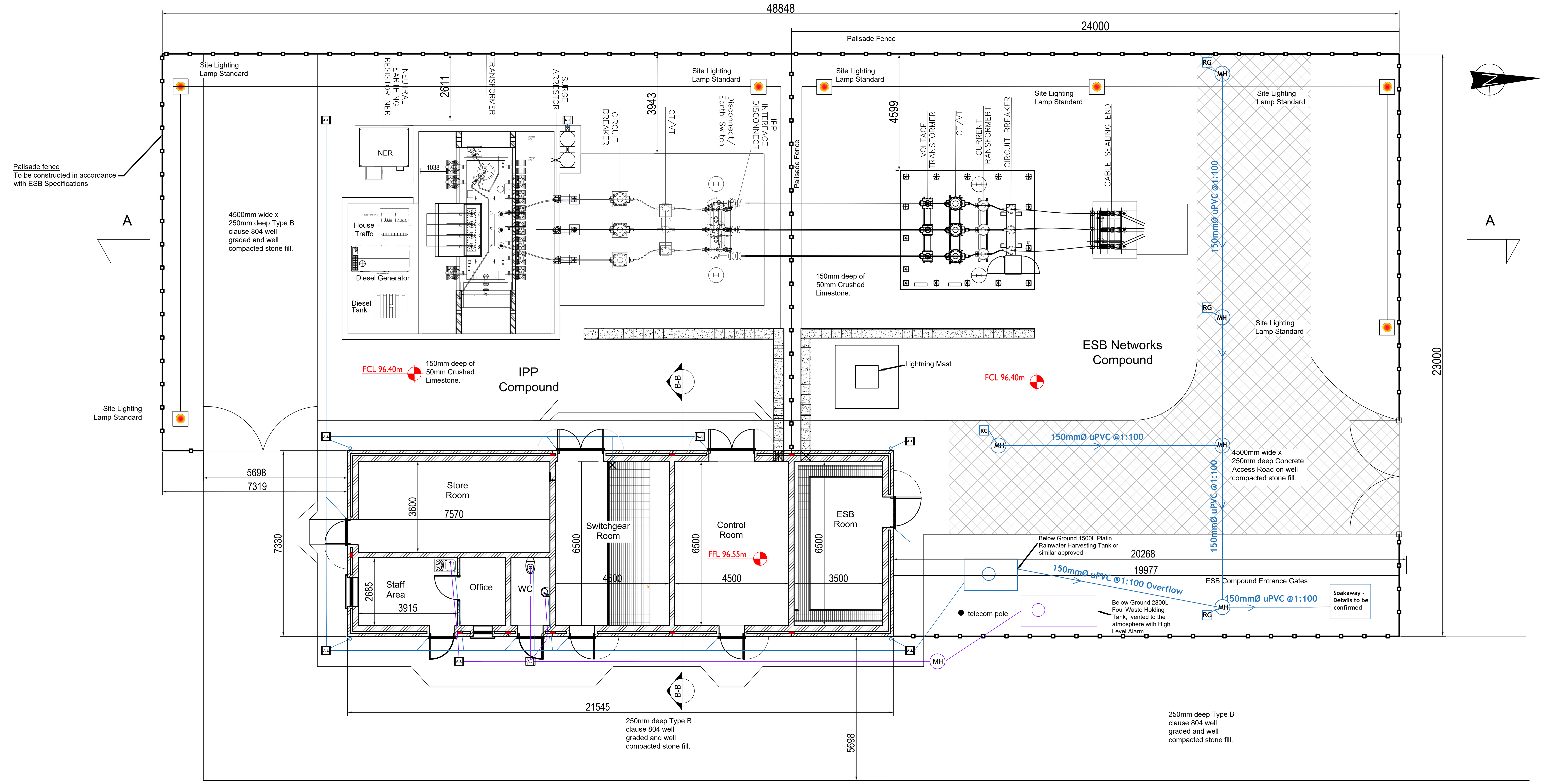
Other Route Options	No other route options were considered in this survey.
Conclusions	The route options shown are the only available for each entrance Bridge and other structure capacities have not been assessed. Tree canopy and overhead cables have not been surveyed as part of this survey A trial run should be carried out prior to delivery to verify works carried out. An early test run is recommended to verify passage of blades through node 3.
ELS	*Edwin Sunderland 15/03/21*

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX 2

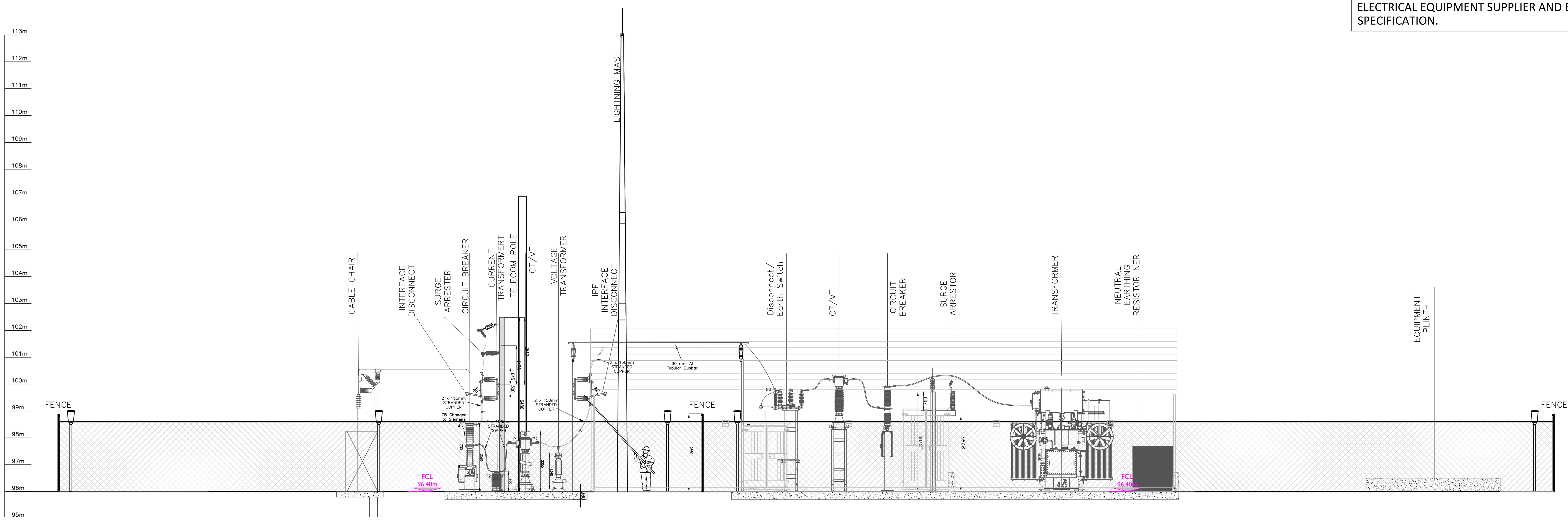
Referenced Drawings



Solar Farm-Substation Compound Layout

SCALE 1:100

PLEASE NOTE THAT THE SUBSTATION LAYOUT AND SUBSTATION COMPONENTS ILLUSTRATED ON THIS DRAWING ARE INDICATIVE ONLY. THE FULL SPECIFICATION AND DETAIL WILL BE DETERMINED FROM THE ELECTRICAL EQUIPMENT SUPPLIER AND ESB FUNCTIONAL SPECIFICATION.



Section A-A Through Substation Compound

SCALE 1:100

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

tli GROUP

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PROJECT

Annagh Wind Farm
38kV Substation

CLIENT

EMPower

CONSULTANTS

NOTES: -

- Configuration of substation equipment and infrastructure is subject to detailed design and ESB design approval.
- The proposed substation layout should be used for planning purposes only.
- 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.

LEGEND: -

- Planning Boundary shown thus
- Surface water drainage shown thus
- Foul drainage shown thus
- Lamp Standard shown thus
- Proposed Levels Shown thus (Planning)
- Proposed Levels Shown thus (Elevation and Sections)
- Concrete Access Road shown thus

ISSUE/REVISION

I/R	DATE	DESCRIPTION
P01	20.10.21	Issued For Planning
P00	30.06.21	Issued for Planning

PROJECT NUMBER

05-813

SHEET TITLE

38kV Substation Compound Layout & Section

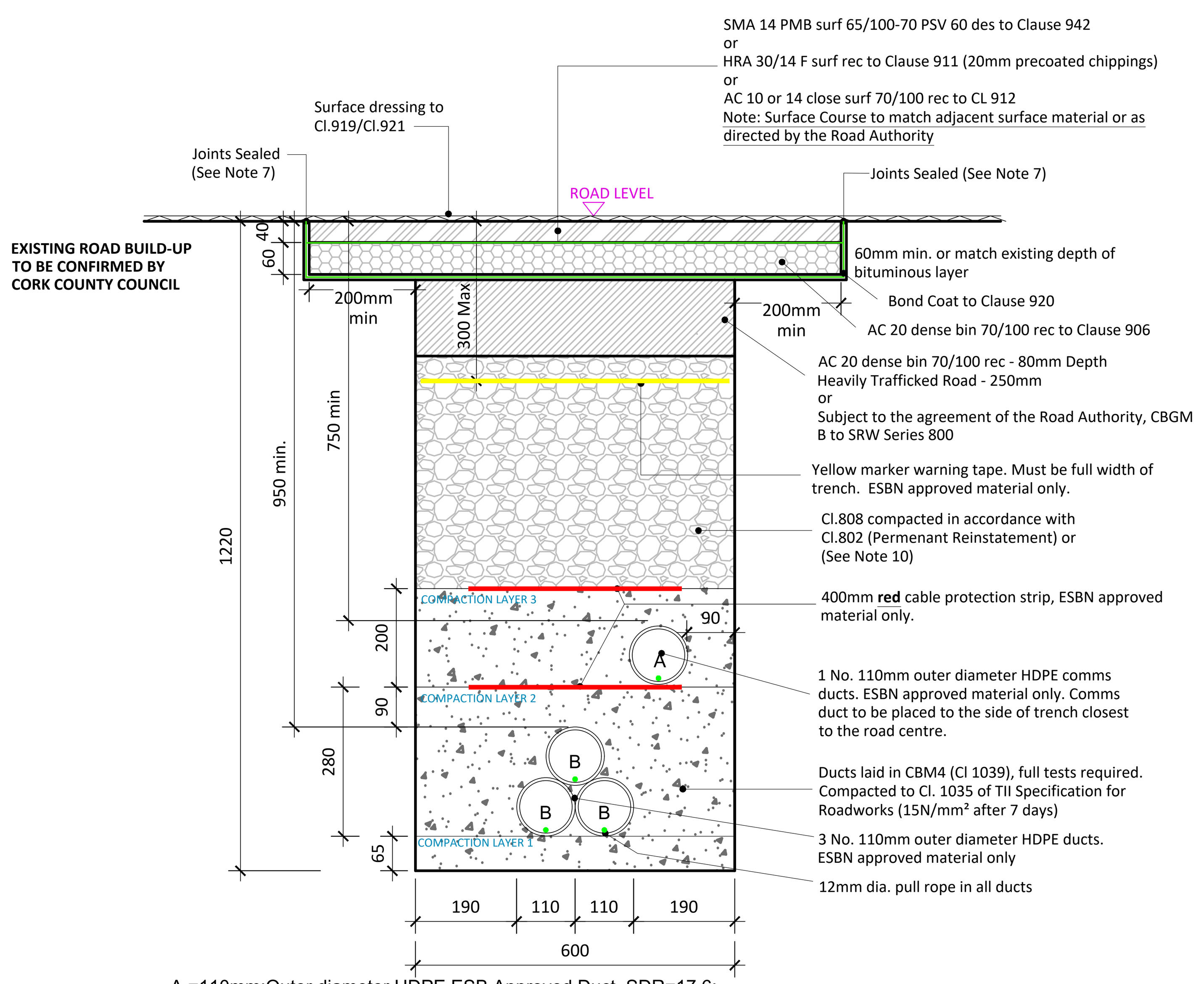
SHEET NUMBER

05813-DR-017

ISO A1 594mm x 841mm

Permanent Reinstatement

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



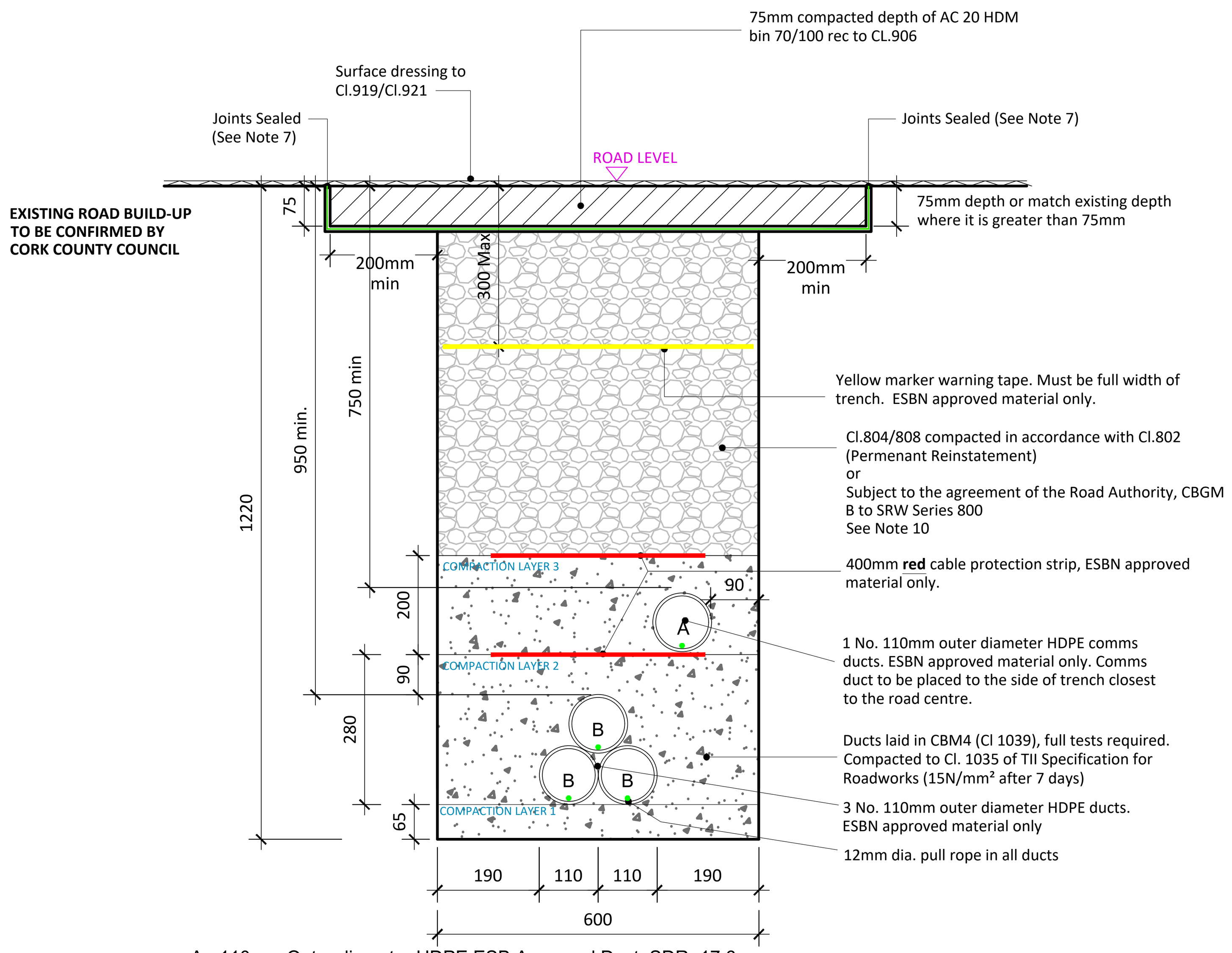
A =110mm:Outer diameter HDPE ESB Approved Duct, SDR=17.6;

B =110mm:Outer diameter HDPE ESB Approved Duct, SDR=17.6;

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 =110mm:Outer diameter HDPE ESB Approved Duct, SDR=17.6;

B =110mm:Outer diameter HDPE ESB Approved Duct, SDR=17.6;

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

SCALE 1:10

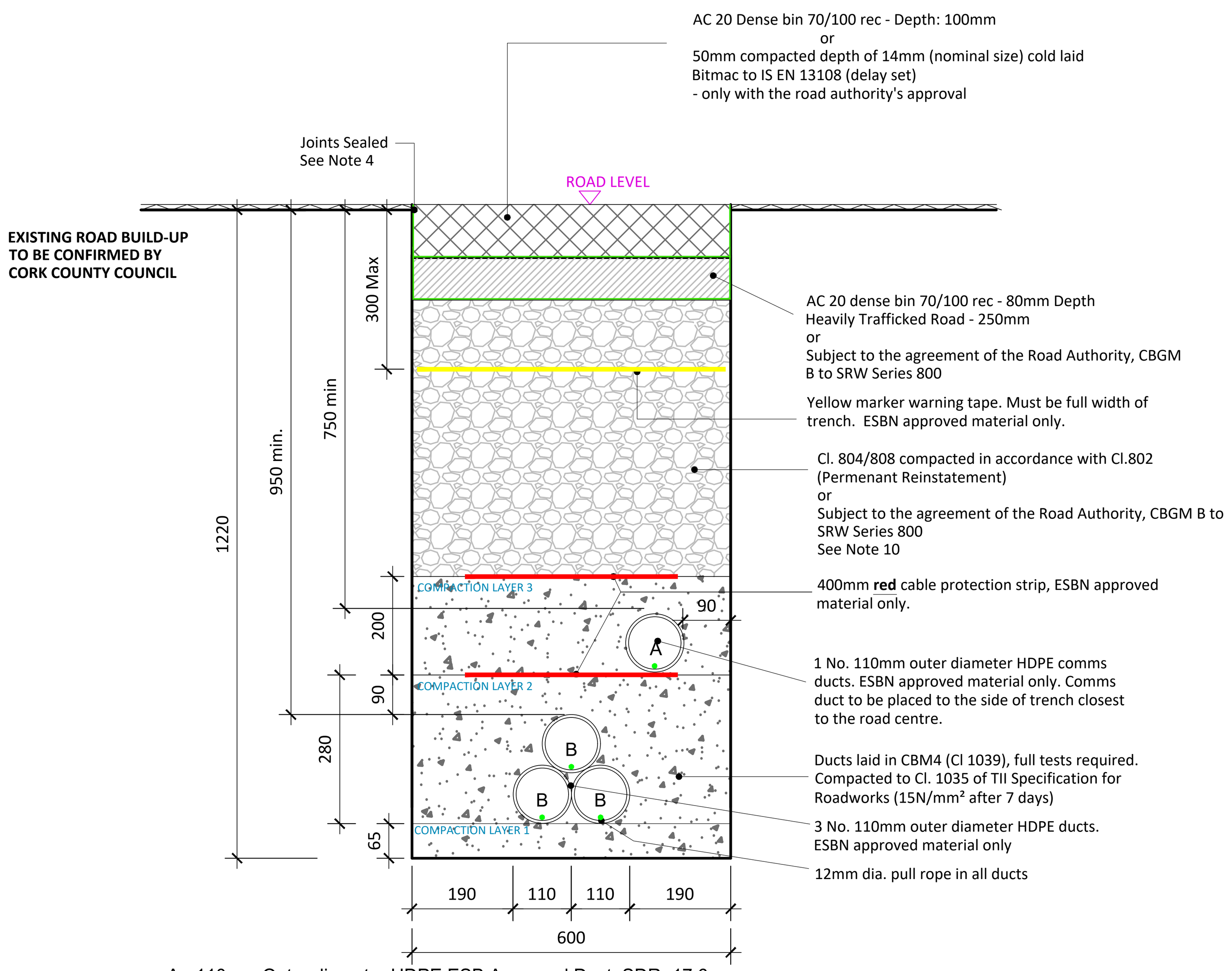
ALL REINSTATEMENT WORKS ARE TO BE IN ACCORDANCE WITH LOCAL AREA ENGINEERS REQUIREMENTS AND GUIDELINES FOR MANAGING OPENINGS IN PUBLIC ROADS

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



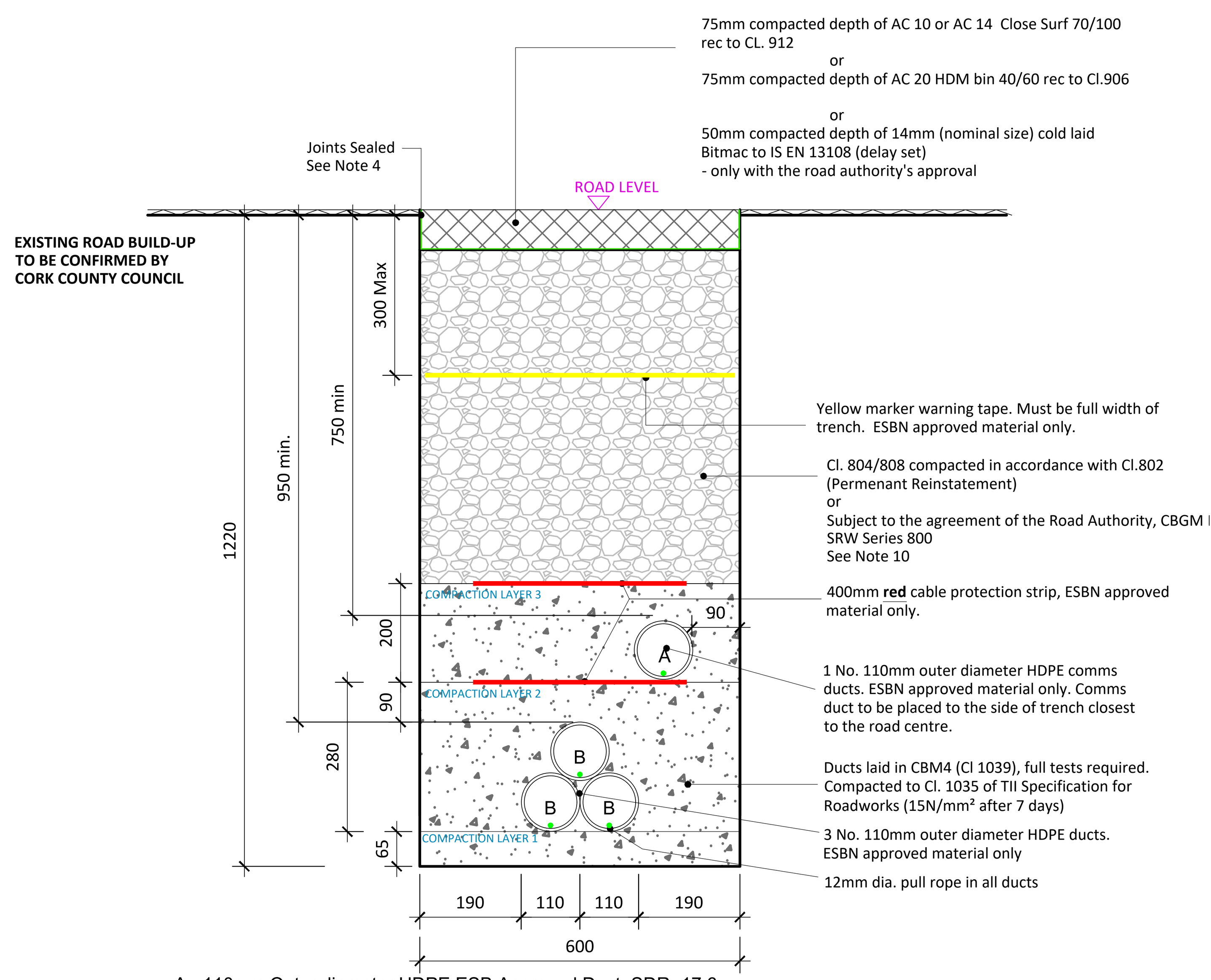
A =110mm:Outer diameter HDPE ESB Approved Duct, SDR=17.6;

B =110mm:Outer diameter HDPE ESB Approved Duct, SDR=17.6;

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 =110mm:Outer diameter HDPE ESB Approved Duct, SDR=17.6;

B =110mm:Outer diameter HDPE ESB Approved Duct, SDR=17.6;

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.

tli GROUP

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Tel: 00 44 1256406664

PROJECT

Annagh Wind Farm 38kV Grid Connection

CLIENT

EMPower

CONSULTANTS

NOTES: -

- This design is subject to ESB approval and should be used for planning purposes only.
- 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.
- Existing road build up and reinstatement requirements to be confirmed with Cork Co.Co.
- Geogrid may be implemented along the cable trench route where deemed necessary by the contractor or as required by Cork County Council.

LEGEND: -

ISSUE/REVISION

I/R	DATE	DESCRIPTION
P00	30.06.21	Issued For Planning

PROJECT NUMBER

05-813

SHEET TITLE

Ducting Through Regional / Local Roadways

SHEET NUMBER

05813-DR-005

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

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX 3

Summary of Standard Specification for ESB Networks 38kV Ducting

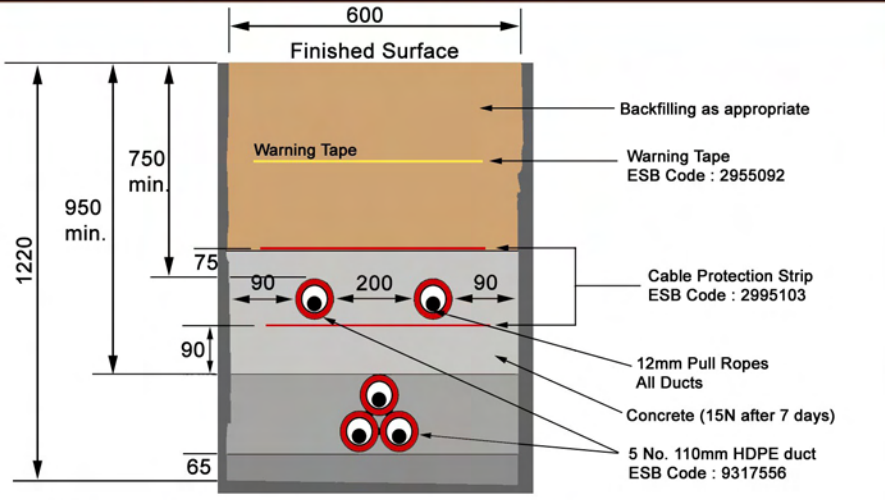
Standard Specification for ESB 38kV Networks Ducting/Cabling (Minimum Standards)

Note 1 : ESB Networks reserves the right not to accept ducting which does not conform to these standards and dimensions
Note 2 : Refer to ESB Networks for Specific job Specification. These instructions do not apply to LV/MV/110kV/220kV cable
Note 3 : All materials (ducts, marker tapes/strips, duct surrounds, mandrels and brushes) must be ESB approved materials

ESB Networks

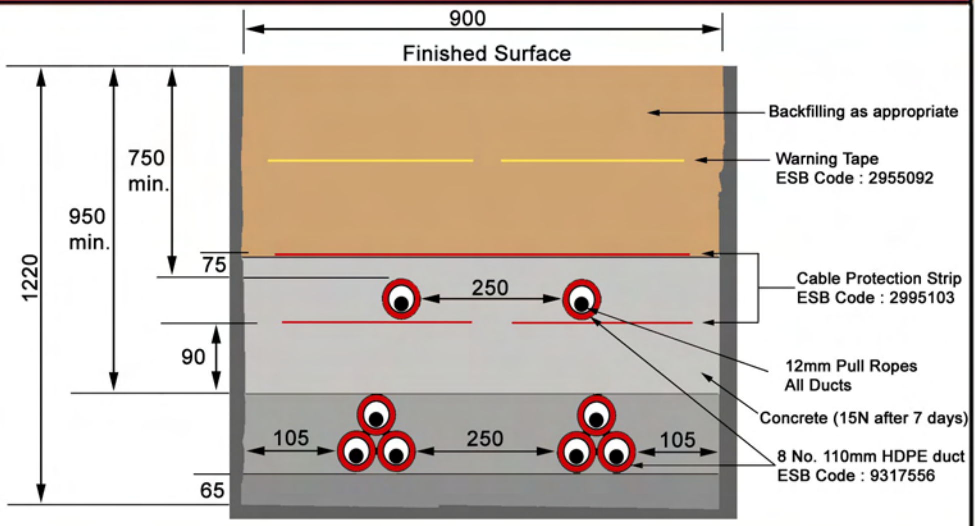
Rev 0: Date 08-09
Approved:

1A 38kV Single Circuit Standard Trench Cross-Section

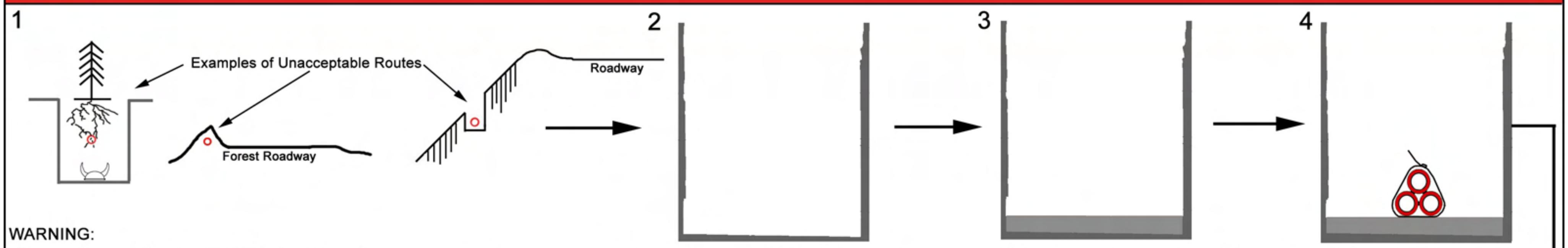


Note : Only 1 ESB comms duct maybe required if ESB specify
Note : Maximum duct depth ≤ 1.5m to top of trefoil group

1B 38kV Double Circuit Standard Trench Cross-Section



1C Trench Installation Sequence



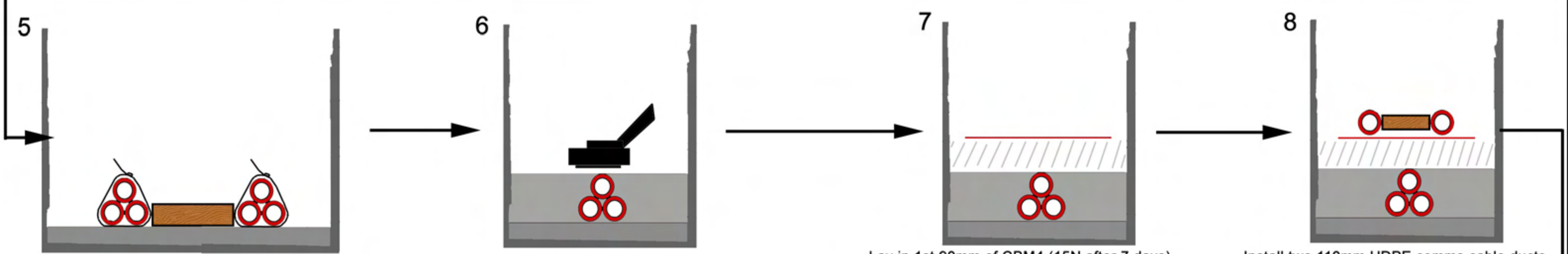
WARNING:
Always agree trench route with ESB before excavation commences.
Unstable, insecure & poor access routes will not be accepted by ESB.

Excavate trench to required dimensions.

Lay in & level 65mm bedding layer of CBM4 (15N after 7 days) concrete

Lay in, joint and trefoil 110mm HDPE power ducts using cable ties. (Code 1131071) at 3m intervals.

NB Semi-dry concrete to be used always

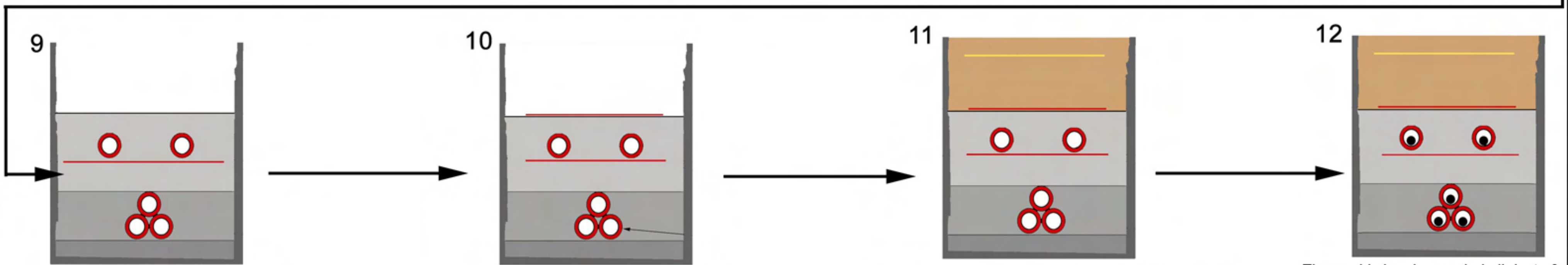


5. For double circuits it is vital to space power ducts 250mm apart using timber or other suitable spacers.

6. Lay in and thoroughly compact 300mm layer of CBM4 (15N after 7 days) concrete around and above ducts

7. -Lay in 1st 90mm of CBM4 (15N after 7 days) concrete
-Install 400mm wide red marker strip, code 2995103. (1 strip for sigle circuit, two for double circuit)

8. Install two 110mm HDPE comms cable ducts, spaced as per drawings above equidistant from both trench edges. Use timber or other suitable spacers to maintain the required spacing.



9. Install further 185mm layer of CBM4 (15N after 7 days) concrete and compact thoroughly.

10. Lay in another 400mm wide marker strip as outlined in fig. 6

11. - Lay in 500mm wide yellow warning tape (1 width for single circuit, 2 for double circuits)
- Backfill the top 300mm of trench per appropriate local authority or other agreed specification

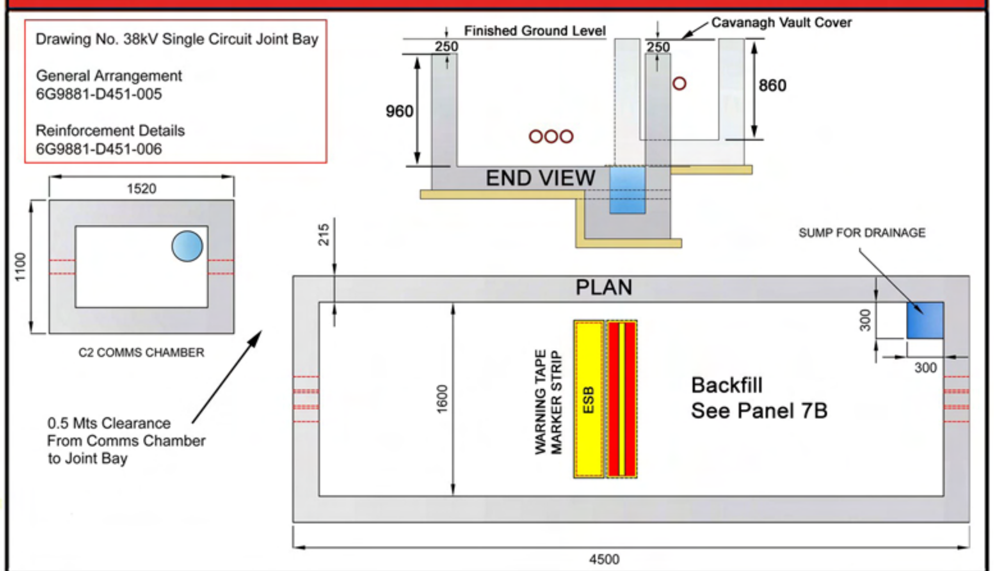
12. Thoroughly brush, mandrel all ducts & install 12mm polyproplene draw rope, then seal all ducts with screw type end plug - Jack Moon type

2A 38kV Single Circuit Joint Bay

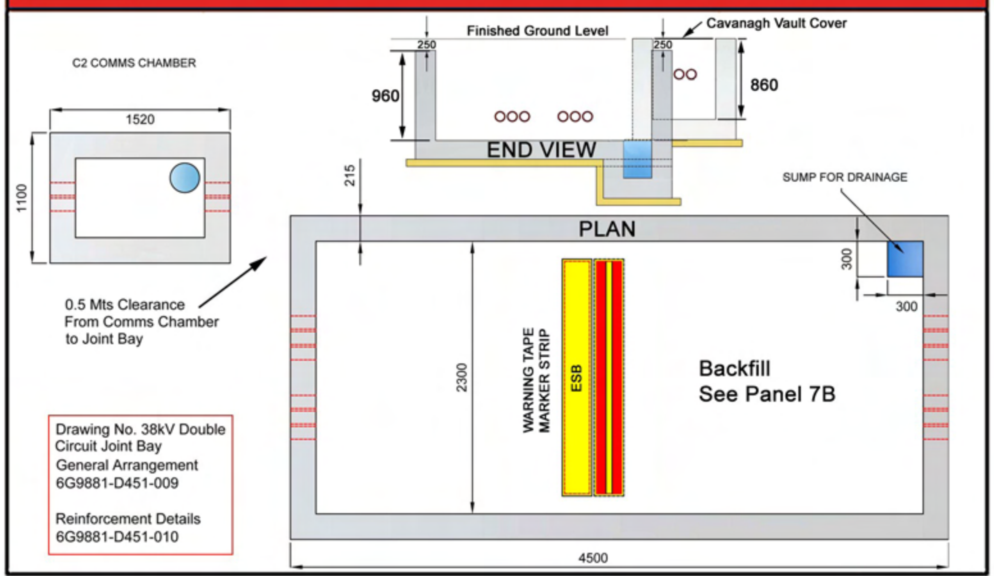
Drawing No. 38kV Single Circuit Joint Bay

General Arrangement
6G9881-D451-005

Reinforcement Details
6G9881-D451-006



2B 38kV Double Circuit Joint Bay



Drawing No. 38kV Double Circuit Joint Bay
General Arrangement
6G9881-D451-009

Reinforcement Details
6G9881-D451-010

Standard Specification for ESB 38kV Networks Ducting/Cabling (Minimum Standards)

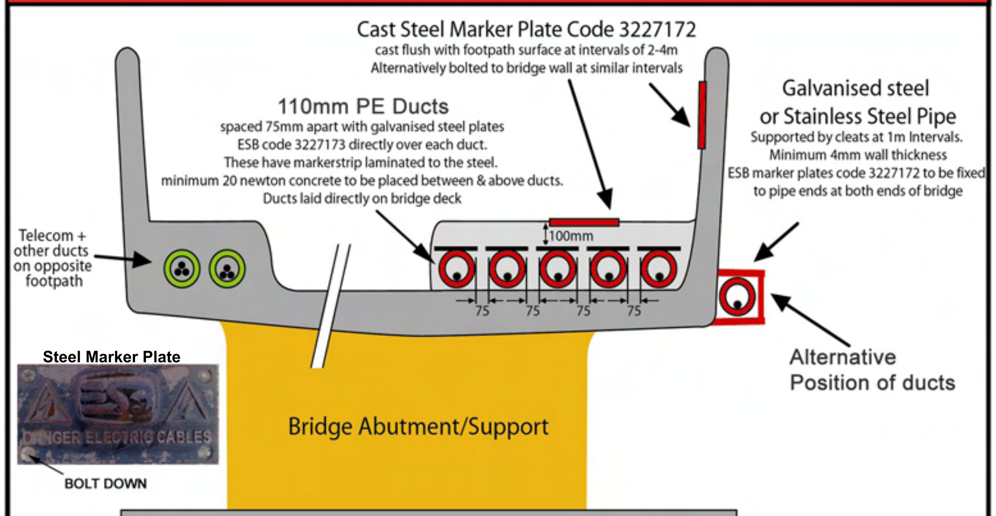
Note 1 : ESB Networks reserves the right not to accept ducting which does not conform to these standards and dimensions
Note 2 : Refer to ESB Networks for Specific job Specification. These instructions do not apply to LV/MV/110kV/220kV cable
Note 3 : All materials (ducts, marker tapes/strips, duct surrounds, mandrels and brushes) must be ESB approved materials

ESB Networks

Rev 0: Date 08-09

Approved:

5A Bridge Crossings: Restricted Footpath Designs

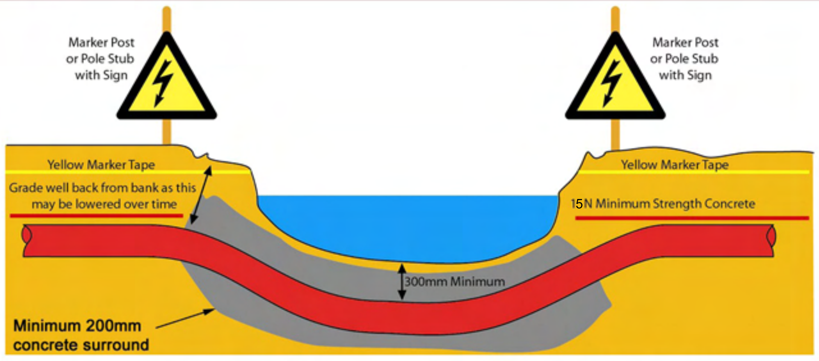


2nd Comms duct may be omitted by agreement

5B Bridge Crossings: Restricted Footpath Designs

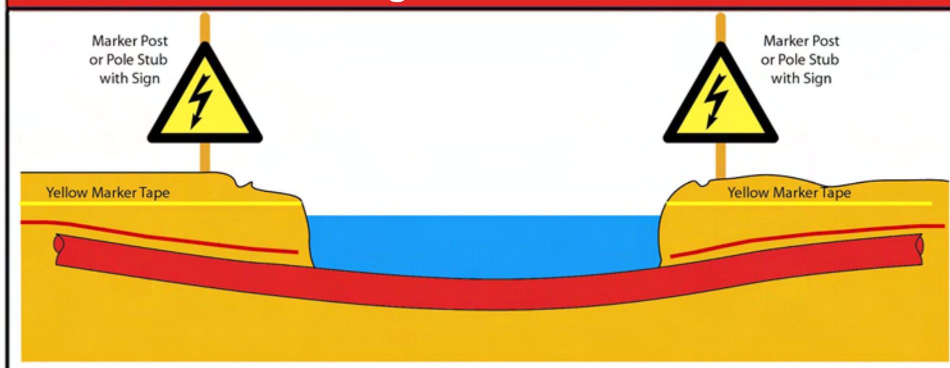
1. The design must be agreed with the bridge authority. Position in footpath is preferred.
2. Minimum cover over ducts on footpath 100mm.
3. Where duct cover is > 300mm, marker strip & surface marker plates can be used.
4. Red ducting is not suitable for cable run external to bridges.
5. Where possible galvanised steel/stainless steel piping should be used, all joints must be free of weld burrs on inside. Alternatively heavy duty 10mm wall thickness black HDPE material with cast steel marker plates attached must be used to permanently warn of presence of electric cable.

6A River/Stream Crossings: Standard Where Burial/Drilling IS Possible



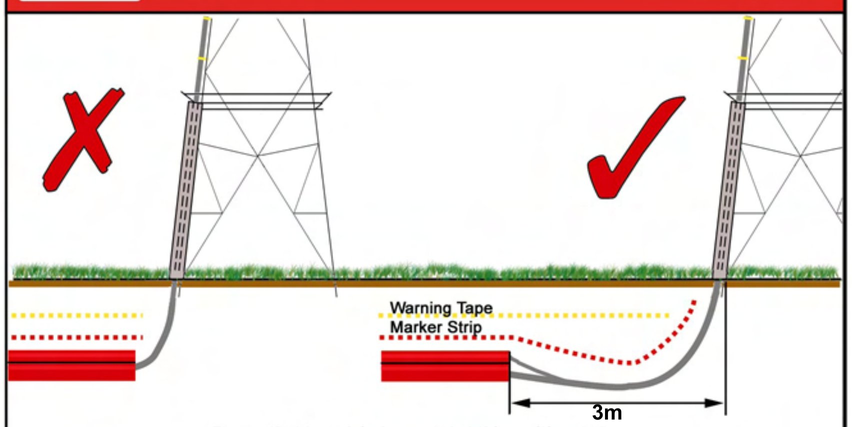
1. Depth of burial below bottom of river or stream to be agreed with relevant authority (if applicable)
2. If normal red ducting is installed by trenching, it must be encased in CBM4 (15N after 7 days) conrete to prevent uplift and to provide mechanical protection. Seal any joints to prevent concrete entering duct.
3. If drilled crossing is practical, use heavy red wall coiled HPPE duct **(sections 2.2 & 2.9 in MV/LV manual)**
4. Install an ESB marker post on both sides of the crossing - ESB code 8327355 or use stub pole minimum 2.0m above ground level & warning sign 8238339.
5. Where circumstances require it a large steel pipe can be installed, into which a number of standard ESB duct sizes are pulled in **(see section 2.9.4 of MV/LV manual for guidance)**
6. If crossing a tidal area, a foreshore licence will be required.

6B River/Stream Crossings: Standard Where Burial/Drilling IS NOT Possible



1. Installation on base of river or stream to be agreed with relevant authority (if applicable)
2. Heavy wall steel pipe to be used free of weld beads/swarf. Minimum 8mm steel wall thickness to be used. Encase in CBM4 (15N after 7 days) concrete for corrosion protection, minimum 100mm surround
3. Install an ESB marker post on both sides of the crossing - ESB code 8327355 or use stub pole minimum 2.0m above ground level & warning sign 8238339.
4. Ensure a smooth connection using rubber coupler between crossing pipe size and ESB standard duct as the steel pipe size will usually differ from the standard ESB ducting. Alternatively run ESB ducting right through the steel pipe
5. If crossing tidal area, a foreshore licence will be required.

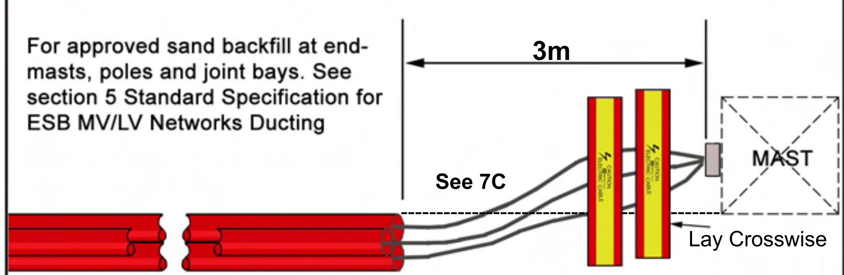
7A Cable End Mast Position



Ensure that trench is deepened at this position and cable is supported all round so that it does not tighten further during Backfilling

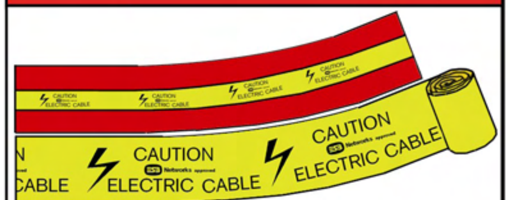
7B Cable End Mast Position

For approved sand backfill at end-masts, poles and joint bays. See section 5 Standard Specification for ESB MV/LV Networks Ducting

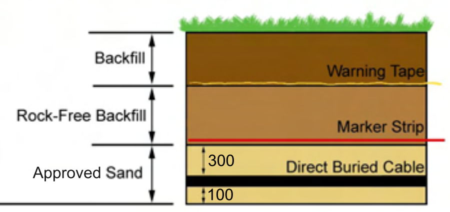


Offset trefoil to line up with edge of mast for ease of cable pulling.
Never install ducting right up to mast or 3-pole base with long radius bend attached.
Both marker strip and warning tape to be used between duct and mast (laying the marker strip crosswise as shown above).

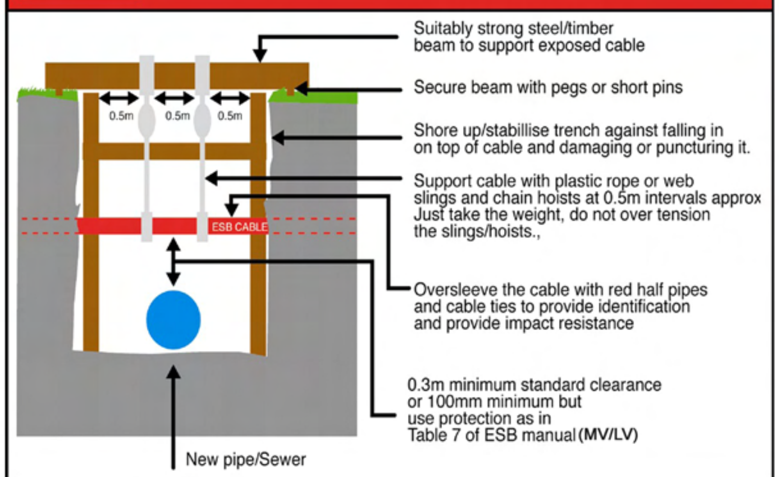
7C Cable End Mast - Marker Strip/Tape



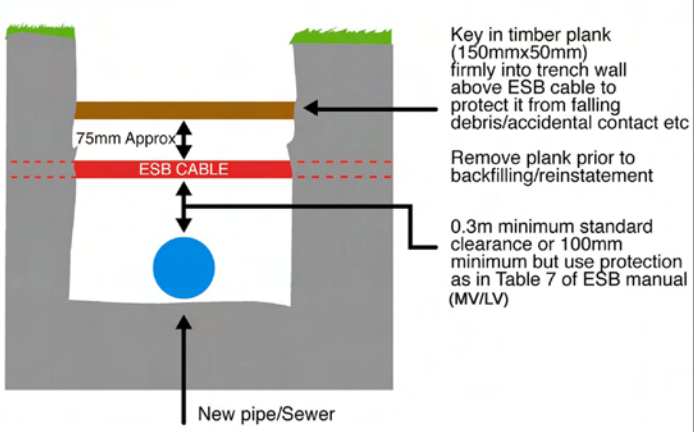
Cover cable between duct and pole with both Marker Strip and Warning Tape.



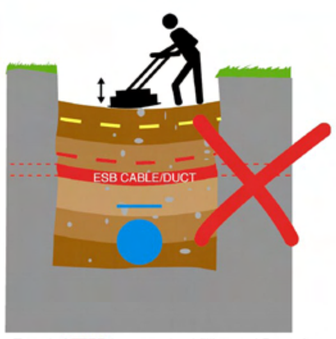
8A Supporting ESB Cables/Ducts During Trenching Works



8B Supporting ESB Cables/Ducts During Trenching Works

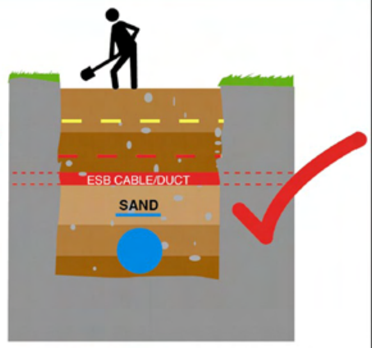


9 Avoidance of Cable Damage Due to Improper Backfilling at Cable Crossings



Trench **AFTER** improper backfilling and Ramming

Excessive deflection resulting in a shearing action at the trench walls and risk of cable or duct failure later.



Trench **AFTER** carefull backfilling and Ramming

Layers all round the cable to be hand tamped. Cable to be well supported by firm bed of sand beneath the cable. No compaction machinery directly over cable/duct for 300mm minimum distance

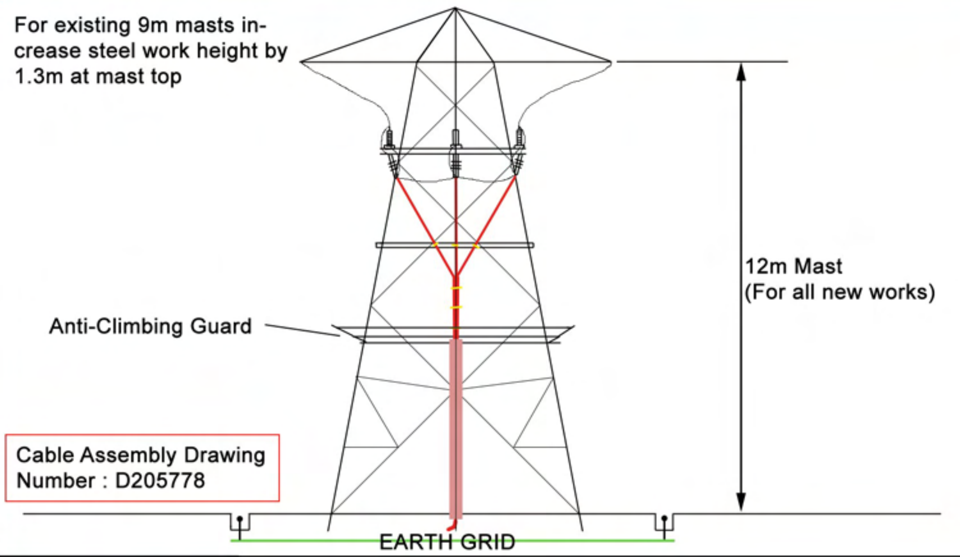
Result : Very little cable deflection and shearing at edges of trench

Standard Specification for ESB 38kV Networks Ducting/Cabling (Minimum Standards)

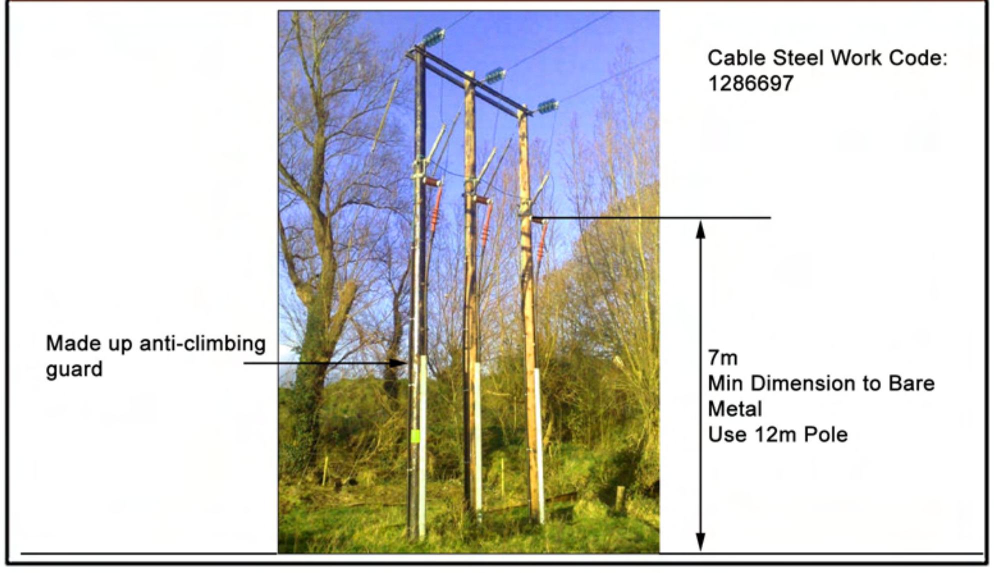
Note 1 : ESB Networks reserves the right not to accept ducting which does not conform to these standards and dimensions
Note 2 : Refer to ESB Networks for Specific job Specification. These instructions do not apply to LV/MV/110kV/220kV cable
Note 3 : All materials (ducts, marker tapes/strips, duct surrounds, mandrels and brushes) must be ESB approved materials

ESB Networks
Rev 0: Date 08-09
Approved:

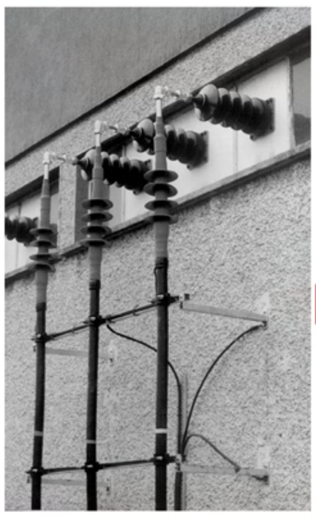
3A End Mast Termination



3B Triple Pole Structure



3C Station Termination



To Cubicle

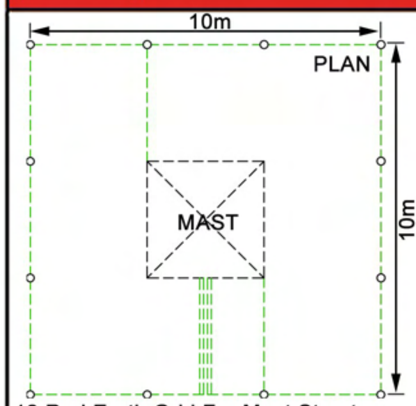
If Cable run <50m install lightning arrestors.

Assess need for mesh screen guard (Code: 3175003)

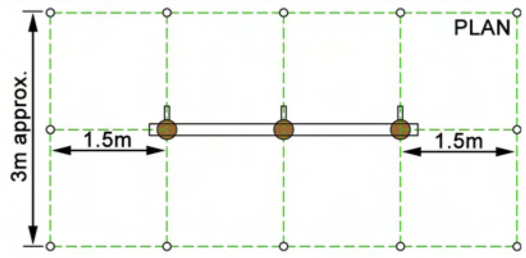
Drg. No A3205856

Clearances : Phase to:
- Phase 500mm outdoor
- Earth 500mm outdoor

3D Earth Grids



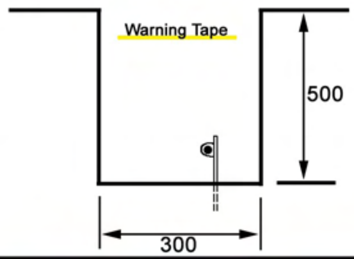
12 Rod Earth Grid For Mast Structure



12 Rod Earth Grid For 3-Pole Structure

Earth Grid resistances <10 Ohms.
If ground is known to be high resistance, plan ahead and put additional earthwire into cable trench.

Drg. No. A4D 205343
PE424-D901-911-001-000



4A Obligation of Duct Installer to minimise the number and severity of duct bends

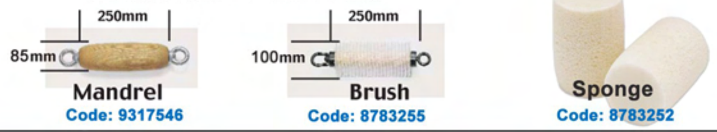
The duct installer must minimise the number and severity of preformed bends in ground with obstructions and other utility service crossings by opening ground 15m ahead of backfilled duct, wherever practical to do so. This safety obligation, which may require use of steel plating, allows the duct installer to pick the least bendy duct route through utility crossings and obstructions. Otherwise, numerous sharp unrecorded duct route deviations will be present making cable installation considerably more difficult and less safe for the cable installer.

4B Standard for Brushing, Mandrelling, Roping and End-Capping of 38kV ducts

All Ducts must be:
- Thoroughly brushed and mandrelled to prove ducts against debris /excessive deflection
- Roped using 12mm polyproplene rope with certified safe breaking load of 1.5 tons -- all rope joints to be properly spliced and PVC taped over. Approved Supplier Silver Strand Bunclana Donegal, ph (074) 9382503 - 500m drum lengths available to minimise splicing/coil handling
- Sealed using endcaps against grit and water getting into them
  NB: Replace mandrels once mandrel wear indicators or grooves are worn down
  Replace brushes once brush diameter falls 5mm below dimensions in table below
- Approved endcaps, both disposable and reusable types, are available from suppliers of approved ESB ducting
- Approved ESB Mandrel and brush suppliers :

Brandon Agencies, Rathnew, Co Wicklow: Phone 0404 20500 (Brushes & Mandrels)
IS Varian, Greenhills industrial Estate, Walkinstown, Dublin 12 Phone: 01-4501150 (Brushes Only)
Clydesdale UK Phone 086 172 6665 (Brushes & Mandrels)
Tynagh Network Systems, Loughrea, Co Galway. Phone: 091 842206 (Brushes & Mandrels)

110mm HDPE Duct Size

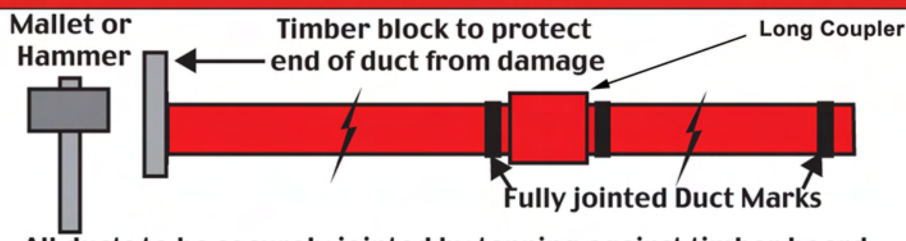


4C Approved ESB Ducting for 38kV Cables

- Use only solid wall high impact resistance ESB approved HDPE red ducting to IS 370 colour standard and ESB specification 16113 (6.3mm minimum wall thickness) Discoloured or unidentified ducting not acceptable. All duct material must be approved by ESB Networks.
- Lightweight flexible corrugated twinwall ducting is not acceptable to ESB irrespective of manufacturer

- Current approved HDPE Duct and duct bend manufacturers are: Lynplast (bend fittings only), Uponor-Radius Systems, Wavin, Quality Plastics

4D Specification for Duct Jointing for 38kV Cables

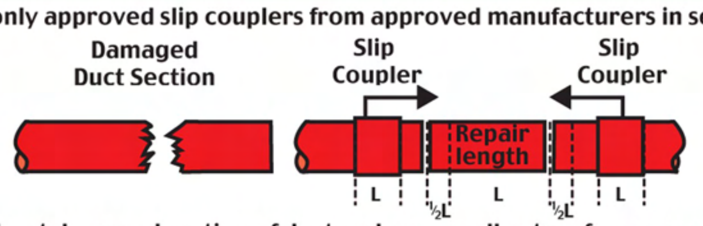


All ducts to be securely jointed by tapping against timber board on each duct until the black depth insertion mark is reached

Always smear duct lubricant on coupler rubber ring

4E Repair of Existing Ducts

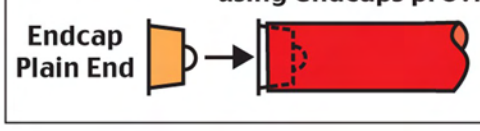
Use only approved slip couplers from approved manufacturers in section 4C



- **Cut out damaged section of duct and ensure all cut surfaces are square and free from sharp edges**
- **Slide, position and centre the repair couplers on the centering marks**

4F Sealing of Ducts

All ducts to be permanently sealed at both ends of duct run
Ducts to be temporarily sealed during installation using endcaps provided with each bale



ESB Code 110mm: 9317569