APPENDIX 7-3

SUMMARY DATA

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Table 7 - 3 - 1 Summary of vantage point records (MKO)

Species	Year	Observations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Buzzard	2023	number of observations													
		flight duration (seconds)													
		bird seconds at PCH													
	2024	number of observations		1	2	1	2	4	2	5	3				**20**
		flight duration (seconds)		65	360	300	60	2580	140	600	180				**4285**
		bird seconds at PCH			240			1380	250	120	150				**2140**
Curlew	2023	number of observations											1		**1**
		flight duration (seconds)													
		bird seconds at PCH													
	2024	number of observations													
		flight duration (seconds)													
		bird seconds at PCH													
Golden Plover	2023	number of observations											3		**3**
		flight duration (seconds)											123		**123**
		bird seconds at PCH													
	2024	number of observations	3			2									**5**
		flight duration (seconds)	510			120									**630**
		bird seconds at PCH	1440			2400									**3840**
Grey Wagtail	2023	number of observations													
		flight duration (seconds)													
		bird seconds at PCH													
	2024	number of observations			2	1		1	1						**5**
		flight duration (seconds)			300	180		600	60						**1140**
		bird seconds at PCH													
Hen Harrier	2023	number of observations													
		flight duration (seconds)													
		bird seconds at PCH													
	2024	number of observations				2				1					**3**

Species	Year	Observations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
		flight duration (seconds)				150				60					**210**
		bird seconds at PCH													
Kestrel	2023	number of observations													
		flight duration (seconds)													
		bird seconds at PCH													
	2024	number of observations	3		5	5	1		2	6	5				**27**
		flight duration (seconds)	7800		1380	780	30		179	420	502				**11091**
		bird seconds at PCH	1410						30	180	53				**1673**
Meadow Pipit	2023	number of observations											5		**5**
		flight duration (seconds)											220		**220**
		bird seconds at PCH													
	2024	number of observations	3		2	4	4	3	3	2	9				**30**
		flight duration (seconds)	30		300	810	1080	480	180	60	60				**3000**
		bird seconds at PCH													
Red Grouse	2023	number of observations											1		**1**
		flight duration (seconds)											60		**60**
		bird seconds at PCH													
	2024	number of observations				2	4				3				**9**
		flight duration (seconds)				30					17				**47**
		bird seconds at PCH													
Redwing	2023	number of observations											1	1	**2**
		flight duration (seconds)											10	30	**40**
		bird seconds at PCH													
	2024	number of observations													
		flight duration (seconds)													
		bird seconds at PCH													
Short-eared Owl	2023	number of observations													
		flight duration (seconds)													

Species	Year	Observations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
		bird seconds at PCH													
	2024	number of observations		1					1						**2**
		flight duration (seconds)		30					60						**90**
		bird seconds at PCH													
Snipe	2023	number of observations												1	**1**
		flight duration (seconds)												30	**30**
		bird seconds at PCH												60	**60**
	2024	number of observations													
		flight duration (seconds)													
		bird seconds at PCH													
Sparrowhawk	2023	number of observations											1		**1**
		flight duration (seconds)											60		**60**
		bird seconds at PCH											60		**60**
	2024	number of observations				1									**1**
		flight duration (seconds)				30									**30**
		bird seconds at PCH				30									**30**
Woodcock	2023	number of observations													
		flight duration (seconds)													
		bird seconds at PCH													
	2024	number of observations			1										**1**
		flight duration (seconds)			5										**5**
		bird seconds at PCH													

Table 7 - 3 - 2 Summary of winter walkover records

Species	Year	Abundance	Jan	Feb	Mar	Oct	Nov	Dec	Total
Golden Plover	2023	number of observations					2		**2**
		number of individuals					4		**4**
	2024	number of observations	2	1					**3**
		number of individuals	71	6					**77**
Meadow Pipit	2023	number of observations					3	1	**4**
		number of individuals					8	1	**9**
	2024	number of observations	2	3	1				**6**
		number of individuals	6	6	5				**17**
Red Grouse	2023	number of observations						1	**1**
		number of individuals						1	**1**
	2024	number of observations							
		number of individuals							
Snipe	2023	number of observations							
		number of individuals							
	2024	number of observations	1	2					**3**
		number of individuals	1	2					**3**

Table 7 - 3 - 3 Summary of breeding walkover records

Species	Year	Abundance	Apr	May	Jun	Jul	Aug	Sep	Total
Buzzard	2024	number of observations			1				**1**
		number of individuals			1				**1**
Golden Plover	2024	number of observations	1						**1**
		number of individuals	15						**15**
Hen Harrier	2024	number of observations	1	2		1			**4**
		number of individuals	1	2		1			**4**
Meadow Pipit	2024	number of observations	5	8	9	1			**23**
		number of individuals	14	29	59	2			**104**

Species	Year	Abundance	Apr	May	Jun	Jul	Aug	Sep	Total
Snipe	2024	number of observations	5						**5**
		number of individuals	8						**8**

Table 7 - 3 - 4 Summary of breeding raptor records

Species	Year	Abundance	Apr	May	Jun	Jul	Total
Buzzard	2024	number of observations	1	3	4	4	**12**
		number of individuals	1	3	4	5	**13**
Hen Harrier	2024	number of observations		2			**2**
		number of individuals		2			**2**
Kestrel	2024	number of observations	1	2	5	3	**11**
		number of individuals	1	2	5	3	**11**

Table 7 - 3 - 5 Summary of breeding red grouse survey records

Species	Year	Abundance	Jan	Feb	Mar	Total
Red Grouse	2024	number of observations		4		**4**
		number of individuals		4		**4**

Table 7 - 3 - 6 Summary of non-target species records

Species	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Barn Swallow	2023												
	2024				✓	✓	✓	✓	✓	✓			
Blackbird	2023											✓	✓
	2024	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Blackcap	2023												
	2024					✓	✓	✓	✓				
Blue Tit	2023											✓	✓
	2024	✓	✓	✓		✓	✓	✓	✓	✓			
Bullfinch	2023											✓	✓
	2024			✓	✓	✓	✓	✓	✓	✓			
Chaffinch	2023											✓	✓
	2024	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Chiffchaff	2023												
	2024			✓	✓	✓		✓	✓	✓			
Coal Tit	2023											✓	✓
	2024	✓	✓	✓		✓	✓	✓	✓	✓			
Crossbill	2023												
	2024	✓				✓	✓			✓			
Cuckoo	2023												
	2024				✓	✓	✓						
Dunnock	2023											✓	✓
	2024	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Fieldfare	2023											✓	✓
	2024	✓											
Goldcrest	2023											✓	
	2024	✓		✓	✓					✓			
Goldfinch	2023												
	2024				✓	✓	✓	✓	✓				

Species	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Grasshopper Warbler	2023												
	2024					✓		✓					
Great Tit	2023											✓	
	2024	✓	✓	✓				✓	✓	✓			
Greenfinch	2023												
	2024	✓			✓			✓					
Grey Heron	2023												
	2024				✓				✓				
Herring Gull	2023												
	2024								✓				
Hooded Crow	2023											✓	✓
	2024	✓	✓	✓	✓	✓	✓	✓	✓	✓			
House Martin	2023												
	2024						✓		✓				
Jack Snipe	2023											✓	✓
	2024		✓										
Jackdaw	2023											✓	✓
	2024	✓	✓	✓	✓	✓	✓	✓		✓			
Jay	2023												
	2024			✓			✓	✓	✓	✓			
Lesser Black-backed Gull	2023												
	2024						✓	✓					
Redpoll	2023												✓
	2024			✓		✓	✓	✓	✓	✓			
Linnet	2023											✓	
	2024	✓			✓	✓	✓	✓	✓	✓			
Long-tailed Tit	2023											✓	
	2024								✓				

Species	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Magpie	2023											✓	✓
	2024	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Mallard	2023												
	2024				✓			✓					
Mistle Thrush	2023												✓
	2024	✓	✓	✓	✓	✓				✓			
Pheasant	2023											✓	✓
	2024				✓	✓	✓	✓					
Pied Wagtail	2023											✓	
	2024	✓		✓			✓	✓	✓	✓			
Raven	2023											✓	✓
	2024	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Reed Bunting	2023											✓	
	2024	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Robin	2023											✓	✓
	2024	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Rook	2023											✓	✓
	2024	✓	✓	✓		✓	✓	✓	✓	✓			
Sand Martin	2023												
	2024						✓			✓			
Sedge Warbler	2023												
	2024					✓	✓	✓					
Siskin	2023											✓	
	2024						✓	✓					
Skylark	2023												
	2024				✓	✓	✓						
Song Thrush	2023											✓	
	2024	✓	✓	✓	✓	✓	✓	✓					

Species	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Starling	2023												
	2024				✓	✓	✓						
Stonechat	2023											✓	✓
	2024	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Whimbrel	2023												
	2024				✓								
Whitethroat	2023												
	2024					✓	✓	✓					
Willow Warbler	2023												
	2024				✓	✓	✓	✓	✓				
Woodpigeon	2023												
	2024	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Wren	2023											✓	✓
	2024	✓	✓	✓	✓	✓	✓	✓	✓	✓			

APPENDIX 7-4

SURVEY DATA

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1. HEN HARRIER

Table 7 - 4 - 1-1 Hen Harrier Vantage Point Survey data 2023 (Ecology Ireland)

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
26	2	28/04/2023	14:19	Hen Harrier	1	On site	85	0	0	0	Hunting 2f NW of VP moving to W out onto valley.	JD
27	4a	27/04/2023	15:47	Hen Harrier	1	On site	10	0	0	0	Seen briefly in distance	MS
28	5	28/04/2023	10:32	Hen Harrier	1	On site	6	0	0	0	Commuting hunting obscured behind ditch.	NL
29	5	28/04/2023	10:33	Hen Harrier	1	On site	90	0	0	0	Commuting/hunting flew out of view beyond hill to the SSE Same as obs 26 HH	NL
77	5	28/04/2023	13:50	Hen Harrier	1	On site	36	0	0	0	Commuting/hunting	NL
78	5	28/04/2023	14:24	Hen Harrier	1	On site	190	0	0	0	Skydancing/commuting	NL
86	1	21/06/2023	14:00	Hen Harrier	1	On site	3	0	0	0	Ringtail-flying	AD
88	1	21/06/2023	14:20	Hen Harrier	1	Off site	10	0	0	0	Male hunting	AD
105	3	21/06/2023	13:55	Hen Harrier	1	On site	0	8	0	0	Hunting and flying	BOM
106	4A	22/06/2023	11:39	Hen Harrier	1	On site	20	0	0	0	Hunting low over moor	PR
111	5	21/06/2023	14:00	Hen Harrier	1	Off site	4	0	0	0	Mostly soaring circline and ascending for a short time	NL
119	5	21/06/2023	14:23	Hen Harrier	1	Off site	2	0	0	0	Seemed to swoop uo into mature trees to land but didn't see it land	NL
135	1	18/07/2023	11:02	Hen Harrier	1	On site	0	92	0	0	W/prey flying to W S of VP	NL
140	1	18/07/2023	13:26	Hen Harrier	1	On and off site	14	240	0	0	Soaring N of VP1 moved across valley and south staying high dropped low hunting on site moved onto E side of hill out of view.	JD
150	3	25/07/2023	09:26	Hen Harrier	1	On and off site	9	8	0	0		NL
154	3	25/07/2023	11:09	Hen Harrier	1	On and off site	50	7	0	0	Carrying prey	NL

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
156	4A	25/07/2023	09:26	Hen Harrier	1	Off site	86	0	0	0	Hunting	BOM
157	4A	25/07/2023	10:44	Hen Harrier	1	On site	3	0	0	0	Hunting-brief view	BOM
162	4A	25/07/2023	11:05	Hen Harrier	1	On site	3	14	0	0	Flying W	BOM
166	4A	25/07/2023	14:05	Hen Harrier	1	Off site	>50mins	0	0	0	Perched in conifers (on fence post) still there at end of VP	BOM
168	4B	18/07/2023	10:58	Hen Harrier	1	On site	140	0	0	0	Hunting, landed for 50secs then flew off	MS
169	4B	18/07/2023	13:30	Hen Harrier	1	On site	30	0	0	0		MS
240	5	25/07/2023	09:25	Hen Harrier	1	On site	6	0	0	0	Hunting	AD
253	5	25/07/2023	10:40	Hen Harrier	1	On site	4	0	0	0	Hunting	AD
263	2	29/09/2023	08:18	Hen Harrier	1	On site and Off site	22	0	0	0	5-10 metres	PR
270	3	28/09/2023	09:34	Hen Harrier	1	On site	12	0	0	0	Hunting	AD
276	4A	28/09/2023	09:34	Hen Harrier	1	On site	60	0	0	0	Flying over bog from VP down over open ground across valley around to S of VP moving E around	JD

Table 7 - 4 - 1-2 Hen Harrier Vantage Point Survey data 2024 (MKO)

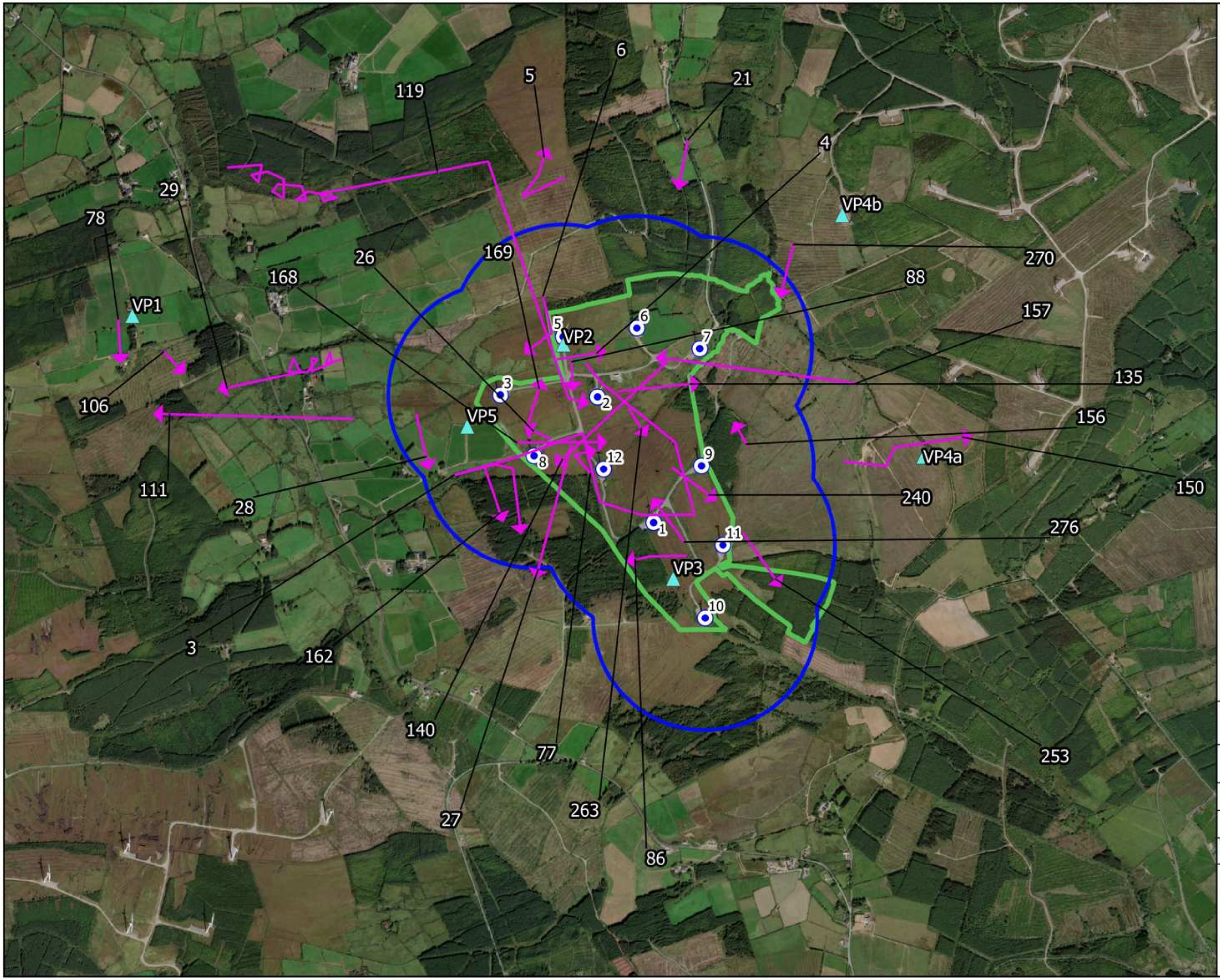
Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
HH001	VP1	16/04/2024	17:11	Hen Harrier	1	120	120	0	0	0	0	upland blanket bog; flying, male	EC
HH002	VP1	16/04/2024	20:55	Hen Harrier	1	30	30	0	0	0	0	improved agricultural grassland and upland blanket bog; flying, male flying low-possibly going to roost but sighting obscured by trees	EC
HH003	VP1	27/08/2024	13:47	Hen Harrier	1	60	0	60	0	0	0	conifer plantation, upland blanket bog and improved agricultural grassland; flying, female / juvenile	EC

Table 7 - 4 - 1-3 Hen Harrier Breeding Walkover Survey data 2024 (MKO)

Ref.	Date	Time	Transect	Species	Number	Habitat and activity	Surveyor
HH001	04/04/2024	15:52	T2	Hen Harrier	1	bogs, wet grassland and conifer plantation; hunting, foraging, seen from t3, but on t2 (suitable nesting habitat; possible breeder)	TK
HH002	23/05/2024	13:20	T4	Hen Harrier	1	bogs and buildings and artificial surfaces; flying, male, flew across wind farm road, went over the ditch and could not be located after. good nesting habitat between t9 and t11 (suitable nesting habitat; possible breeder)	CMC
HH003	23/05/2024	13:28	T4	Hen Harrier	1	bogs; flying, male, likely same bird (suitable nesting habitat; possible breeder)	CMC
HH004	24/07/2024	12:08	T7	Hen Harrier	1	conifer plantation and buildings and artificial surfaces; flying, female (suitable nesting habitat; possible breeder)	CMC

Table 7 - 4 - 1-4 Hen Harrier Breeding Raptor Survey data 2024 (MKO)

Ref.	BR	Date	Time	Species	Number	Habitat and activity	Breeding status	Surveyor
HH001	BR1	21/05/2024	13:41	Hen Harrier	1	bogs and improved grassland, flying, male	suitable nesting habitat; possible breeder	EC
HH002	BR2	30/05/2024	11:53	Hen Harrier	1	upland blanket bog, flying, male	suitable nesting habitat; possible breeder	EC



Map Legend

🟩 Site Boundary

◉ Turbine Locations

🟦 500m Radius of Turbine Locations

▲ EcologyIreland VP Locations

→ Flight Observation

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Drawing Title Hen Harrier Observations Vantage Point Surveys 2023 (undertaken by EcologyIreland)	
Project Title Taurbeg Wind Farm Extension of Operational Life	
Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.1.1
Scale 1:22,000	Date 13.12.2024

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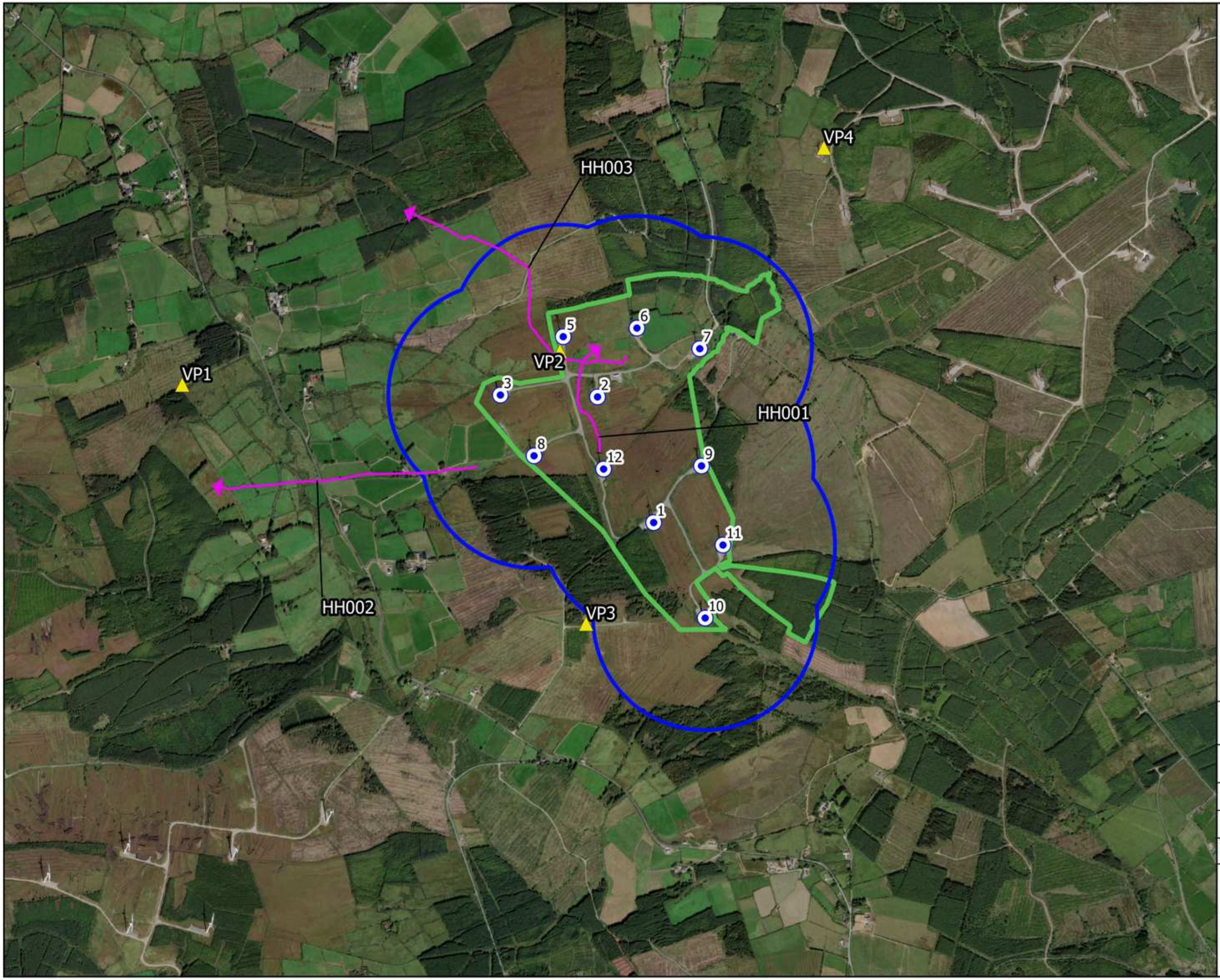

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Drawing Title Hen Harrier Observations Vantage Point Surveys	
Project Title Taurbeg Wind Farm Extension of Operational Life	
Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.1.2
Scale 1:22,000	Date 13.12.2024

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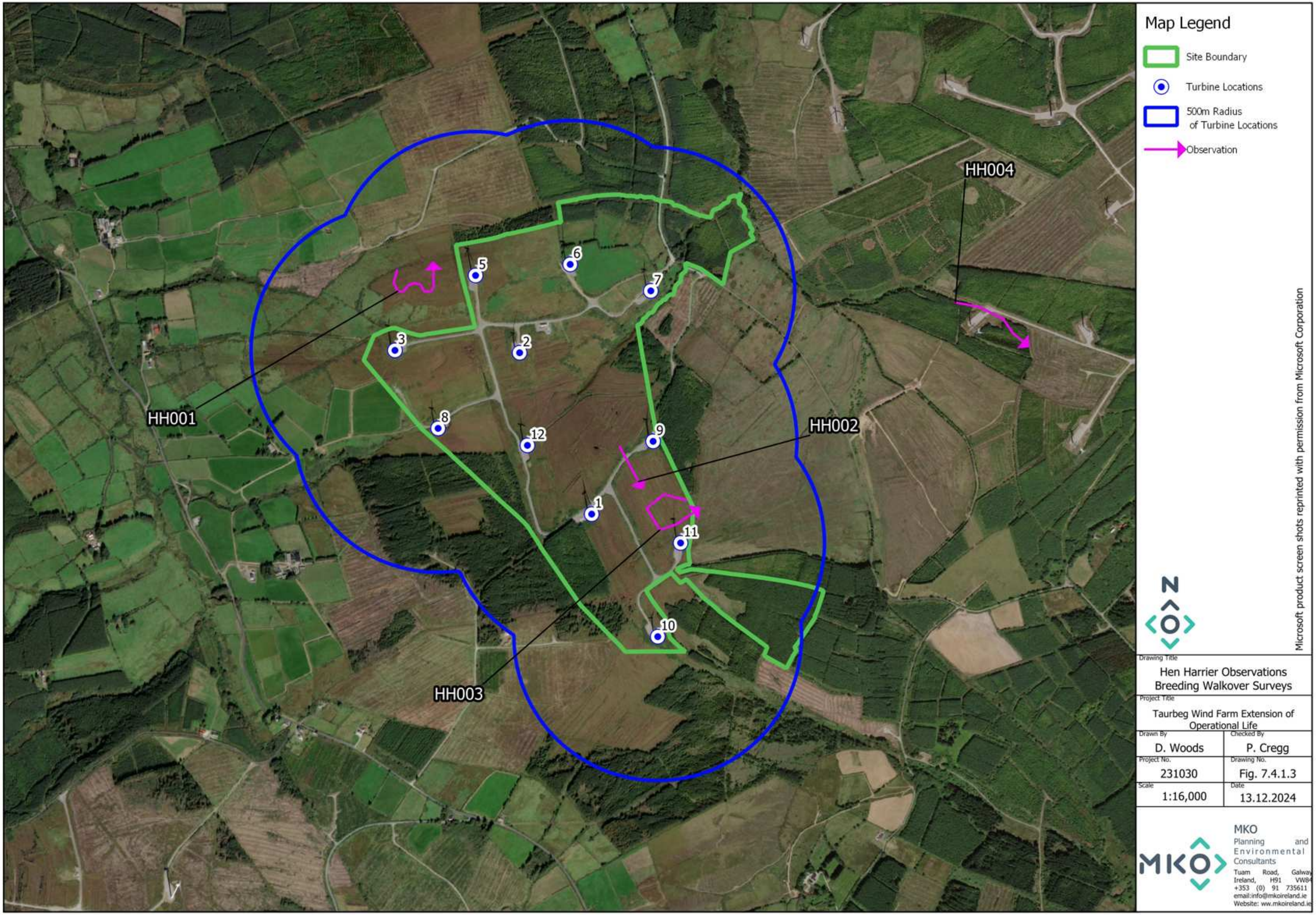

Drawing Title Hen Harrier Observations Breeding Walkover Surveys	
Project Title Taurbeg Wind Farm Extension of Operational Life	
Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.1.3
Scale 1:16,000	Date 13.12.2024

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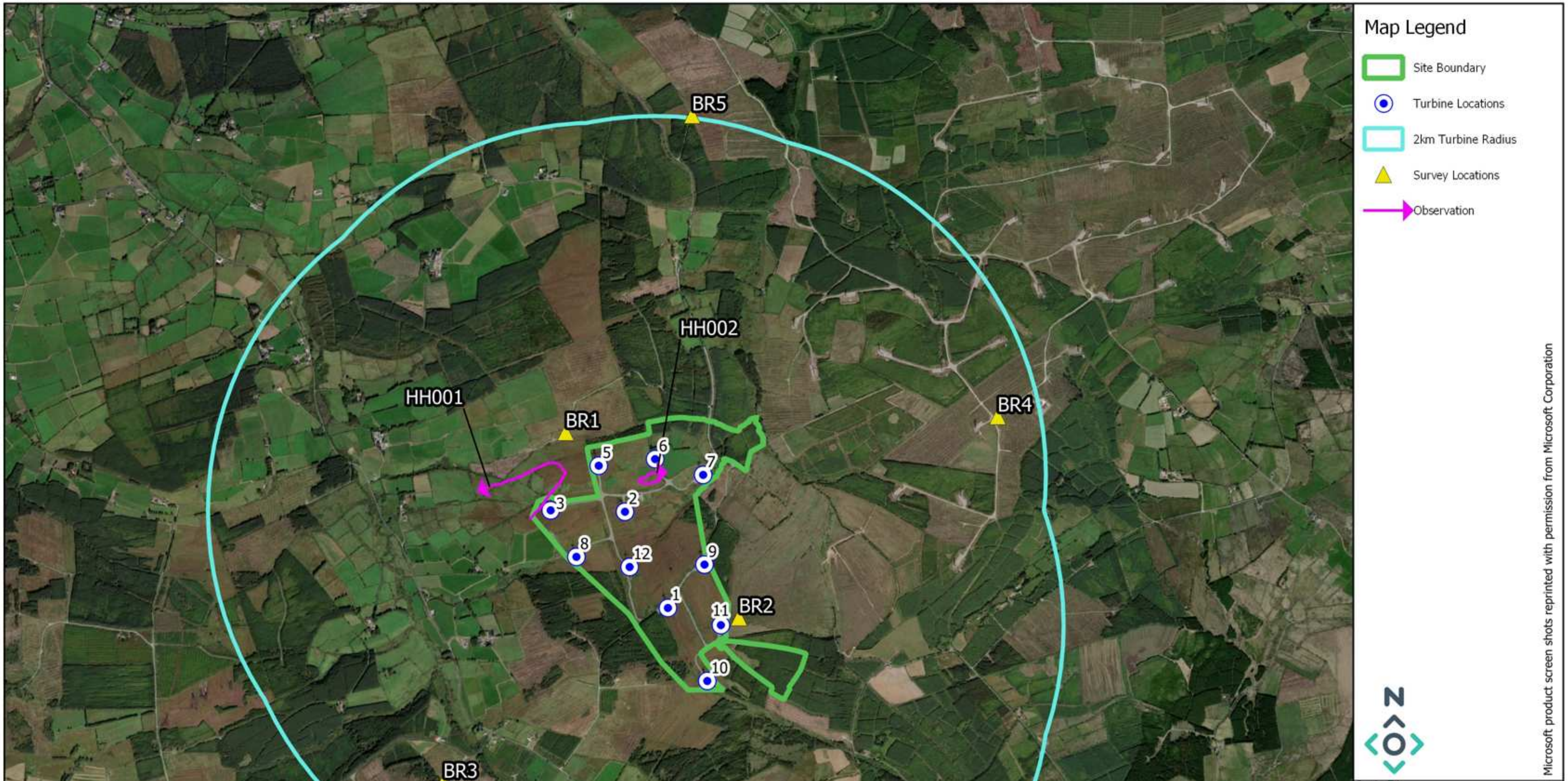

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Drawing Title
Hen Harrier Observations
Breeding Raptor Surveys

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.1.4
Scale 1:32,000	Date 13.12.2024

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2. GOLDEN PLOVER

Table 7 - 4 - 2-1 Golden Plover Vantage Point Survey data 2023 (Ecology Ireland)

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
242	2	29/09/2023	08:34	Golden Plover	16	On site and Off site	51mins	0	0	0	Mostly circling near VP2 Low near ground at times at 09:15 9 more GP joined them and flew high through site twice before flying SW	PR
244	2	29/09/2023	10:28	Golden Plover	13	Off site	0	130	0	0	Flying SW	PR
248	2	29/09/2023	11:36	Golden Plover	2	On site and Off site	0	75	0	0	Flying over site high probably flew from ground near VP2 calling	PR
252	3	28/09/2023	08:36	Golden Plover	16	On site	0	90	0	0	Flying over site	AD
254	3	28/09/2023	10:25	Golden Plover	13	On site	0	45	0	0	Flying over site	AD
256	3	28/09/2023	12:25	Golden Plover	9	On site	15	0	0	0	Flying over site	AD
260	4A	28/09/2023	08:34	Golden Plover	16	On site	0	106	0	0	Flying around N of VP1	JD
261	4A	28/09/2023	08:37	Golden Plover	16	On site	420	0	0	0	Low intermediately visible flying around hill top near VP2.	JD
266	4A	28/09/2023	11:36	Golden Plover	2	Off site	0	239	0	0	Flying S along E edge of site down into valley flying around between VP4A and 4B before landing near VP	JD
268	4A	28/09/2023	12:09	Golden Plover	9	On site and Off site	0	249	0	0	See note in 10 for GP	JD
271	4B	28/09/2023	08:35	Golden Plover	16	On site	180	0	0	0		MS
273	4B	28/09/2023	08:50	Golden Plover	16	On site	0	60	0	0		MS
274	4B	28/09/2023	09:05	Golden Plover	25	On site	0	1200	0	0		MS
280	4B	28/09/2023	12:12	Golden Plover	9	Off site	30	0	0	0		MS
281	5	28/09/2023	08:32	Golden Plover	16	On site and Off site	53mins	0	0	0	Circling eventually flying off to SW	NL

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
282	5	28/09/2023	09:11	Golden Plover	9	On site and Off site	14mins	0	0	0	Behaviour as above	NL
283	5	28/09/2023	10:26	Golden Plover	13	Off site	212	0	0	0	Flying landed out of view in treeline	NL

Table 7 - 4 - 2-2 Golden Plover Vantage Point Survey data 2024 (MKO)

Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
GP001	VP2	28/11/2023	13:18	Golden Plover	100	120	0	0	0	0	120	upland blanket bog; flying, circling high over windfarm 200+m	EC
GP002	VP2	30/11/2023	07:30	Golden Plover	1	3	3	0	0	0	0	bogs; flying, flushed when arrived	TK
GP003	VP2	30/11/2023	09:30	Golden Plover	1	-	-	-	-	-	-	bogs; calling, not seen	TK
GP004	VP4	25/01/2024	10:15	Golden Plover	100	30	0	30	0	0	0	upland blanket bog; flying, appeared to land in moderate visibility	EC
GP005	VP2	30/01/2024	11:30	Golden Plover	200	300	0	0	0	150	150	bogs and conifer plantation; travelling, a large flock flying in between turbines, then over forestry, was first following 4 individuals around t3 then joined the larger group, then possibly landed as their disappeared	TK
GP006	VP3	31/01/2024	08:48	Golden Plover	16	180	0	90	90	0	0	conifer plantation and bogs; travelling	TK
GP007	VP1	16/04/2024	16:43	Golden Plover	20	60	0	0	60	0	0	upland blanket bog; flying	EC
GP008	VP1	16/04/2024	17:49	Golden Plover	20	60	0	0	60	0	0	upland blanket bog; flying	EC

Table 7 - 4 - 2-3 Golden Plover Breeding Walkover Survey data 2024 (MKO)

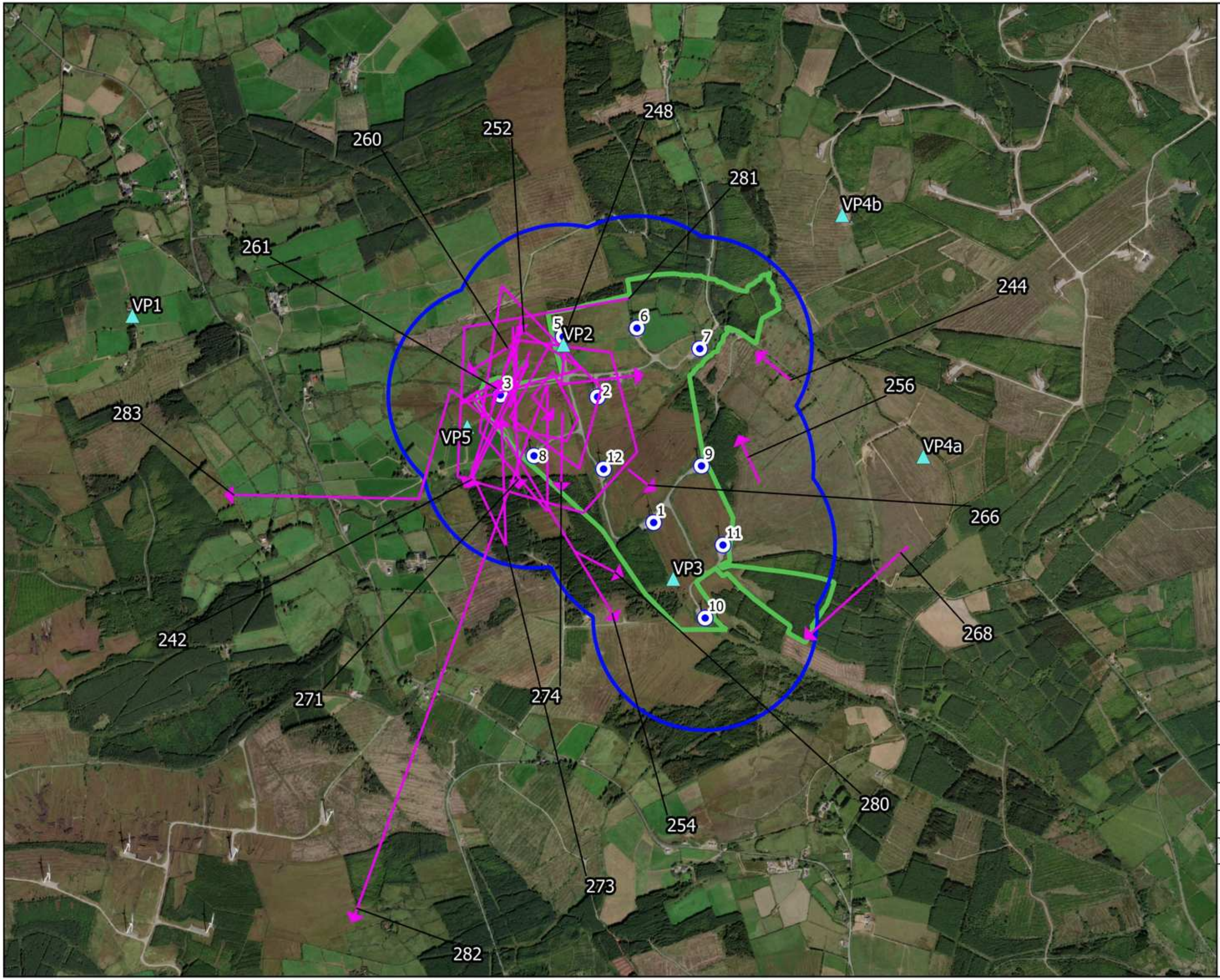
Ref.	Date	Time	Transect	Species	Number	Habitat and activity	Surveyor
GP001	04/04/2024	15:52	T3	Golden Plover	15	bogs and wet grassland; flying, calling, chaotic flight, disrupted and hunted by female hen harrier (migrating; non-breeding)	TK

Table 7 - 4 - 2-4 Golden Plover Winter Walkover Survey data (MKO)

Ref.	Date	Time	Transect	Species	Number	Habitat and activity	Surveyor
GP001	24/11/2023	11:12	-	Golden Plover	1	upland blanket bog; flying, calling, 50m height (wintering)	EC
GP002	24/11/2023	12:07	-	Golden Plover	3	upland blanket bog; flying, calling (wintering)	EC
GP003	24/01/2024	11:02	T6	Golden Plover	70	bogs; flying, circling, dropped behind ridge out of sight (wintering)	CMC
GP004	24/01/2024	11:32	T3	Golden Plover	1	bogs; flying, calling, flew through spinning turbine blades (wintering)	CMC
GP005	28/02/2024	12:33	T3	Golden Plover	6	bogs; flushed (wintering)	CMC

Table 7 - 4 - 2-5 Golden Plover Incidental Records (MKO)

Ref.	Location	Date	Time	Species	Number	Habitat and activity	Surveyor
GP001	Hen Harrier Roost Survey; HHVP3	18/12/2023	15:14	Golden Plover	55	upland blanket bog; flying, calling	EC



Map Legend

🟩 Site Boundary

● Turbine Locations

🟦 500m Radius of Turbine Locations

▲ EcologyIreland VP Locations

→ Flight Observation

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Drawing Title
Golden Plover Observations
Vantage Point Surveys 2023
(undertaken by EcologyIreland)

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.2.1
Scale 1:22,000	Date 13.12.2024

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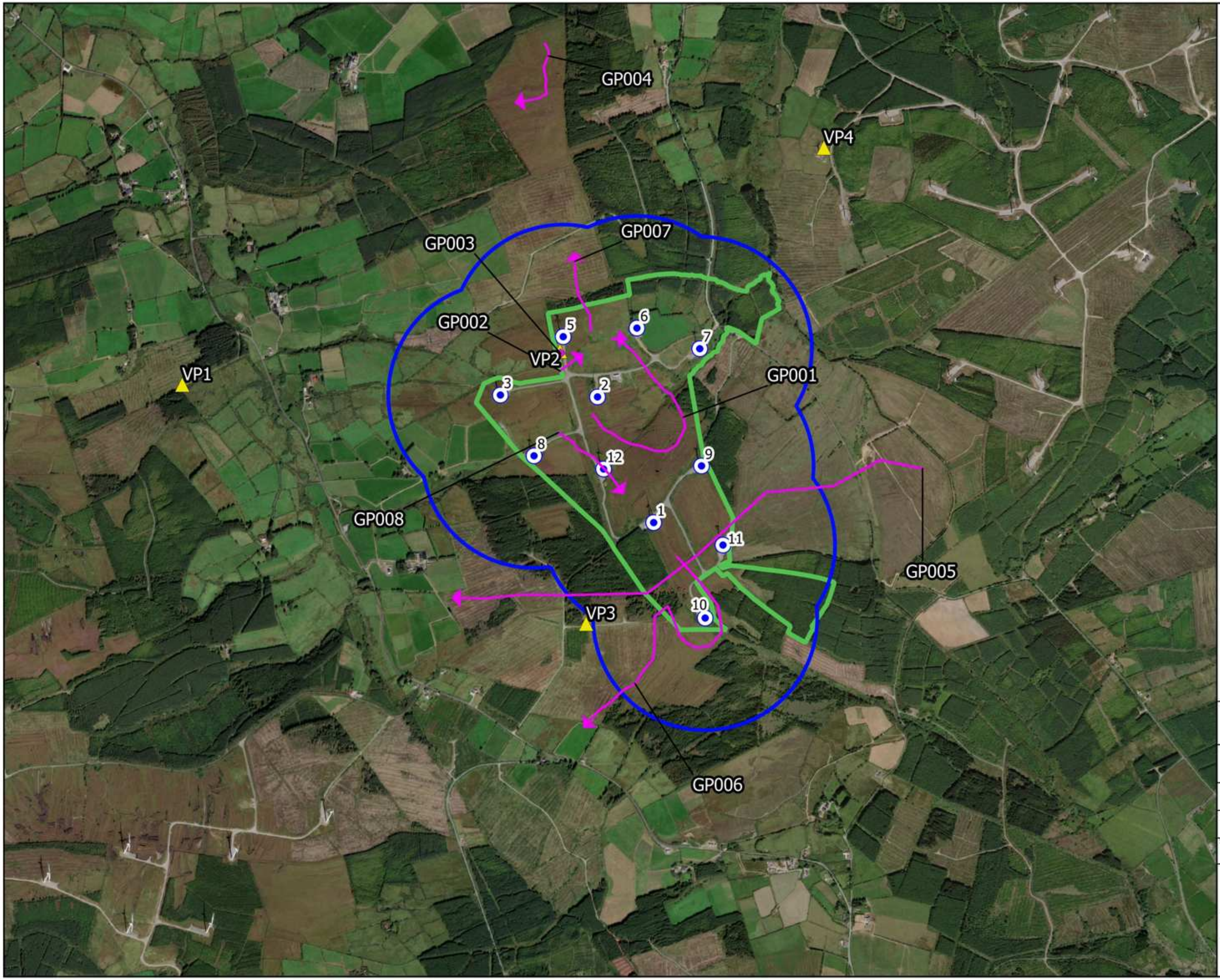

Map Legend

🟩	Site Boundary
◉	Turbine Locations
🟦	500m Radius of Turbine Locations
▲	Vantage Point Locations
→	Flight Observation
◆	Non-flight Observation

N

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Drawing Title
Golden Plover Observations
Vantage Point Surveys

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By	Checked By
D. Woods	P. Cregg
Project No.	Drawing No.
231030	Fig. 7.4.2.2
Scale	Date
1:22,000	13.12.2024

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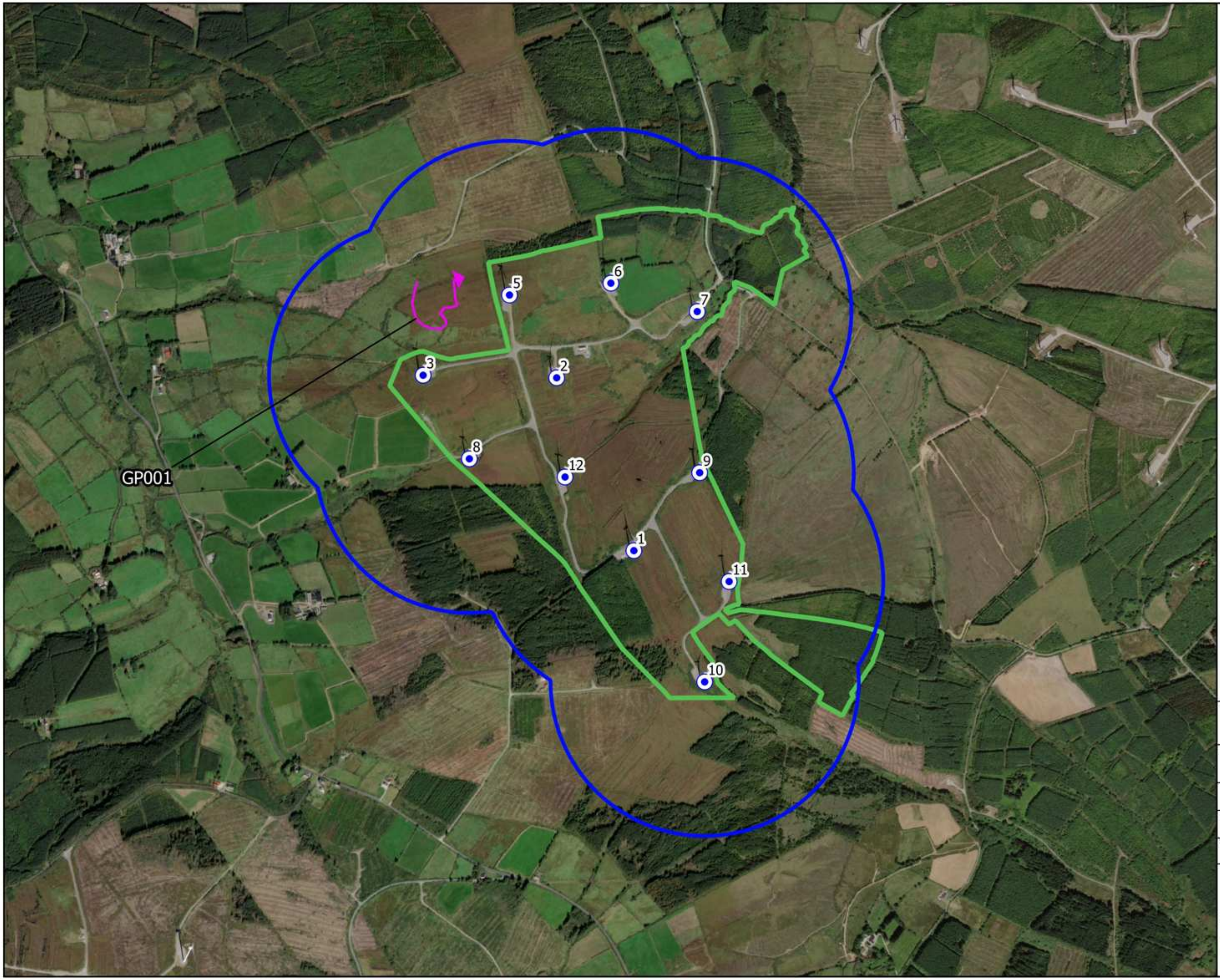

Map Legend

- 🟩 Site Boundary
- ◉ Turbine Locations
- 🟦 500m Radius of Turbine Locations
- → Observation

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Drawing Title	Golden Plover Observations Breeding Walkover Surveys
Project Title	Taurbeg Wind Farm Extension of Operational Life
Drawn By	D. Woods
Checked By	P. Cregg
Project No.	231030
Drawing No.	Fig. 7.4.2.3
Scale	1:16,000
Date	13.12.2024

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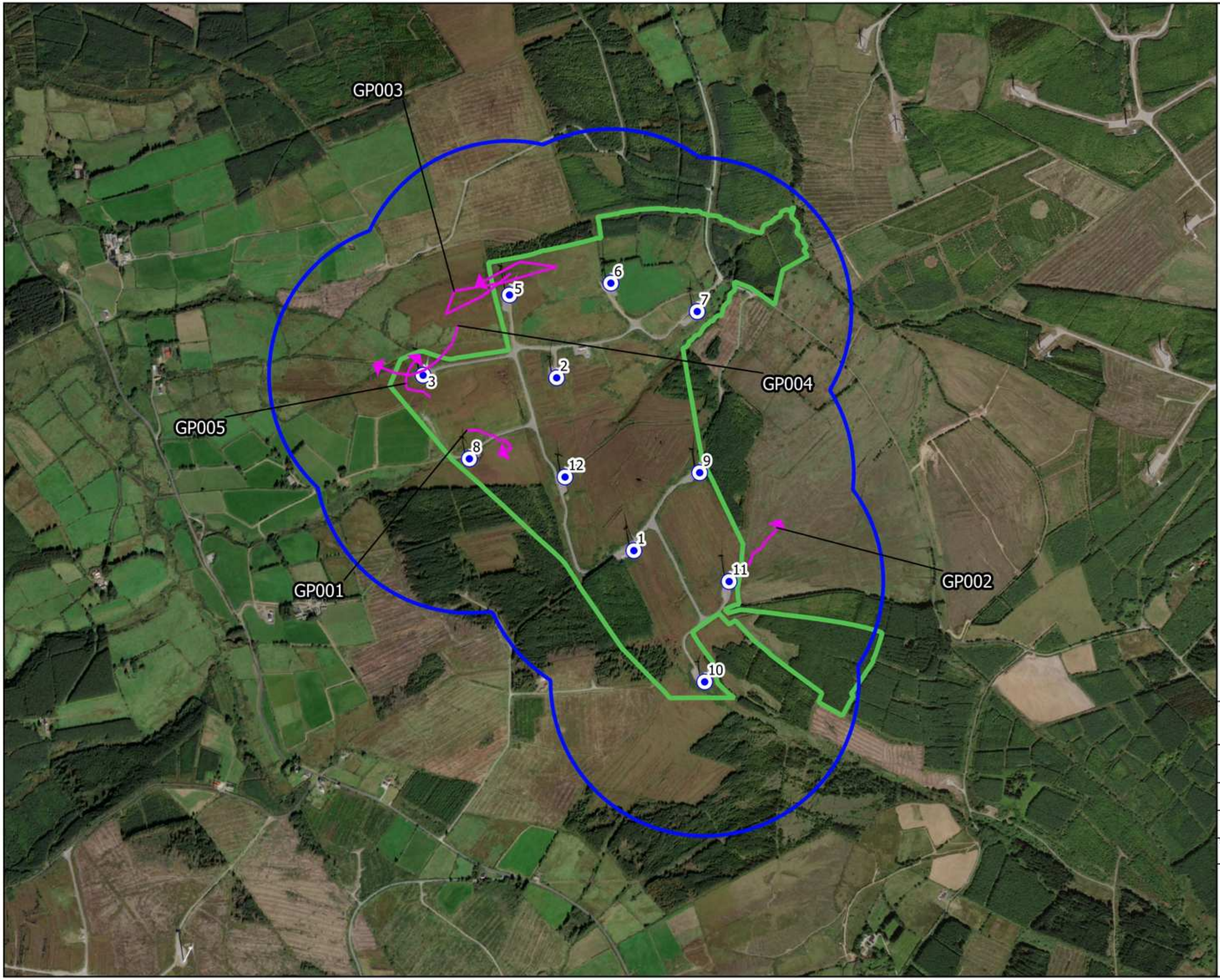

Map Legend

🟩 Site Boundary

● Turbine Locations

🟦 500m Radius of Turbine Locations

→ Observation

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Drawing Title Golden Plover Observations Winter Walkover Surveys	
Project Title Taurbeg Wind Farm Extension of Operational Life	
Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.2.4
Scale 1:16,000	Date 13.12.2024

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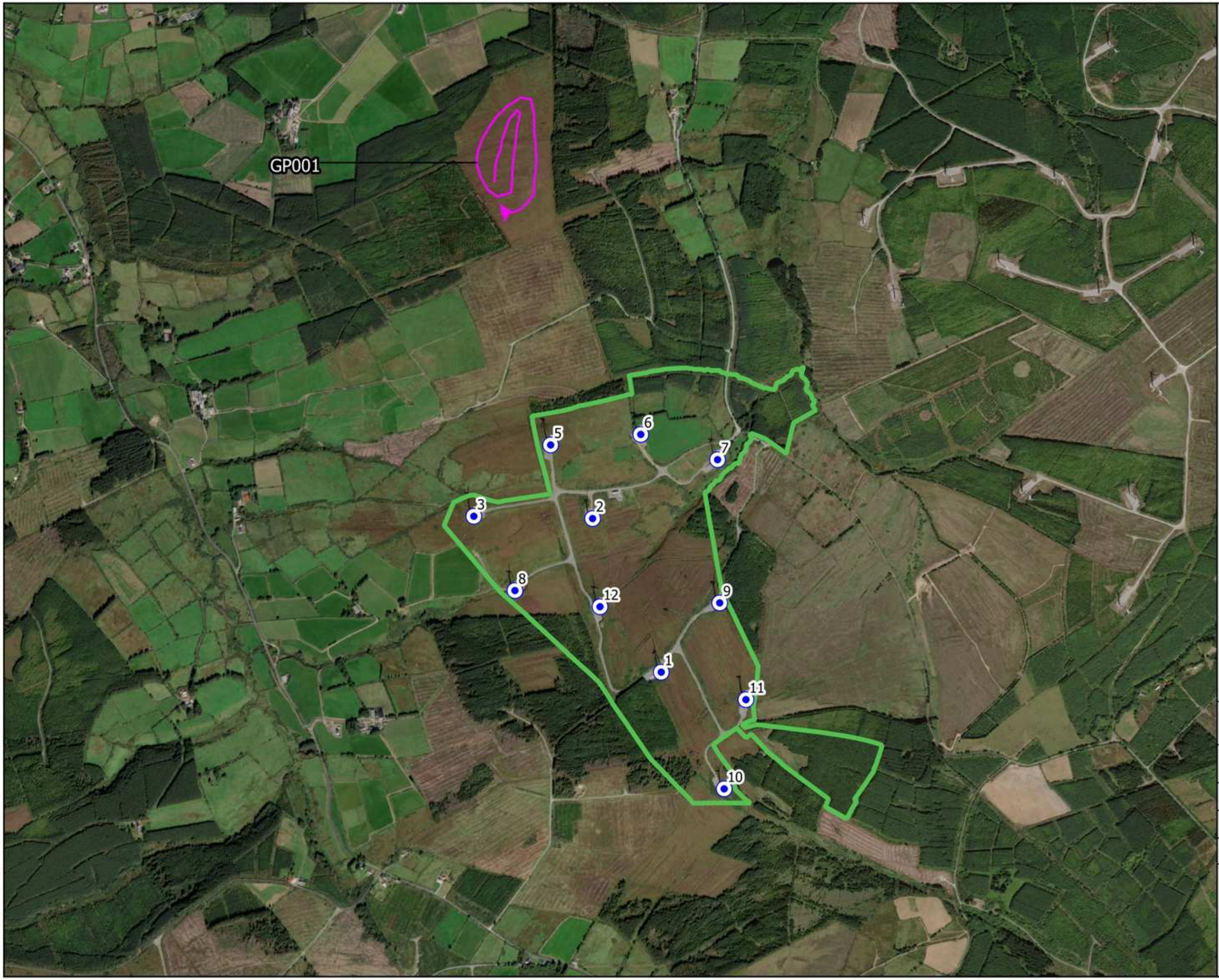

Map Legend

🟩 Site Boundary

● Turbine Locations

→ Observation

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Drawing Title Golden Plover Incidental Records	
Project Title Taurbeg Wind Farm Extension of Operational Life	
Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.2.5
Scale 1:18,000	Date 13.12.2024

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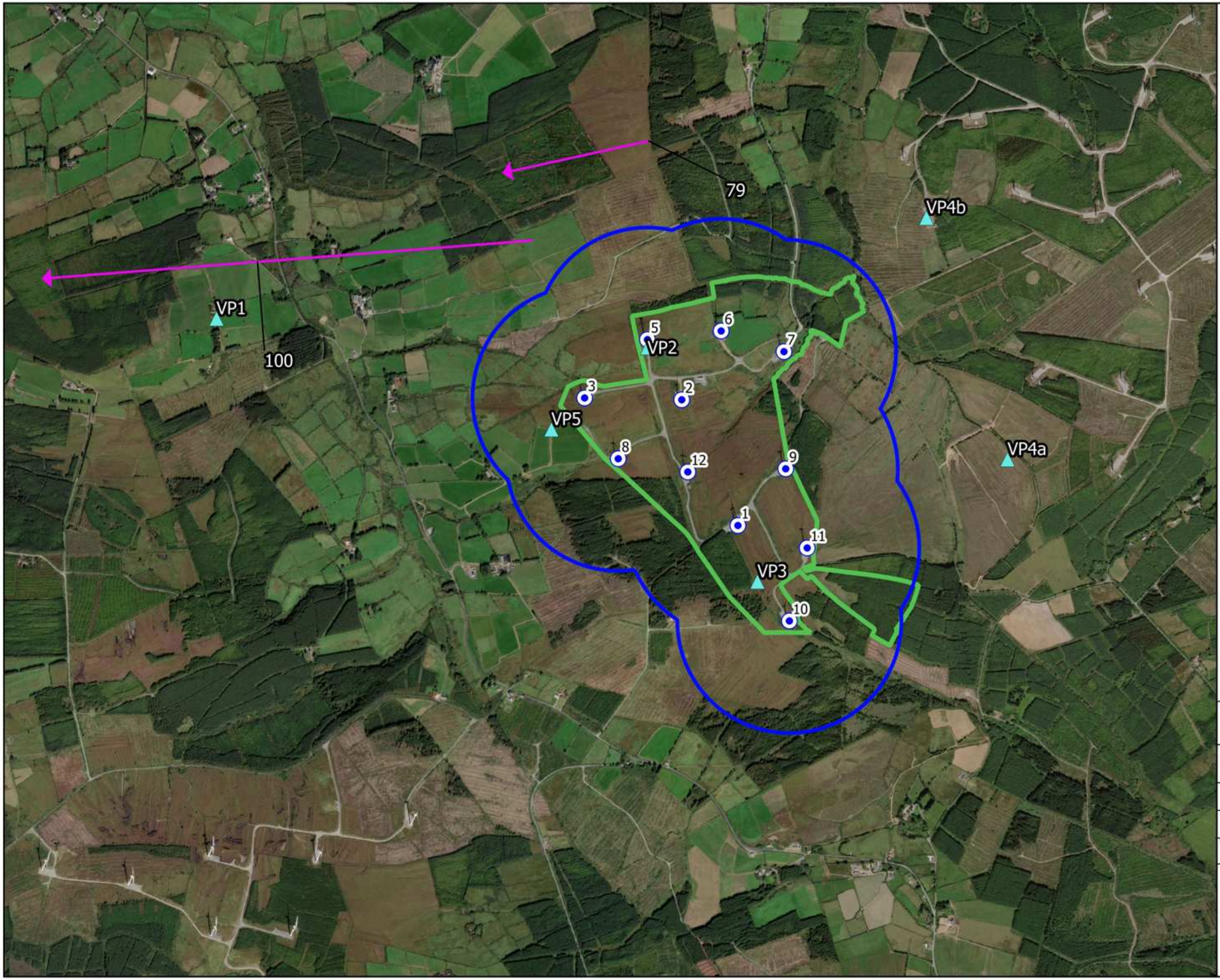
3. NIGHTJAR

Data and figures shown in Confidential Appendix 7-5

4. OSPREY

Table 7 - 4 - 4-1 Osprey Vantage Point Survey data 2023 (Ecology Ireland)

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments
79	2	21/06/2023	09:49	Osprey	1	Off site	0	90	0	0	Flying to W , N of site, down out of view. Picked up by NW who tracked it west for long period.
100	5	21/06/2023	09:50	Osprey	1	Off site	720	0	0	0	Mostly soaring for a little while circling and ascending.



Map Legend

🟩	Site Boundary
●	Turbine Locations
▢	500m Radius of Turbine Locations
▲	EcologyIreland VP Locations
→	Flight Observation

N

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Drawing Title
Osprey Observations
Vantage Point Surveys 2023
(undertaken by EcologyIreland)

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By	Checked By
D. Woods	P. Cregg
Project No.	Drawing No.
231030	Fig. 7.4.4.1
Scale	Date
1:22,000	13.12.2024

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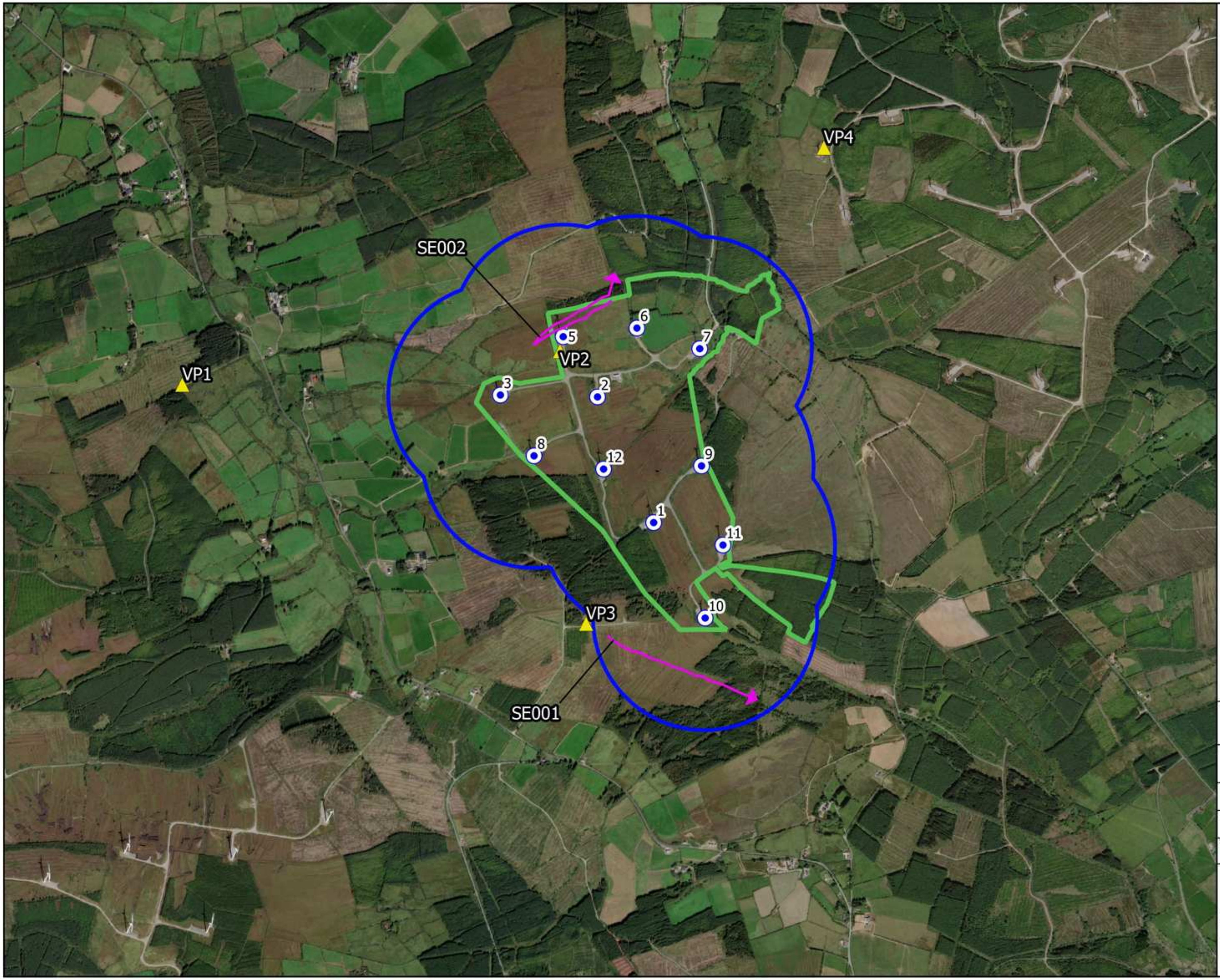
5. SHORT-EARED OWL

Table 7 - 4 - 5-1 Short-eared Owl Vantage Point Survey data 2024 (MKO)

Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
SE001	VP3	27/02/2024	18:04	Short-eared Owl	1	30	0	30	0	0	0	upland blanket bog and conifer plantation; flying, mobbed by hooded crows	EC
SE002	VP1	05/07/2024	09:21	Short-eared Owl	1	60	60	0	0	0	0	conifer plantation and upland blanket bog; flying, observed hunting successfully and carrying prey	EC



Map Legend

- 🟩 Site Boundary
- ◉ Turbine Locations
- ▭ 500m Radius of Turbine Locations
- ▲ Vantage Point Locations
- → Flight Observation

N

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Drawing Title	Short-eared Owl Observations Vantage Point Surveys
Project Title	Taurbeg Wind Farm Extension of Operational Life
Drawn By	D. Woods
Checked By	P. Cregg
Project No.	231030
Drawing No.	Fig. 7.4.5.1
Scale	1:22,000
Date	13.12.2024

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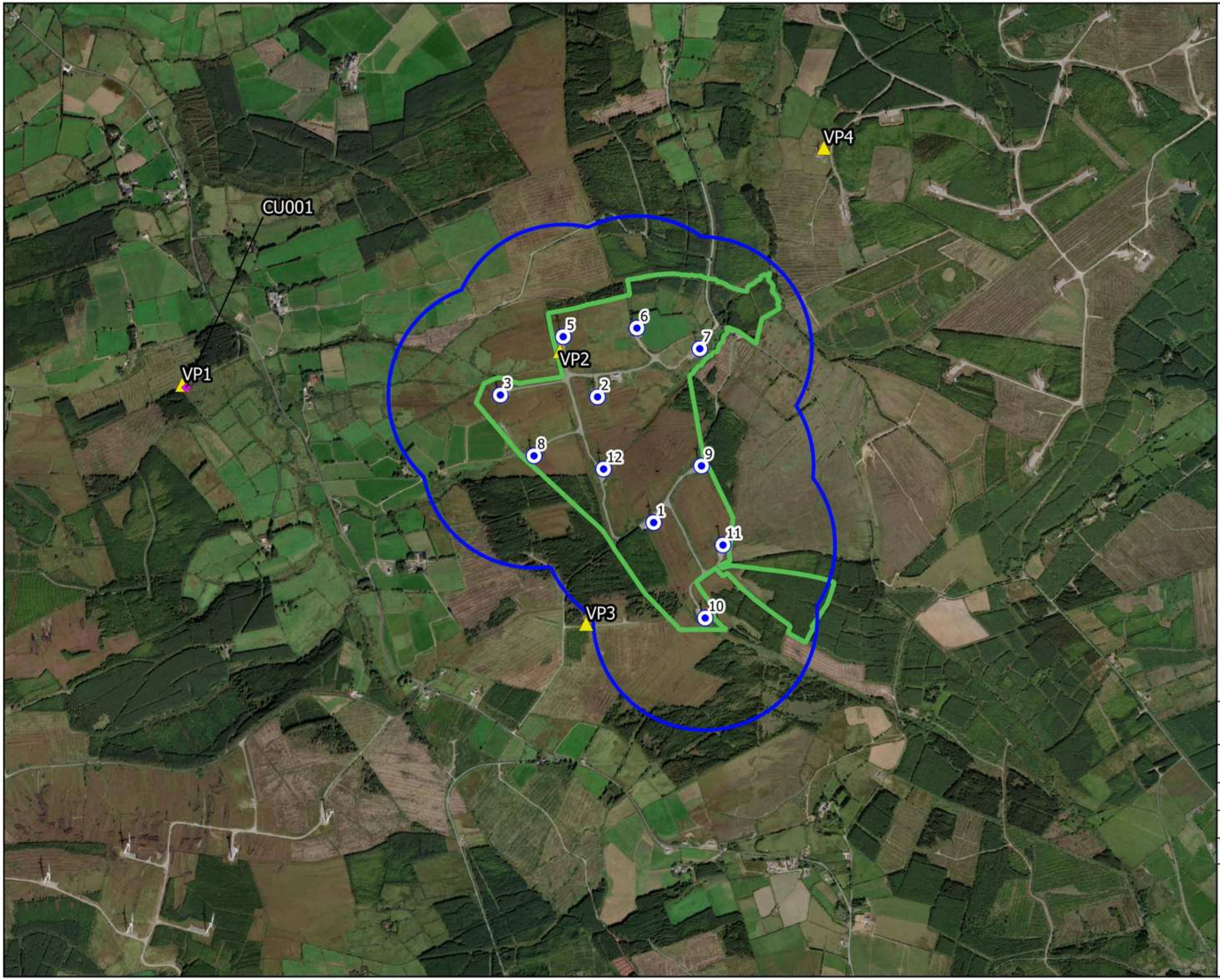
6. CURLEW

Table 7 - 4 - 6-1 Curlew Vantage Point Survey data 2024 (MKO)

Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
CU001	VP1	27/11/2023	08:20	Curlew	1	-	-	-	-	-	-	bogs, improved grassland and conifer plantation; calling, flyover, not seen	TK



Map Legend

🟩	Site Boundary
◉	Turbine Locations
🟦	500m Radius of Turbine Locations
▲	Vantage Point Locations
◆	Non-flight Observation

Drawing Title
Curlew Observations
Vantage Point Surveys

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By	Checked By
D. Woods	P. Cregg
Project No.	Drawing No.
231030	Fig. 7.4.6.1
Scale	Date
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7. KESTREL

Table 7 - 4 - 7-1 Kestrel Vantage Point Survey data 2023 (Ecology Ireland)

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
1	2	28/04/2023	09:53	Kestrel	1	On site	95	0	0	0	Flying from N of VP, around to NW hunting dropped behind hill out of view	JD
2	2	28/04/2023	09:59	Kestrel	1	On site	65	0	0	0	Flying/hunting over 2nd rot N of VP strike to ground flew to perch in tree. NL of 2nd Kestrel. Displaying at same time from VP5.	JD
7	2	28/04/2023	13:14	Kestrel	1	Off site	0	305	0	0	Hunting N of site	JD
9	2	28/04/2023	14:51	Kestrel	1	On site	218	0	0	0	Hunting N and NW of VP moved SW down behind hill	JD
11	3	27/04/2023	11:57	Kestrel	1	On site	0	220	0	0	Hunting centre of site between VP2+3 moved W+N	JD
12	3	27/04/2023	12:53	Kestrel	1	On site	0	151	0	0	Hunting off N side of site E/N of VP2	JD
13	3	27/04/2023	15:54	Kestrel	1	On site	82	0	0	0	Hunting N of T5/VP2	JD
14	3	27/04/2023	13:03	Kestrel	1	On site	0	104	0	0	Hunting N of T5/VP2	JD
15	3	27/04/2023	13:23	Kestrel	1	On site	35	0	0	0	Hunting NW of T5/VP2	JD
16	3	27/04/2023	13:58	Kestrel	1	On site	0	68	0	0	Hunting S of VP	JD
17	3	27/04/2023	14:04	Kestrel	1	On site	0	91	0	0	Hunting N of T5/VP2	JD
18	3	27/04/2023	15:24	Kestrel	1	On site	0	210	0	0	Hunting N and NE of T5/VP2	JD
20	4a	27/04/2023	12:50	Kestrel	1	On site	50	0	0	0	Hunting	MS
23	5	28/04/2023	09:58	Kestrel	1	On and off site	0	240	0	0	Displaying	NL
24	5	28/04/2023	10:20	Kestrel	1	On and off site	0	240	0	0	Hovering along flightline incl.2stoops to ground. Perched on a tree turn @end of flightline.	NL
30	5	28/04/2023	14:56	Kestrel	1	On site	130	0	0	0	Seen previously hovering along flightline by JD	NL

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
35	2	26/05/2023	10:47	Kestrel	1	On site	30	50	0	0	Hunting	AD
36	2	26/05/2023	14:41	Kestrel	1	On site	20	0	0	0	Fly over	AD
38	3	26/05/2023	10:37	Kestrel	1	On site	14	0	0	0	Flying east	PR
39	3	26/05/2023	10:43	Kestrel	1	On site	106	0	0	0	Hovering	PR
41	3	26/05/2023	11:25	Kestrel	2	On site	112	0	0	0	Flying E	PR
44	3	26/05/2023	11:59	Kestrel	1	Off site	0	130	0	0	Hovering moving NW	PR
46	3	26/05/2023	14:19	Kestrel	1	Off site	0	268	0	0	Hovering moving NW	PR
47	3	26/05/2023	14:34	Kestrel	1	Off site	0	24	0	0	Hovering moving NW	PR
48	3	26/05/2023	14:37	Kestrel	1	On site	0	30	0	0	Hovering	PR
49	3	26/05/2023	15:10	Kestrel	1	On site	0	42	0	0	Hovering moving N	PR
55	4B	25/05/2023	10:40	Kestrel	1	On site	0	360	360	0	Hunting N of turbine over 2nd roost	JD
56	4B	25/05/2023	10:55	Kestrel	1	On site	0	55	0	0	Hunting over valley	JD
58	4B	25/05/2023	11:20	Kestrel	1	On site	0	58	0	0	Hunting on top of hill W of VP	JD
70	5	26/05/2023	10:50	Kestrel	1	On site	15	0	0	0	Flying to S in trees	JD
71	5	26/05/2023	11:01	Kestrel	1	On site	5	0	0	0	Moving in trees around out of view	JD
74	1	21/06/2023	10:07	Kestrel	1	Off site	0	60	0	0	Hunting	AD
75	1	21/06/2023	10:40	Kestrel	1	Off site	0	90	0	0	Hunting	AD
94	4A	22/06/2023	14:35	Kestrel	1	Off site	0	229	0	0	Flying SW	PR
107	1	18/07/2023	09:25	Kestrel	1	On site	117	0	0	0	Hunting on SW side of hillside	NL

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
108	1	18/07/2023	10:19	Kestrel	2	On site and off site	240	248	0	0	Hunting VP on site near VP2 moved N and back to S back onsite	NL
109	1	18/07/2023	10:19	Kestrel	1	On site and off site	60	180	0	0	Hunting/flying close to 2 moved N along hillside 2 of 5 birds	NL
110	1	18/07/2023	10:19	Kestrel	3	On site	0	240	0	0	Hunting/flying along fence and top of hillside N of site	NL
112	1	18/07/2023	11:08	Kestrel	2	On site	95	0	0	0	Hunting/flying on hillside N of site	NL
113	1	18/07/2023	11:43	Kestrel	1	On site	107	0	0	0	Hunting in 2nd rot W of VP3	NL
114	1	18/07/2023	11:43	Kestrel	1	Off site	180	0	0	0	Hunting on top of hillside N of site	NL
115	1	18/07/2023	12:20	Kestrel	4	On site	60	0	0	0	Flying around trees/hunting N of site	NL
120	1	18/07/2023	13:41	Kestrel	1	On site	0	30	0	0	Hunting on site	JD
121	1	18/07/2023	13:47	Kestrel	1	Off site	120	0	0	0	Hunting over stream SSE of VP	JD
122	1	18/07/2023	13:55	Kestrel	1	On site	19	0	0	0	Briefly visible over ridge line	JD
123	1	18/07/2023	14:07	Kestrel	1	On site	0	79	0	0	Hunting on site	JD
125	1	18/07/2023	14:22	Kestrel	1	Off site	76	0	0	0	Hunting up on site near VP2	JD
127	1	18/07/2023	14:28	Kestrel	1	Off site	0	97	0	0	Mobbing buzzards	JD
128	2	18/07/2023	10:30	Kestrel	1	On site	0	73	0	0	Hunting	BOM
129	2	18/07/2023	13:33	Kestrel	1	On site	14	0	0	0	Hunting	BOM
130	2	18/07/2023	13:42	Kestrel	1	On site	0	7	0	0	Hunting	BOM
131	2	18/07/2023	13:54	Kestrel	2	Off site	0	135	0	0	Hunting	BOM
132	2	18/07/2023	14:00	Kestrel	2	On site	0	600	0	0	Hunting	BOM

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
133	2	18/07/2023	14:23	Kestrel	2	On site	0	240	0	0	Hunting	BOM
134	2	18/07/2023	14:30	Kestrel	2	Off site	0	260	0	0	Hunting	BOM
136	3	25/07/2023	09:49	Kestrel	1	Off site	0	5	0	0	Hunting	NL
137	3	25/07/2023	09:58	Kestrel	1	Off site	0	28	0	0	Hunting	NL
138	3	25/07/2023	10:24	Kestrel	1	Off site	0	53	0	0	Hunting	NL
139	3	25/07/2023	10:32	Kestrel	1	Off site	0	47	0	0	Hunting	NL
141	3	25/07/2023	11:08	Kestrel	1	Off site	0	5	0	0	Commuting	NL
142	3	25/07/2023	11:26	Kestrel	1	On and off site	12	7	0	0	Commuting	NL
143	3	25/07/2023	11:49	Kestrel	1	Off site	0	0	209	0	Hunting	NL
144	3	25/07/2023	12:36	Kestrel	1	On and off site	0	17	30	0	Hunting	NL
145	3	25/07/2023	13:21	Kestrel	1	Off site	0	192	0	0	Hunting	NL
146	3	25/07/2023	14:47	Kestrel	1	Off site	0	63	600	0	Hunting	NL
147	3	25/07/2023	14:56	Kestrel	1	On and off site	0	60	60	0	Hunting	NL
148	3	25/07/2023	14:58	Kestrel	1	Off site	60	0	0	0	Perched	NL
149	3	25/07/2023	14:58	Kestrel	1	Off site	300	0	0	0	Perched	NL
151	4A	25/07/2023	09:26	Kestrel	1	Off site	4	0	0	0	Flushed from perch by HH	BOM
152	4A	25/07/2023	09:46	Kestrel	1	Off site	13	0	0	0	Flying to perch	BOM
153	4A	25/07/2023	10:41	Kestrel	1	On site	6	0	0	0	Flying perch to perch	BOM
155	4A	25/07/2023	10:52	Kestrel	1	On site	4	0	0	0	Brief flight to perch	BOM

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
158	4B	18/07/2023	09:06	Kestrel	1	On site	600	0	0	0	Perched on tree	MS
159	4B	18/07/2023	10:19	Kestrel	2	On site	60	0	0	0		MS
160	4B	18/07/2023	10:37	Kestrel	1	On site	45	0	0	0		MS
161	4B	18/07/2023	10:46	Kestrel	1	On site	30	0	0	0		MS
163	4B	18/07/2023	11:11	Kestrel	1	On site	30	0	0	0		MS
164	4B	18/07/2023	11:23	Kestrel	1	On site	125	0	0	0		MS
165	4B	18/07/2023	12:32	Kestrel	1	On site	55	0	0	0		MS
167	4B	18/07/2023	14:03	Kestrel	1	On site	120	0	0	0		MS
170	5	25/07/2023	11:24	Kestrel	2	On site	25	0	0	0	Commuting	AD
171	5	25/07/2023	12:15	Kestrel	2	On site	20	0	0	0	Flying-mobbed by hooded crow	AD
173	1	29/08/2023	10:11	Kestrel	1	Off site	5	0	0	0	Flying low and swift heading north	MK
174	1	29/08/2023	10:56	Kestrel	1	Off site	70	0	0	0	Flying and hunting to the north of the site	MK
177	1	29/08/2023	14:05	Kestrel	1	Off site	5	0	0	0	Seen briefly flew swiftly over VP1 heading NE	MK
178	2	29/08/2023	09:36	Kestrel	2	On site	61	0	0	0	Flying around 2nd bird perched on tree before flying to perch on willow bush	JD
179	2	29/08/2023	09:55	Kestrel	1	On site	3	0	0	0	briefly N of VP low around back of hill to W	JD
180	2	29/08/2023	10:05	Kestrel	1	Off site	50	0	0	0	Hunting over open bog N of site moved Wand down out of view	JD
181	2	29/08/2023	10:10	Kestrel	1	On site	5	0	0	0	Flying to perch on tree down valley near turbine	JD
182	2	29/08/2023	10:58	Kestrel	1	On site	120	0	0	0	Hunting SW of VP E over 2nd	JD
183	2	29/08/2023	11:01	Kestrel	1	On site	0	102	0	0	Back VP hunting in 2F	JD

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
184	2	29/08/2023	11:58	Kestrel	1	On site	131	0	0	0	Hunting over small S of substation	JD
186	2	29/08/2023	12:13	Kestrel	1	On site	0	319	0	0	Hunting SE of VP moved to E	JD
187	2	29/08/2023	12:57	Kestrel	1	On site	0	120	0	0	Hunting behind VP moved N	JD
188	2	29/08/2023	12:58	Kestrel	1	On site	60	0	0	0	2 of 2 further N hunting	JD
190	2	29/08/2023	13:24	Kestrel	1	On site	30	0	0	0	Hunting SW of VP	JD
191	2	29/08/2023	13:50	Kestrel	1	On site	0	45	0	0	Hunting on site S of VP	JD
192	2	29/08/2023	14:56	Kestrel	1	On site	0	87	0	0	Hunting SW of VP	JD
193	3	29/08/2023	09:32	Kestrel	2	On site	14	0	0	0	Flushed from ground perch and flew W	JD
194	3	29/08/2023	11:14	Kestrel	1	On site	4	0	0	0	hunting	JD
195	3	29/08/2023	11:51	Kestrel	1	On site	10	0	0	0	hunting	JD
196	3	29/08/2023	13:54	Kestrel	1	On site	23	0	0	0	hunting	JD
198	4A	29/08/2023	10:11	Kestrel	1	Off site	20	0	0	0	Commuting	AD
199	4A	29/08/2023	10:30	Kestrel	1	Off site	0	360	0	0	Hunting	AD
200	4A	29/08/2023	11:04	Kestrel	1	On site	0	45	0	0	Hunting	AD
201	4A	29/08/2023	11:54	Kestrel	1	On site	10	0	0	0	Commuting	AD
202	4A	29/08/2023	12:36	Kestrel	1	On site	70	0	0	0	Hunting	AD
203	4A	29/08/2023	13:11	Kestrel	1	Off site	30	0	0	0	Hunting	AD
204	4A	29/08/2023	13:47	Kestrel	1	On site	25	0	0	0	Commuting	AD
205	4B	29/08/2023	09:34	Kestrel	2	Off site	6mins	0	0	0	Perched on trees flying and returning to tree	PR

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
206	4B	29/08/2023	09:59	Kestrel	2	Off site	42	0	0	0	Hovering second bird 0.5km further west briefly hovering	PR
208	4B	29/08/2023	10:27	Kestrel	1	Off site	95	0	0	0	Hovering	PR
210	4B	29/08/2023	11:01	Kestrel	1	Off site	170	0	0	0	Hovering	PR
211	4B	29/08/2023	11:54	Kestrel	2	Off site	206	0	0	0	Hovering	PR
212	4B	29/08/2023	12:14	Kestrel	1	Off site	540	0	0	0	Hovering	PR
213	4B	29/08/2023	12:57	Kestrel	1	Off site	148	0	0	0	Hovering	PR
214	4B	29/08/2023	13:03	Kestrel	2	Off site	200	0	0	0	Flying north second K. while viewing at number 2 one min later joined by another K at number 10 possibly 3 birds but not all seen together	PR
215	4B	29/08/2023	13:18	Kestrel	1	Off site	0	312	0	0	Flew low near BP then high and hovering landed briefly on moor close to site. K briefly at number2	PR
216	4B	29/08/2023	13:30	Kestrel	1	Off site	29	0	0	0	Gliding north	PR
217	4B	29/08/2023	13:51	Kestrel	1	Off site	70	0	0	0	Hovering	PR
218	4B	29/08/2023	13:56	Kestrel	1	Off site	0	48	0	0	Flying south hovering also	PR
219	4B	29/08/2023	14:06	Kestrel	1	Off site	540	0	0	0	Hovering mark had 4 K at VP5 same time	PR
220	4B	29/08/2023	14:32	Kestrel	1	Off site	420	0	0	0	Hovering went to ground briefly once	PR
221	5	25/08/2023	09:50	Kestrel	1	On site	30	0	0	0		MS
223	5	25/08/2023	11:03	Kestrel	1	On site	10	0	0	0		MS
224	5	25/08/2023	11:08	Kestrel	1	On site	0	150	0	0		MS
225	5	25/08/2023	11:10	Kestrel	1	On site	0	120	0	0		MS

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
226	5	25/08/2023	11:14	Kestrel	1	Off site	0	30	0	0		MS
227	5	25/08/2023	12:13	Kestrel	1	On site	60	0	0	0		MS
228	5	25/08/2023	12:30	Kestrel	1	On site	0	220	0	0		MS
229	5	25/08/2023	12:57	Kestrel	1	On site	25	0	0	0		MS
232	5	25/08/2023	14:05	Kestrel	1	Off site	0	10	0	0		MS
233	5	25/08/2023	14:15	Kestrel	1	On site	10	0	0	0		MS
234	5	25/08/2023	14:18	Kestrel	4	On site	40	0	0	0	Hunting over forest	MS
235	5	25/08/2023	14:20	Kestrel	1	On site	20	0	0	0		MS
236	1	07/10/2023	08:30	Kestrel	1	Off site	0	15	0	0	Hunting and heading N	MK
238	1	07/10/2023	10:31	Kestrel	1	Off site	20	0	0	0	Seen to the E of VP1 hunting	MK
239	1	07/10/2023	12:06	Kestrel	1	Off site	0	0	0	0	flying low and swift (10secs) before perching in conifer tree for 11mins and 22secs	MK
241	2	29/09/2023	08:32	Kestrel	1	On site	120	0	0	0	Perced on tree	PR
243	2	29/09/2023	09:00	Kestrel	1	On site	164	0	0	0	Hovering flying S	PR
245	2	29/09/2023	10:36	Kestrel	1	Off site	0	75	0	0	Hovering flying NW	PR
246	2	29/09/2023	10:42	Kestrel	3	Off site	0	390	0	0	Hovering one perched on tree stump also	PR
247	2	29/09/2023	11:00	Kestrel	1	Off site	0	300	0	0	Hovering	PR
249	2	29/09/2023	11:53	Kestrel	1	On site and Off site	0	900	0	0	Flew to telegraph perched 9mins hovering flew to ground	PR
250	2	29/09/2023	12:16	Kestrel	1	Off site	0	54	0	0	Hovering	PR

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
251	2	29/09/2023	13:26	Kestrel	1	Off site	0	40	0	0	Hovering	PR
257	3	28/09/2023	13:46	Kestrel	1	On site	10	0	0	0	Flying over site	AD
258	4A	28/09/2023	08:23	Kestrel	1	On site	30	0	0	0	Hunting close to E most turbine	JD
262	4A	28/09/2023	09:17	Kestrel	1	On site	179	0	0	0	Hunting on bog heath on hillside opp VP	JD
264	4A	28/09/2023	10:37	Kestrel	1	Off site	0	53	0	0	Hunting/flying in valley moving N	JD
265	4A	28/09/2023	11:35	Kestrel	1	Off site	0	50	0	0	Hunting between VP4A AND VP4B	JD
267	4A	28/09/2023	12:00	Kestrel	1	On site	45	0	0	0	Flying around bog near 4A moved across valley over bog landed hunting on site	JD
272	4B	28/09/2023	08:45	Kestrel	1	On site	20	0	0	0		MS
275	4B	28/09/2023	09:21	Kestrel	1	On site	30	0	0	0		MS
278	4B	28/09/2023	10:38	Kestrel	1	On site	15	0	0	0		MS
279	4B	28/09/2023	10:40	Kestrel	1	Off site	20	0	0	0		MS
285	5	28/09/2023	11:27	Kestrel	1	Off site	134	0	0	0		NL
286	5	28/09/2023	11:35	Kestrel	1	Off site	206	0	0	0	Hunting	NL

Table 7 - 4 - 7-2 Kestrel Vantage Point Survey data 2024 (MKO)

Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
K.001	VP1	29/01/2024	12:15	Kestrel	1	5400	2700	2700	0	0	0	bogs and conifer plantation; hunting, soaring, hunting for over 1h30, in and out of the viewshed, was still hunting over clearfell and bog area when I left	TK
K.002	VP3	31/01/2024	10:17	Kestrel	1	420	0	0	420	0	0	conifer plantation and bogs; hunting, soaring, foraging over clearfelled areas	TK

Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
K.003	VP3	31/01/2024	11:34	Kestrel	1	1980	0	990	990	0	0	conifer plantation and bogs; hunting, hovering, foraging for 33 minutes until got out of the viewshed behind trees	TK
K.004	VP1	22/03/2024	08:17	Kestrel	1	60	60	0	0	0	0	improved agricultural grassland; flying	EC
K.005	VP1	22/03/2024	09:31	Kestrel	1	60	0	60	0	0	0	improved agricultural grassland; flying	EC
K.006	VP1	22/03/2024	10:20	Kestrel	1	600	300	300	0	0	0	improved agricultural grassland; flying, hovering	EC
K.007	VP1	22/03/2024	11:22	Kestrel	1	600	300	300	0	0	0	upland blanket bog and improved agricultural grassland; flying, hovering	EC
K.008	VP1	22/03/2024	12:00	Kestrel	1	60	0	60	0	0	0	improved agricultural grassland; flying, mobbed by hooded crow	EC
K.009	VP1	16/04/2024	15:25	Kestrel	1	60	0	60	0	0	0	upland blanket bog; flying, hovering	EC
K.010	VP1	16/04/2024	16:50	Kestrel	1	60	0	60	0	0	0	upland blanket bog; flying, hovering	EC
K.011	VP1	16/04/2024	20:16	Kestrel	1	600	0	600	0	0	0	upland blanket bog; flying, hovering	EC
K.012	VP1	16/04/2024	21:18	Kestrel	1	30	30	0	0	0	0	improved agricultural grassland and upland blanket bog; flying	EC
K.013	VP2	17/04/2024	20:38	Kestrel	1	30	30	0	0	0	0	upland blanket bog and conifer plantation; flying	EC
K.014	VP3	10/05/2024	07:00	Kestrel	1	30	30	0	0	0	0	conifer plantation; flying	EC
K.015	VP4	03/07/2024	15:17	Kestrel	1	149	49	100	0	0	0	bogs and highly modified/non-native woodland; hunting	CR
K.016	VP1	05/07/2024	12:36	Kestrel	1	30	0	0	30	0	0	improved agricultural grassland and conifer plantation; flying, hovering	EC
K.017	VP1	27/08/2024	12:48	Kestrel	1	120	0	0	120	0	0	upland blanket bog, improved agricultural grassland and conifer plantation; flying, hovering	EC
K.018	VP1	27/08/2024	13:46	Kestrel	1	30	0	0	30	0	0	conifer plantation and improved agricultural grassland; flying	EC
K.019	VP1	27/08/2024	14:20	Kestrel	2	120	0	120	0	0	0	upland blanket bog, improved agricultural grassland and conifer plantation; flying, hovering	EC

Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
K.020	VP1	27/08/2024	14:29	Kestrel	1	60	60	0	0	0	0	improved agricultural grassland; flying, mobbed by corvids	EC
K.021	VP4	28/08/2024	09:05	Kestrel	1	60	0	60	0	0	0	upland blanket bog and conifer plantation; flying, hovering	EC
K.022	VP4	28/08/2024	13:55	Kestrel	1	30	0	0	30	0	0	upland blanket bog and conifer plantation; flying, hovering	EC
K.023	VP2	04/09/2024	09:47	Kestrel	1	56	30	23	0	0	0	bogs; hunting	CR
K.024	VP2	04/09/2024	11:10	Kestrel	1	100	0	0	23	77	0	bogs; hunting	CR
K.025	VP2	04/09/2024	11:41	Kestrel	1	199	0	24	30	145	0	bogs and conifer plantation; hunting	CR
K.026	VP1	10/09/2024	08:29	Kestrel	1	30	30	0	0	0	0	improved agricultural grassland; flying	EC
K.027	VP3	17/09/2024	10:15	Kestrel	1	120	120	0	0	0	0	conifer plantation; flying	EC

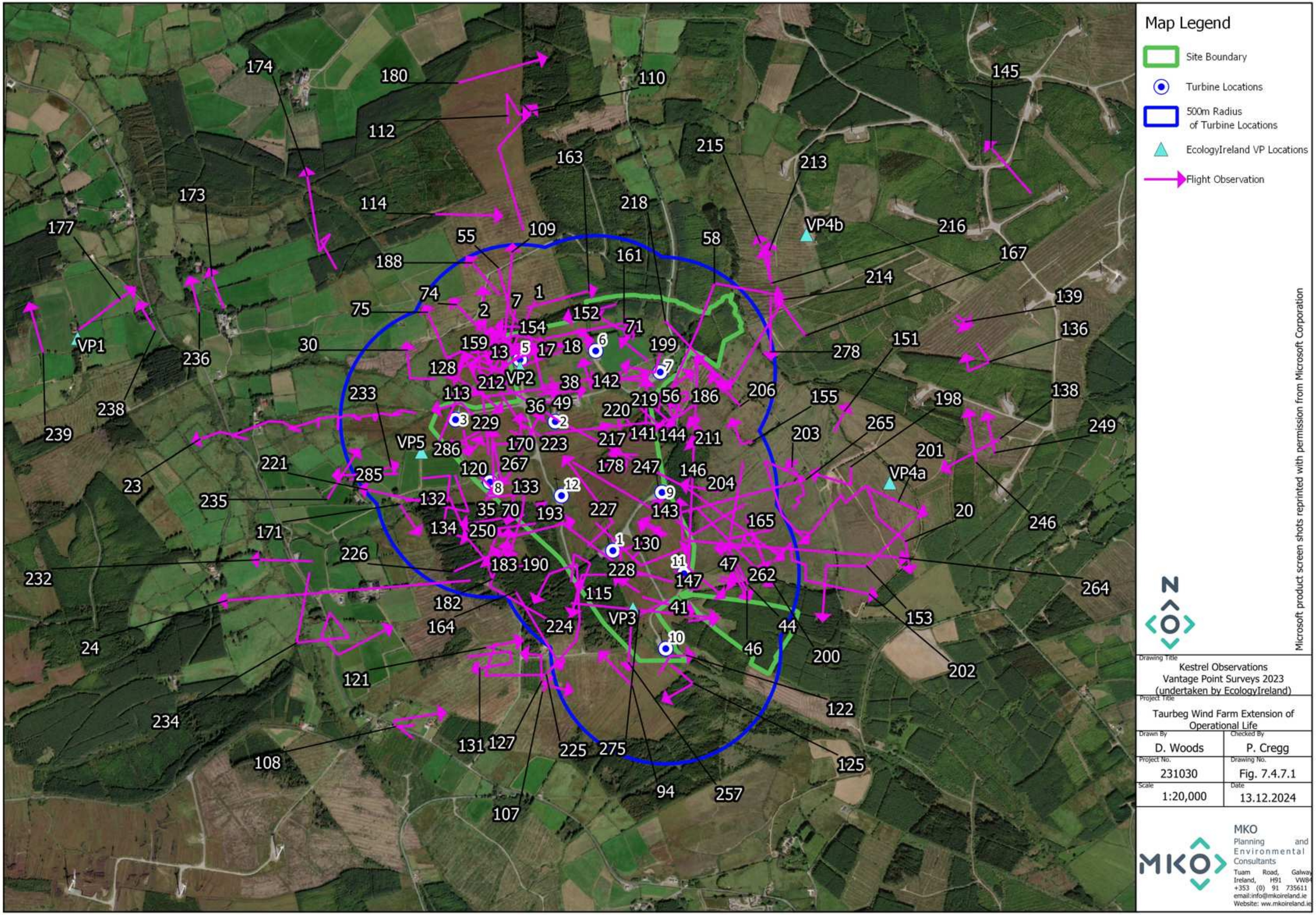
Table 7 - 4 - 7-3 Kestrel Breeding Raptor Survey data 2024 (MKO)

Ref.	BR	Date	Time	Species	Number	Habitat and activity	Breeding status	Surveyor
K.001	BR3	26/04/2024	10:23	Kestrel	1	conifer plantation, flying, hovering	suitable nesting habitat; possible breeder	CMC
K.002	BRT3	23/05/2024	11:53	Kestrel	1	improved agricultural grassland and conifer plantation, flying, hovering	suitable nesting habitat; possible breeder	EC
K.003	BRT1	30/05/2024	10:12	Kestrel	1	upland blanket bog, flying, hovering	adult carrying food/faecal sac; confirmed breeding	EC
K.004	BR3	11/06/2024	13:28	Kestrel	1	upland blanket bog, flying	suitable nesting habitat; possible breeder	EC
K.005	BRT1	25/06/2024	10:41	Kestrel	1	upland blanket bog, flying, hovering	adult carrying food/faecal sac; confirmed breeding	EC
K.006	BR2	25/06/2024	12:36	Kestrel	1	upland blanket bog, flying	adult carrying food/faecal sac; confirmed breeding	EC
K.007	BR2	25/06/2024	12:37	Kestrel	1	upland blanket bog, flying	suitable nesting habitat; possible breeder	EC
K.008	BRT2	26/06/2024	13:50	Kestrel	1	conifer plantation and upland blanket bog, flying	suitable nesting habitat; possible breeder	EC
K.009	BRT3	04/07/2024	09:57	Kestrel	1	conifer plantation, improved agricultural grassland and upland blanket bog, flying	suitable nesting habitat; possible breeder	EC

Ref.	BR	Date	Time	Species	Number	Habitat and activity	Breeding status	Surveyor
K.010	BR5	04/07/2024	11:12	Kestrel	1	conifer plantation and improved agricultural grassland, flying, hovering	suitable nesting habitat; possible breeder	EC
K.011	BR5	04/07/2024	13:44	Kestrel	1	conifer plantation, flying, hovering	suitable nesting habitat; possible breeder	EC

Table 7 - 4 - 7-4 Kestrel Incidental Records (MKO)

Ref.	Location	Date	Time	Species	Number	Habitat and activity	Surveyor
K.001	Breeding Walkover Survey; Taurbeg	25/07/2024	09:45	Kestrel	1	bogs and buildings and artificial surfaces; flying, hunting, observed while driving through the site	CMC



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Drawing Title
Kestrel Observations
Vantage Point Surveys 2023
(undertaken by EcologyIreland)

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.7.1
Scale 1:20,000	Date 13.12.2024

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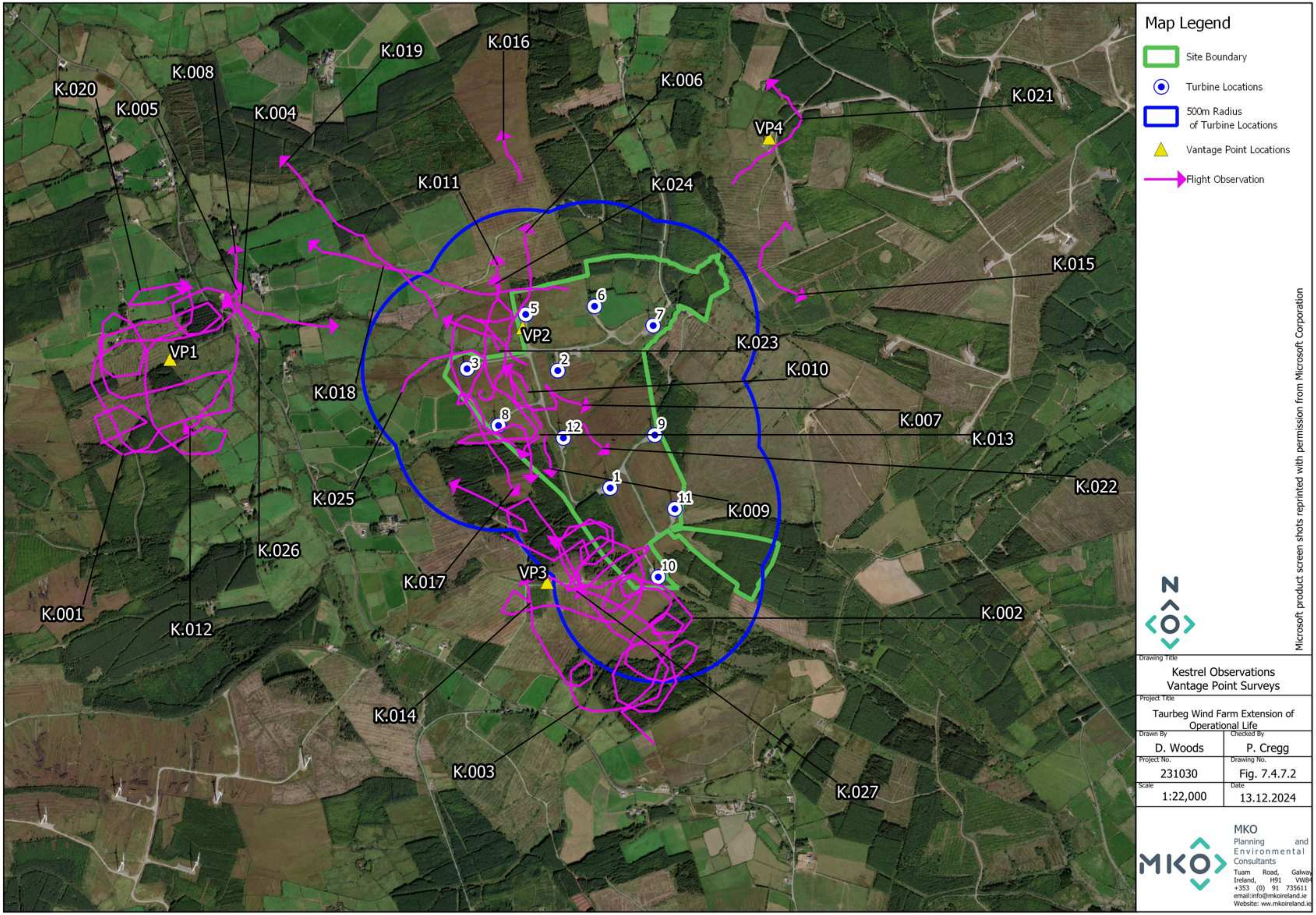

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Drawing Title Kestrel Observations Vantage Point Surveys	
Project Title Taurbeg Wind Farm Extension of Operational Life	
Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.7.2
Scale 1:22,000	Date 13.12.2024

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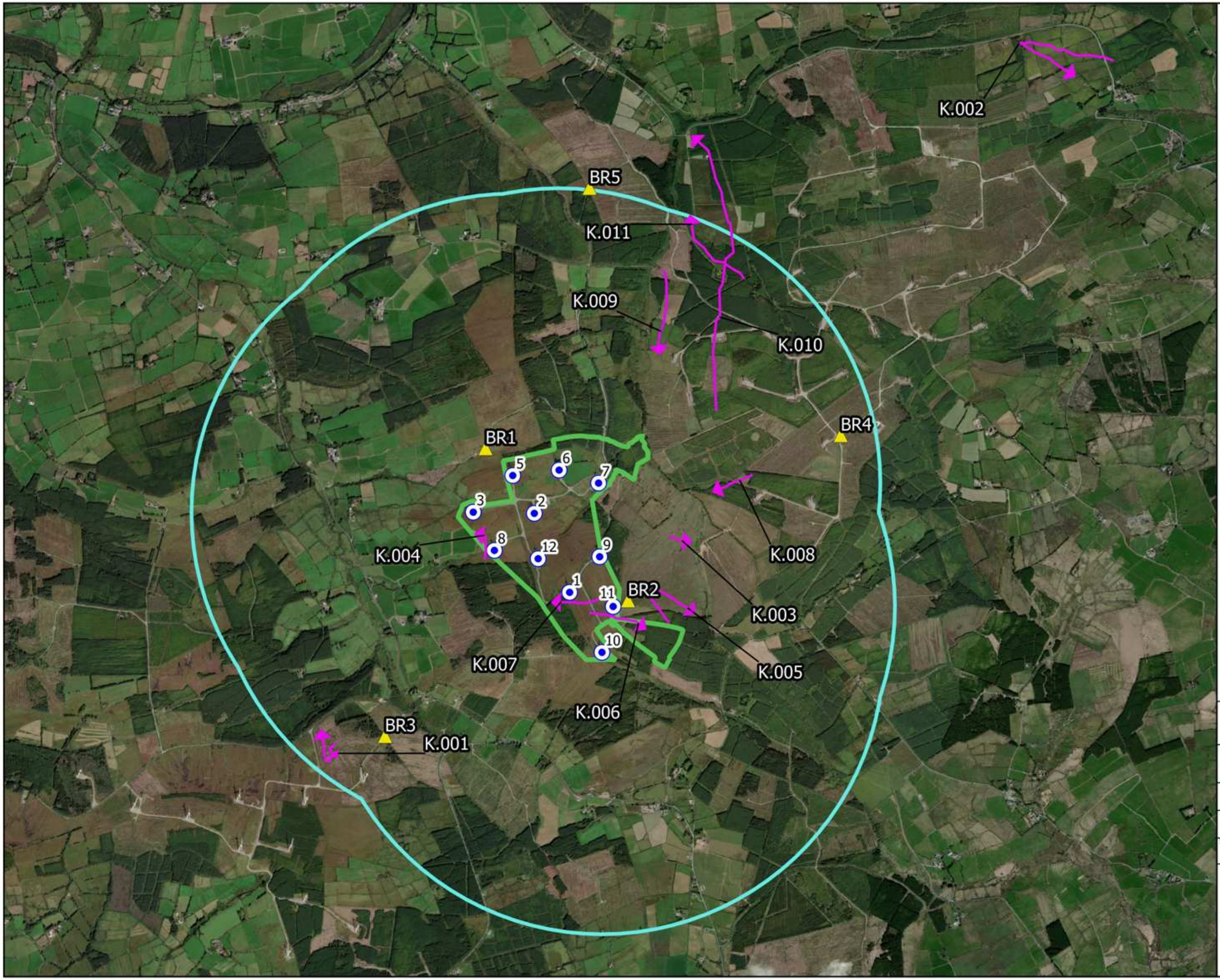

Map Legend

🟩 Site Boundary

● Turbine Locations

🟦 2km Turbine Radius

▲ Survey Locations

→ Observation

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Drawing Title
Kestrel Observations
Breeding Raptor Surveys

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By	Checked By
D. Woods	P. Cregg
Project No.	Drawing No.
231030	Fig. 7.4.7.3
Scale	Date
1:35,000	13.12.2024

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Drawing Title

Kestrel
Incidental Records

Project Title

Taurbeg Wind Farm Extension of Operational Life

Drawn By	Checked By
D. Woods	P. Cregg
Project No.	**Drawing No.**
231030	Fig. 7.4.7.4
Scale	**Date**
1:16,000	13.12.2024

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8. RED GROUSE

Table 7 - 4 - 8-1 Red Grouse Vantage Point Survey data 2023 (Ecology Ireland)

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
19	4a	27/04/2023	12:45	Red Grouse	1	On site	10	0	0	0	Flew up from bog	MS
22	4b	27/04/2023	13:04	Red Grouse	2	On site	4	0	0	0	Landed in heather out of view	AD
197	4A	29/08/2023	09:13	Red Grouse	1	Off site	3	0	0	0	Flushed from bog close to VP4A	AD

Table 7 - 4 - 8-2 Red Grouse Vantage Point Survey data 2024 (MKO)

Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
RG001	VP2	28/11/2023	07:47	Red Grouse	2	60	0	60	0	0	0	upland blanket bog; walking near turbine, then flew, called several times	EC
RG002	VP3	30/04/2024	16:25	Red Grouse	2	30	30	0	0	0	0	upland blanket bog and conifer plantation; flying, calling	EC
RG003	VP3	30/04/2024	20:27	Red Grouse	1	-	-	-	-	-	-	upland blanket bog and conifer plantation; calling, heard calling several times during a 10 minute period	EC
RG004	VP3	10/05/2024	06:33	Red Grouse	1	-	-	-	-	-	-	upland blanket bog and conifer plantation; calling, heard calling on several occasions	EC
RG005	VP3	10/05/2024	07:17	Red Grouse	1	-	-	-	-	-	-	upland blanket bog and conifer plantation; calling, heard on several occasions	EC
RG006	VP3	10/05/2024	08:48	Red Grouse	1	-	-	-	-	-	-	upland blanket bog and conifer plantation; calling	EC
RG007	VP3	10/05/2024	10:41	Red Grouse	1	-	-	-	-	-	-	upland blanket bog; calling	EC
RG008	VP2	04/09/2024	08:52	Red Grouse	1	-	-	-	-	-	-	bogs; calling, calling for 20 minutes.	CR
RG009	VP2	04/09/2024	10:54	Red Grouse	3	7	7	0	0	0	0	bogs; flying, calling	CR

Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
RG010	VP2	04/09/2024	11:00	Red Grouse	1	10	10	0	0	0	0	bogs; flying	CR

Table 7 - 4 - 8-3 Red Grouse Breeding Red Grouse Survey data 2024 (MKO)

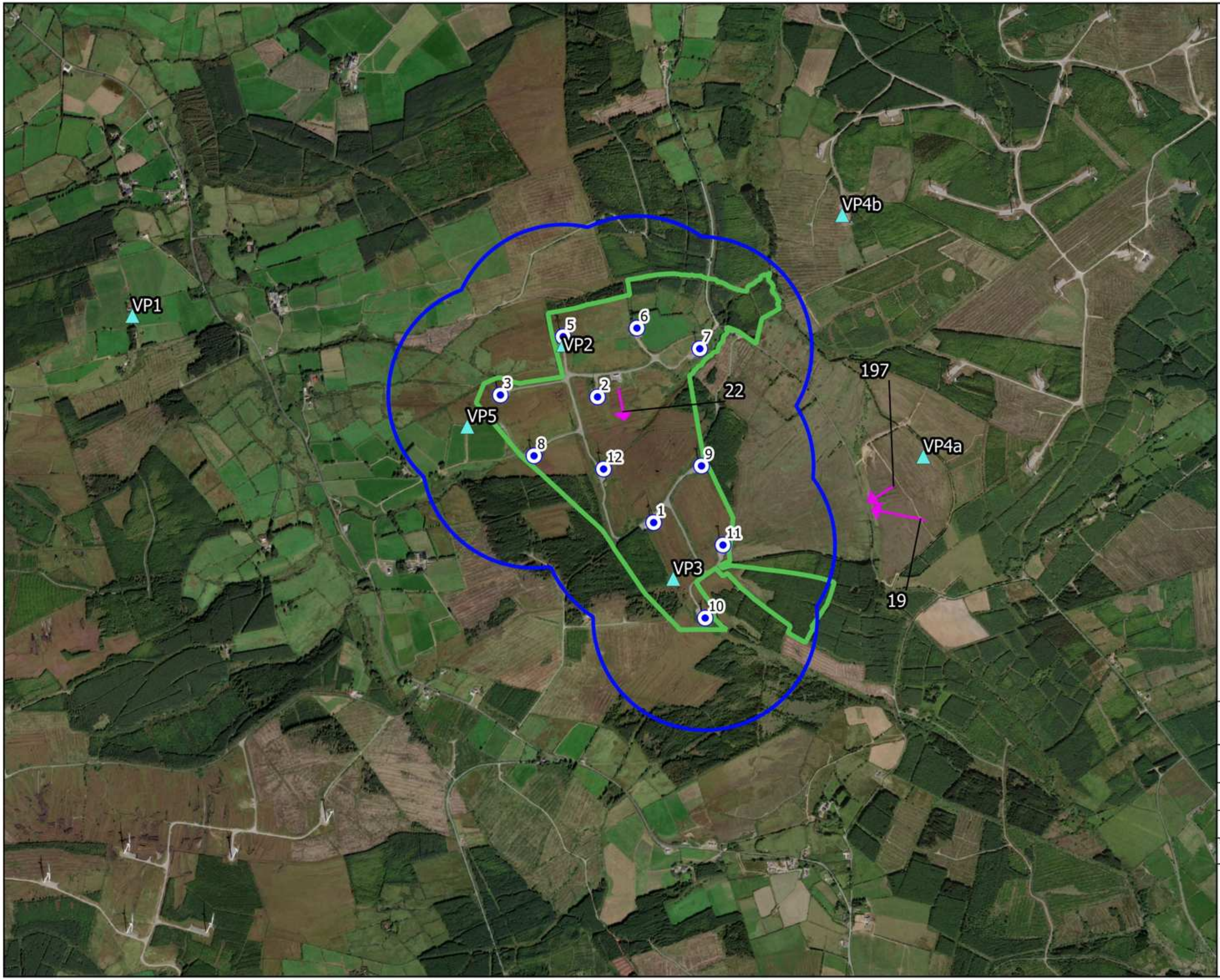
Ref.	Transect	Date	Time	Species	Number	Habitat and activity	Surveyor
RG001	T1	07/02/2024	11:10	Red Grouse	1	bogs, flushed, male, no calls	CMC
RG002	T1	07/02/2024	11:28	Red Grouse	1	bogs, flying, after playing the tape, no call back	CMC
RG003	T1	07/02/2024	11:33	Red Grouse	1	bogs, flushed, no calls	CMC
RG004	T2	07/02/2024	12:15	Red Grouse	1	bogs, flushed, calling	CMC

Table 7 - 4 - 8-4 Red Grouse Winter Walkover Survey data 2024 (MKO)

Ref.	Date	Time	Transect	Species	Number	Habitat and activity	Surveyor
RG001	14/12/2023	11:08	-	Red Grouse	1	buildings and artificial surfaces; droppings, fresh dropping on the windfarm road - photos taken (wintering)	CMC

Table 7 - 4 - 8-5 Red Grouse Incidental Records (MKO)

Ref.	Location	Date	Time	Species	Number	Habitat and activity	Surveyor
RG001	Vantage Point Survey; VP2	30/11/2023	08:00	Red Grouse	1	bogs and conifer plantation; flying, went to check out noise/call	TK
RG002	Hen Harrier Roost Survey; HHVP3	18/12/2023	15:15	Red Grouse	2	upland blanket bog; flying, calling	EC
RG003	Breeding Raptor Survey; Taurbeg	16/04/2024	10:21	Red Grouse	1	upland blanket bog; calling, not seen	CMC



Map Legend

- 🟩 Site Boundary
- ● Turbine Locations
- 🟦 500m Radius of Turbine Locations
- ▲ EcologyIreland VP Locations
- → Flight Observation

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Drawing Title
Red Grouse Observations
Vantage Point Surveys 2023
(undertaken by EcologyIreland)

Project Title
Taurbeg Wind Farm Extension of
Operational Life

Drawn By	Checked By
D. Woods	P. Cregg
Project No.	**Drawing No.**
231030	Fig. 7.4.8.1
Scale	**Date**
1:22,000	13.12.2024

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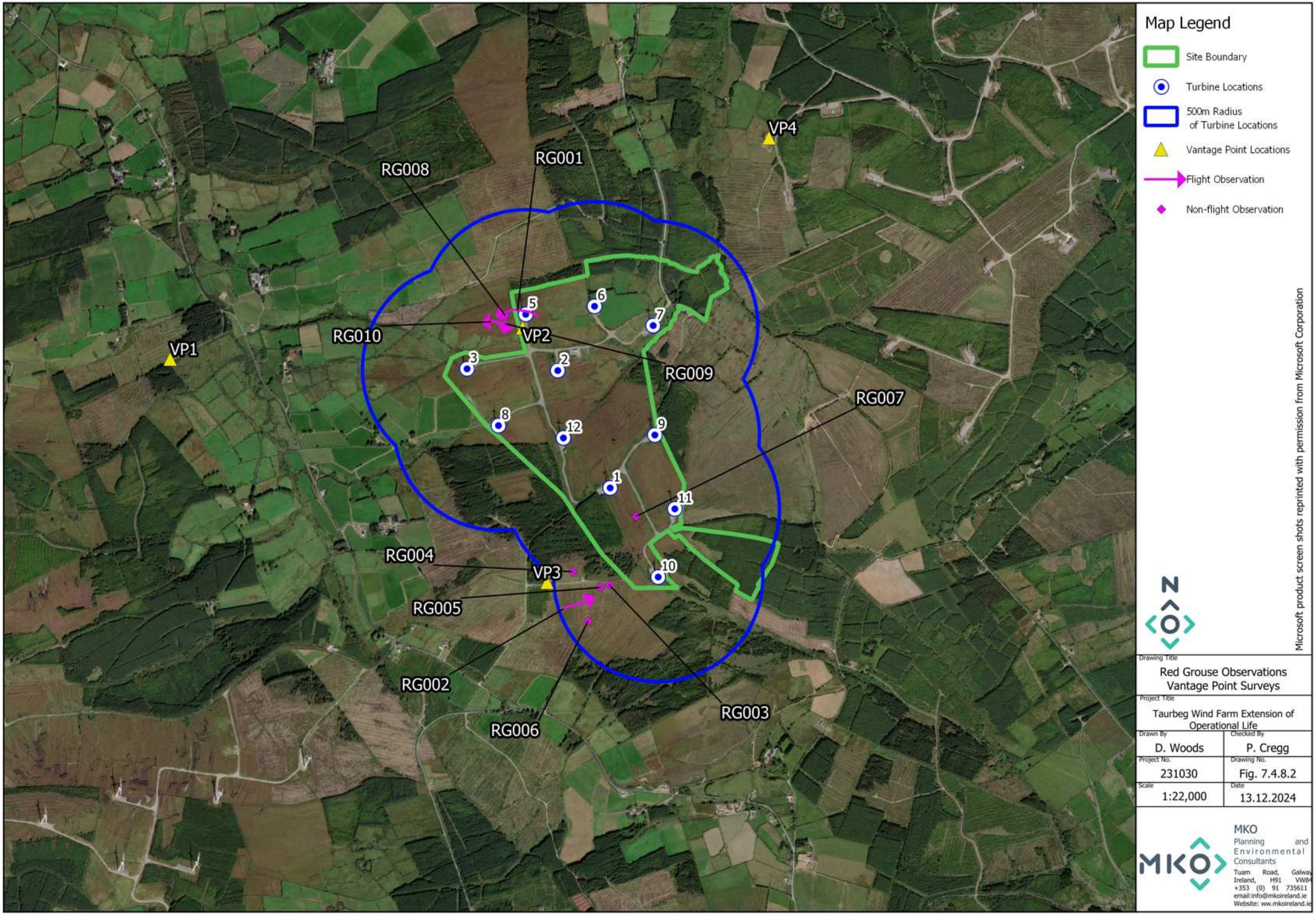

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Drawing Title
Red Grouse Observations Vantage Point Surveys

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By
D. Woods

Checked By
P. Cregg

Project No.
231030

Drawing No.
Fig. 7.4.8.2

Scale
1:22,000

Date
13.12.2024

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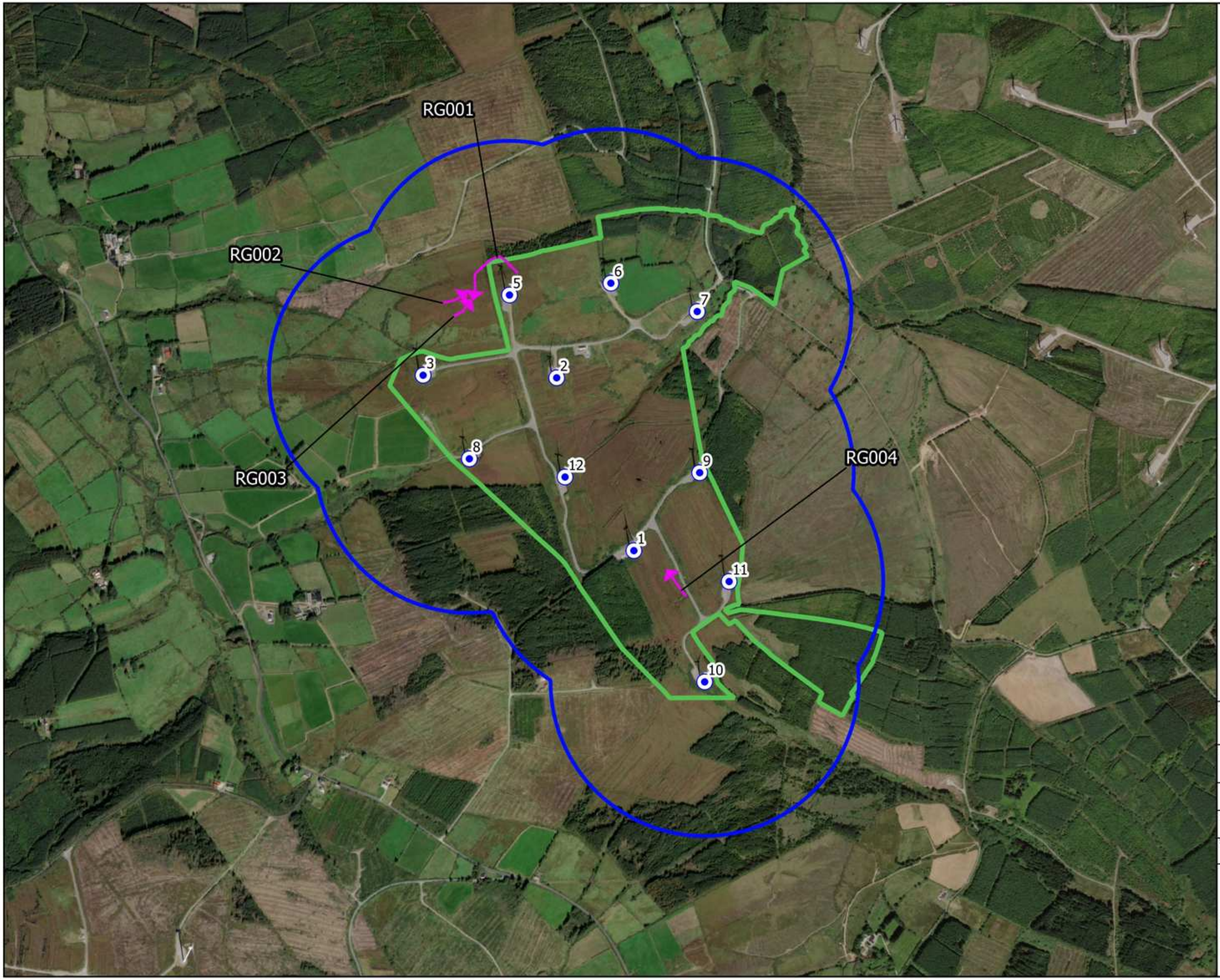

Map Legend

🟩 Site Boundary
◉ Turbine Locations
🟦 500m Radius of Turbine Locations
→ Observation

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Drawing Title
Red Grouse Observations
Breeding Red Grouse Surveys

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.8.3
Scale 1:16,000	Date 13.12.2024

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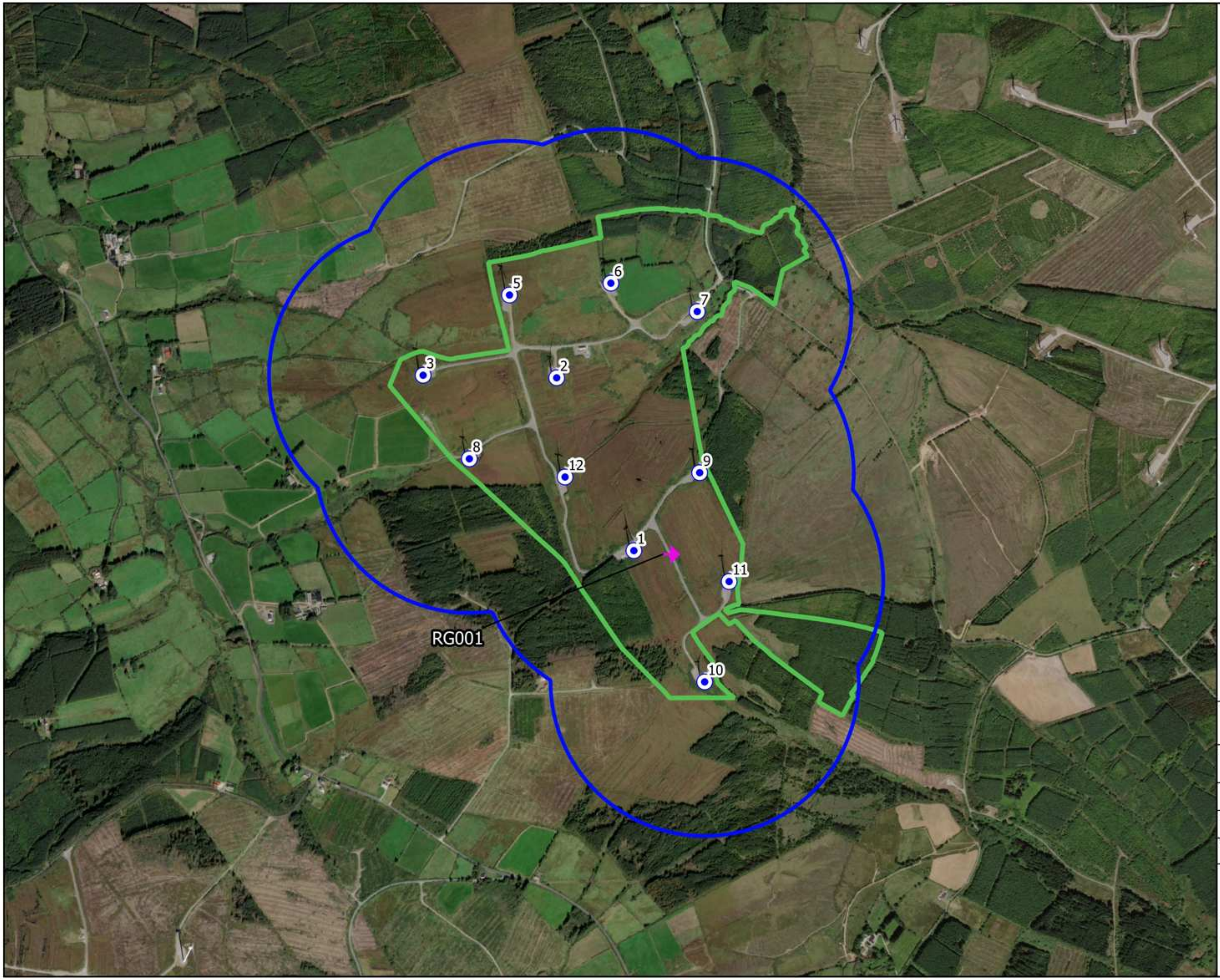

Map Legend

🟩 Site Boundary

⦿ Turbine Locations

🟦 500m Radius of Turbine Locations

→ Observation

N

Drawing Title
Red Grouse Observations Winter Walkover Surveys

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.8.4
Scale 1:16,000	Date 13.12.2024

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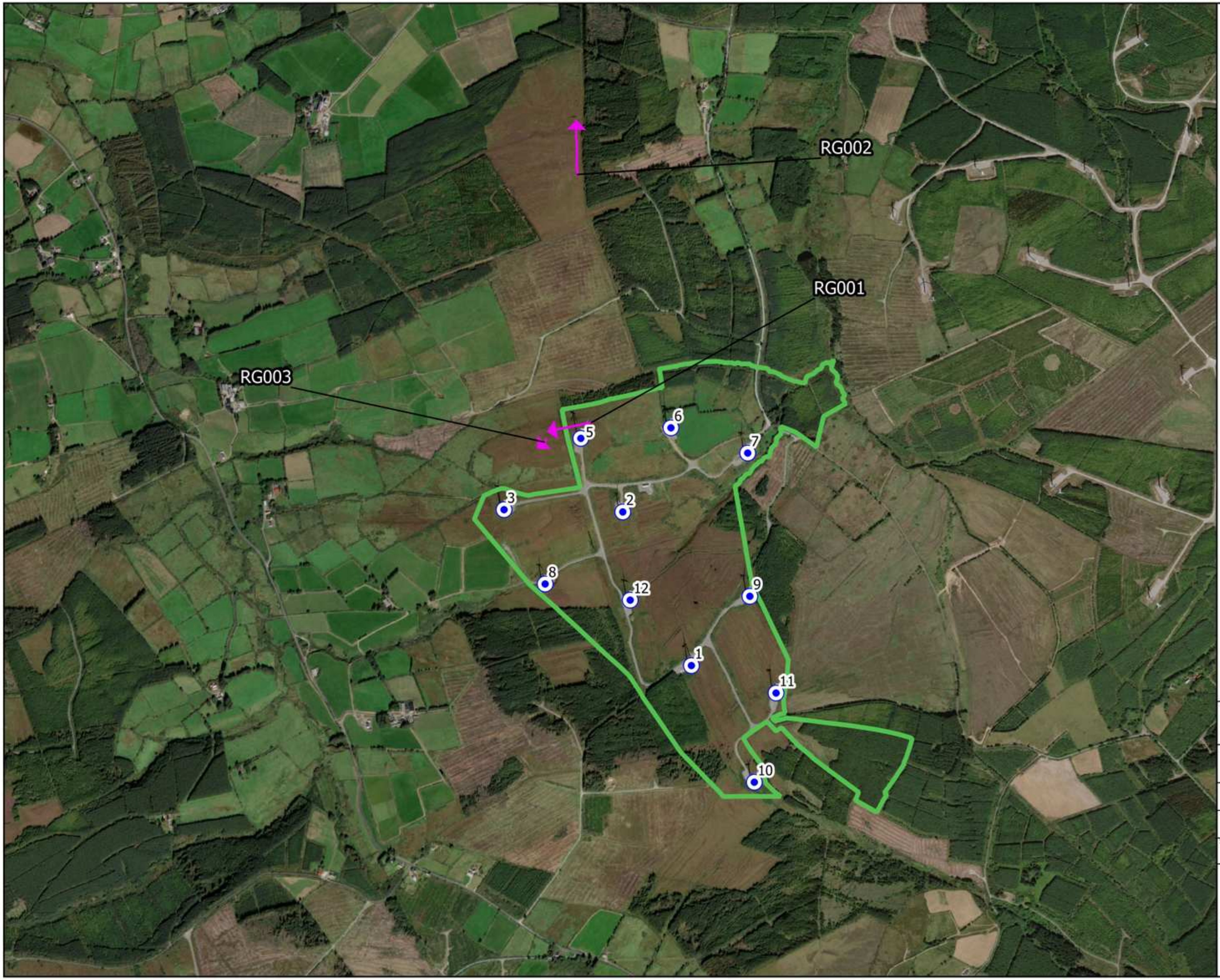

Map Legend

🟩 Site Boundary

● Turbine Locations

→ Observation

N

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Drawing Title	Red Grouse Incidental Records
Project Title	Taurbeg Wind Farm Extension of Operational Life
Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.8.5
Scale 1:18,000	Date 13.12.2024

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9. SNIPE

Table 7 - 4 - 9-1 Snipe Vantage Point Survey data 2024 (MKO)

Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
SN001	VP1	05/12/2023	13:42	Snipe	2	30	0	0	30	0	0	improved agricultural grassland and upland blanket bog; flying	EC

Table 7 - 4 - 9-2 Snipe Breeding Walkover Survey data 2024 (MKO)

Ref.	Date	Time	Transect	Species	Number	Habitat and activity	Surveyor
SN001	04/04/2024	14:53	T2	Snipe	1	bogs and wet grassland; calling, heard, not seen (suitable nesting habitat; possible breeder)	TK
SN002	04/04/2024	15:00	T2	Snipe	2	bogs and wet grassland; flushed, flying, the second one flushed 2 minutes after the first, roughly same spot (pair; probable breeding)	TK
SN003	04/04/2024	15:33	T3	Snipe	1	bogs and wet grassland; flushed, calling (suitable nesting habitat; possible breeder)	TK
SN004	04/04/2024	15:53	T3	Snipe	2	bogs; flushed, pair (pair; probable breeding)	TK
SN005	08/04/2024	16:06	T5	Snipe	2	bogs; roosting, flushed (pair; probable breeding)	TK

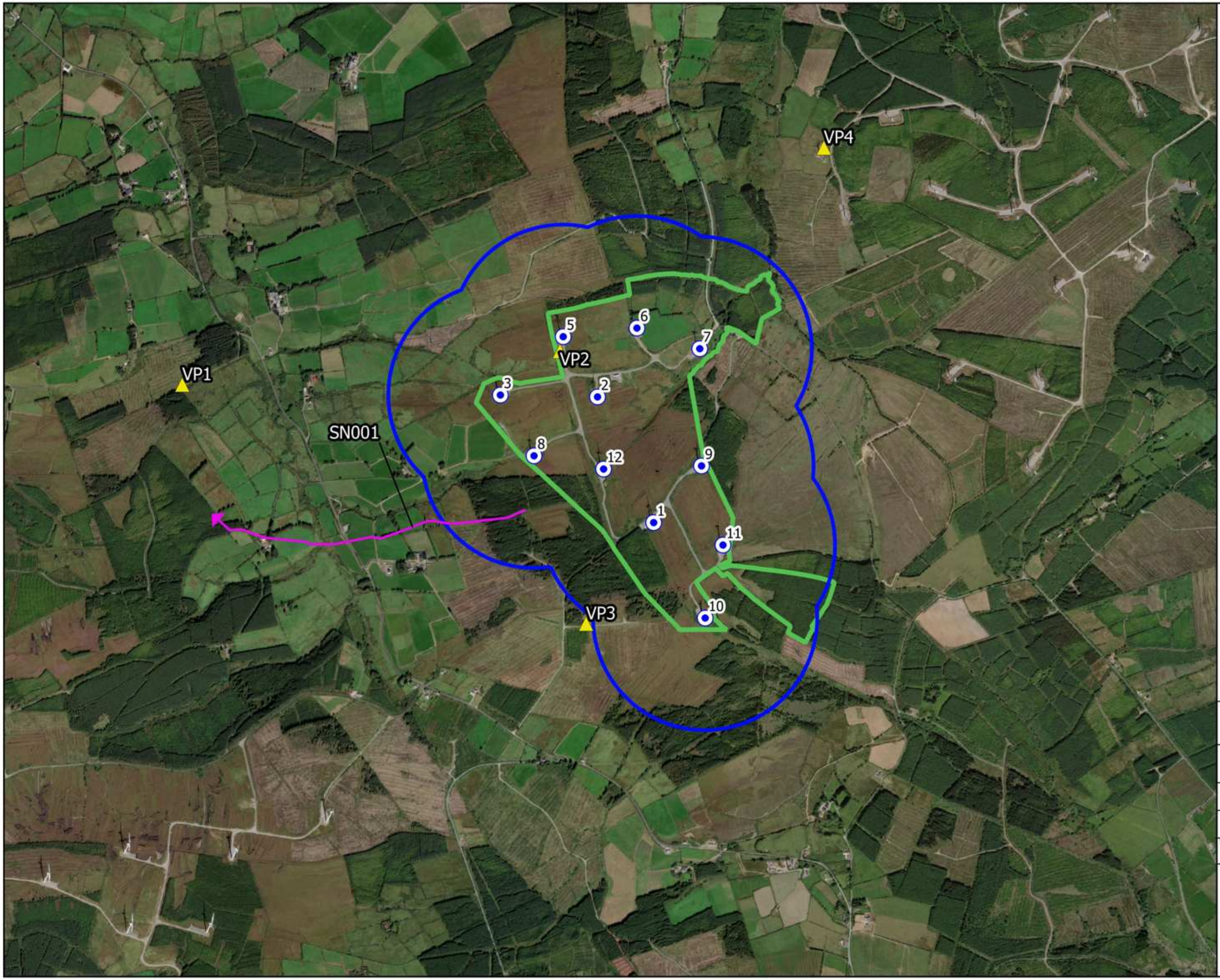
Table 7 - 4 - 9-3 Snipe Winter Walkover Survey data 2024 (MKO)

Ref.	Date	Time	Transect	Species	Number	Habitat and activity	Surveyor
SN001	24/01/2024	11:23	T2	Snipe	1	bogs; flushed (wintering)	CMC
SN002	28/02/2024	12:33	T3	Snipe	1	bogs; flushed (wintering)	CMC
SN003	28/02/2024	12:34	T2	Snipe	1	bogs; flushed (wintering)	CMC

Table 7 - 4 - 9-4 Snipe Incidental Records (MKO)

Ref.	Location	Date	Time	Species	Number	Habitat and activity	Surveyor
SN001	Hen Harrier Roost Survey; HHVP3 parking spot	29/11/2023	15:32	Snipe	2	buildings and artificial surfaces; flushed, at the side of the road, flew away when surveyor got out of the van.	CMC
SN002	Breeding Red Grouse Survey; Taurbeg	07/02/2024	11:05	Snipe	1	bogs; flushed	CMC

Ref.	Location	Date	Time	Species	Number	Habitat and activity	Surveyor
SN003	Breeding Red Grouse Survey; Taurbeg	07/02/2024	16:17	Snipe	1	bogs; flushed	CMC
SN004	Vantage Point Survey; Taurbeg	21/02/2024	18:59	Snipe	1	bogs; flushed, flushed from the road as surveyor was driving out	CMC



Drawing Title
Snipe Observations
Vantage Point Surveys

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.9.1
Scale 1:22,000	Date 13.12.2024

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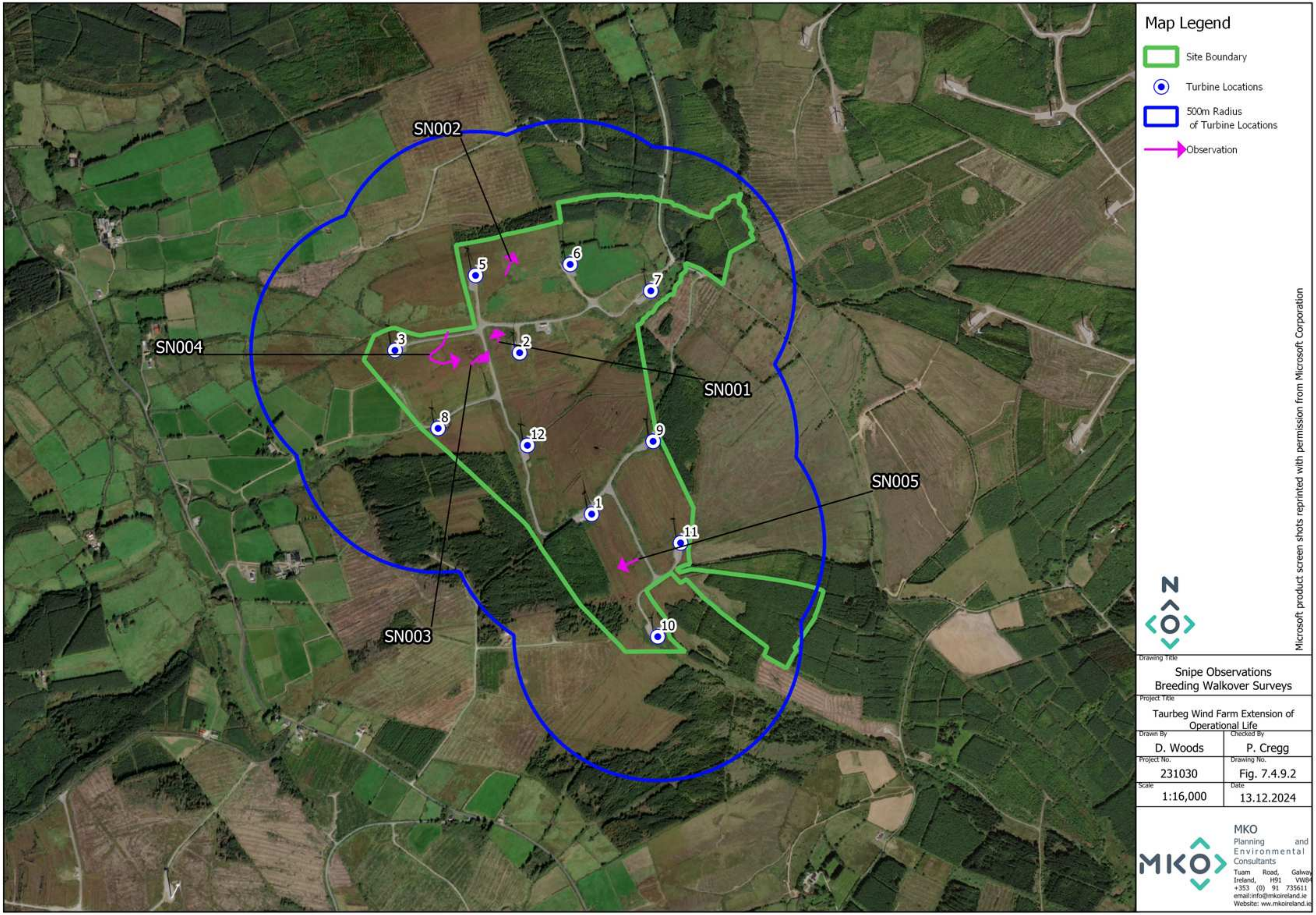

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Drawing Title
Snipe Observations
Breeding Walkover Surveys

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.9.2
Scale 1:16,000	Date 13.12.2024

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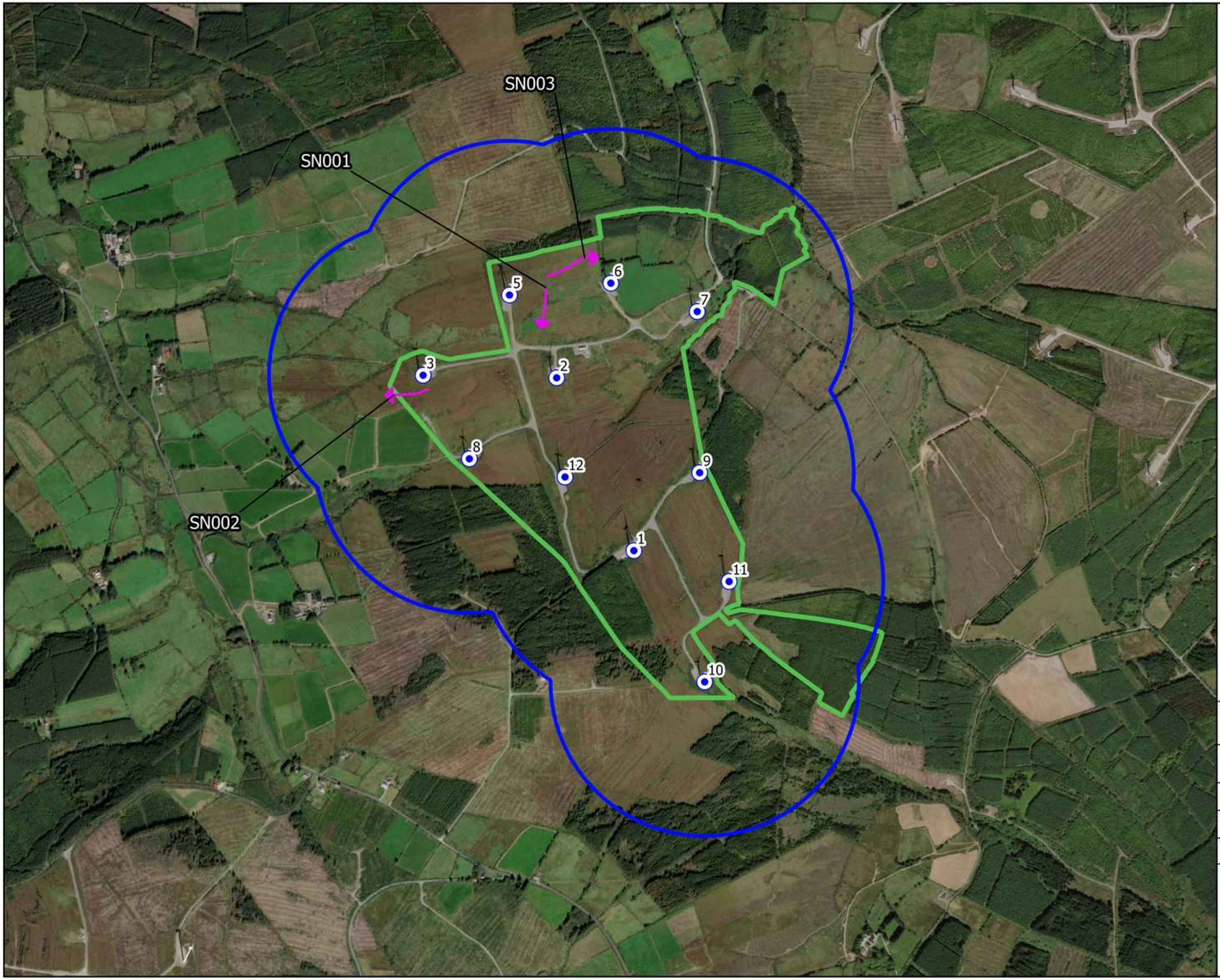

Map Legend

🟩 Site Boundary

● Turbine Locations

🟦 500m Radius of Turbine Locations

→ Observation

Drawing Title
Snipe Observations
Winter Walkover Surveys

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.9.3
Scale 1:16,000	Date 13.12.2024

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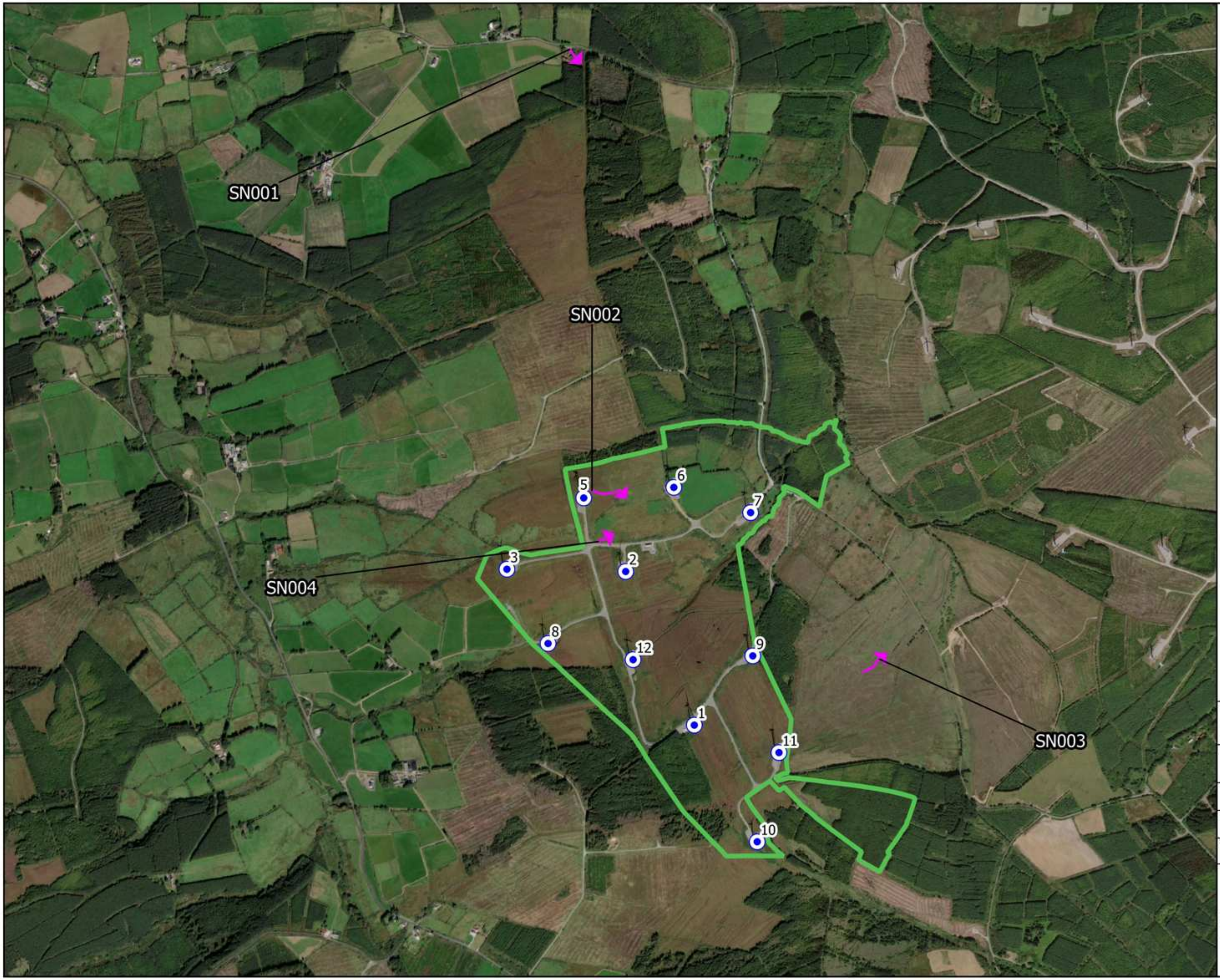

Map Legend

🟩 Site Boundary

● Turbine Locations

→ Observation

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Drawing Title

Snipe
Incidental Records

Project Title

Taurbeg Wind Farm Extension of Operational Life

Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.9.4
Scale 1:18,000	Date 13.12.2024

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10. WOODCOCK

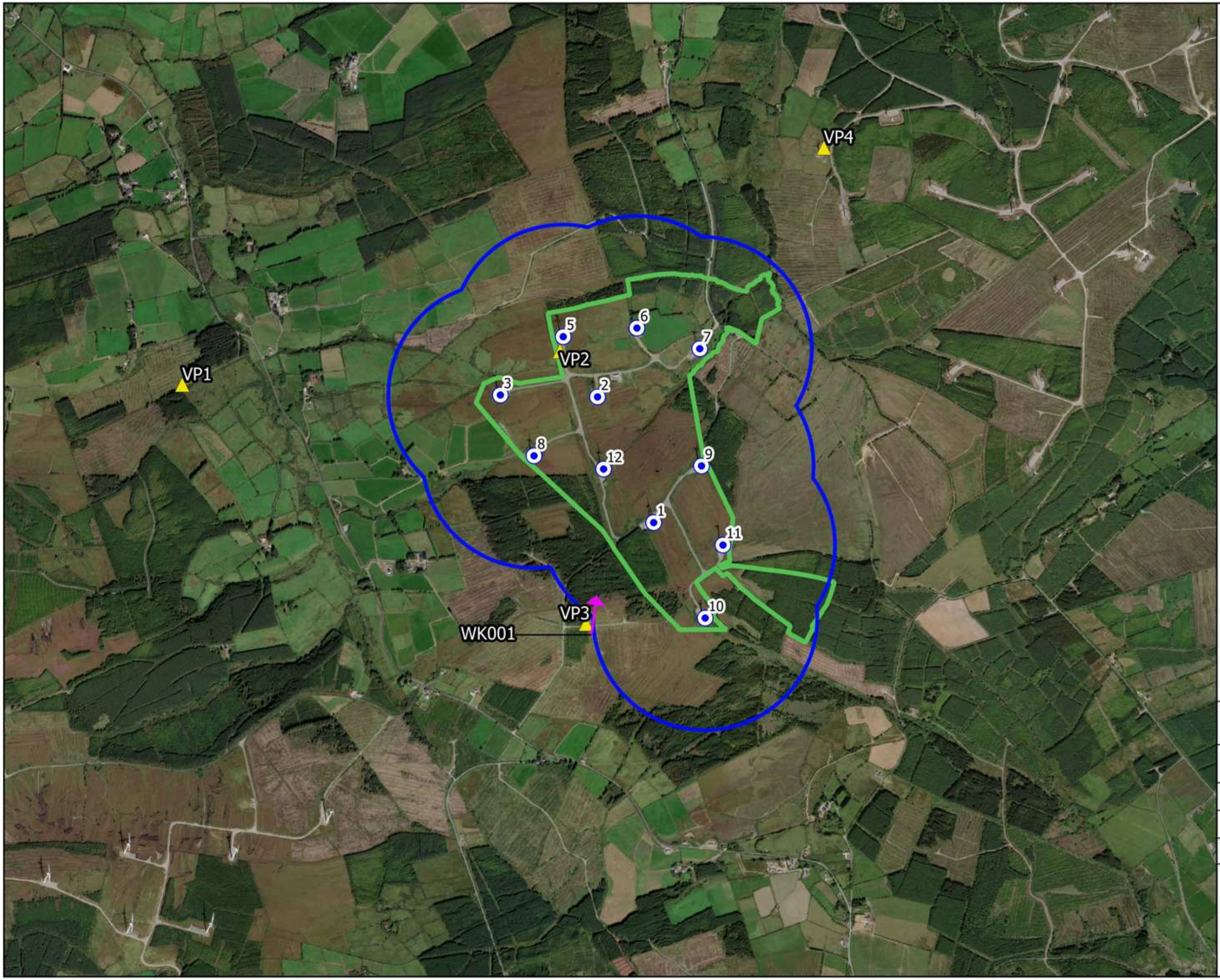
Table 7 - 4 - 10-1 Woodcock Vantage Point Survey data 2024 (MKO)

Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
WK001	VP3	05/03/2024	18:45	Woodcock	1	5	5	0	0	0	0	conifer plantation; flying	CMC

Table 7 - 4 - 10-2 Woodcock Incidental Records (MKO)

Ref.	Location	Date	Time	Species	Number	Habitat and activity	Surveyor
WK001	Vantage Point Survey; Taurbeg	21/02/2024	19:00	Woodcock	1	buildings and artificial surfaces; flushed, bird was sitting on road outside wind farm gate	CMC
WK002	Vantage Point Survey; Knockacummer	06/03/2024	06:00	Woodcock	1	buildings and artificial surfaces and conifer plantation; flushed	CMC

Note: There were no observations during the dedicated Breeding Woodcock Surveys.



Map Legend

🟩 Site Boundary

● Turbine Locations

▭ 500m Radius of Turbine Locations

▲ Vantage Point Locations

→ Flight Observation

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Drawing Title Woodcock Observations Vantage Point Surveys	
Project Title Taurbeg Wind Farm Extension of Operational Life	
Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.10.1
Scale 1:22,000	Date 13.12.2024

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Drawing Title Woodcock Incidental Records	
Project Title Taurbeg Wind Farm Extension of Operational Life	
Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.10.2
Scale 1:20,000	Date 13.12.2024

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11. BUZZARD

Table 7 - 4 - 11-1 Buzzard Vantage Point Survey Data 2023 (EcologyIreland)

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
25	5	28/04/2023	10:21	Buzzard	1	On site	0	900	0	0	Circling soaring hovering around small area.	NL
33	2	26/05/2023	10:00	Buzzard	1	On site	0	240	0	0	Fly over	AD
34	2	26/05/2023	10:24	Buzzard	1	On site	0	50	0	0	Fly over	AD
37	3	26/05/2023	10:00	Buzzard	2	On site	0	0	0	0	Flew west then returned in easterly direction	PR
42	3	26/05/2023	11:30	Buzzard	1	Off site	0	660	0	0	Mobbed by Kestrel for 2mins. Kestrel was off site.	PR
43	3	26/05/2023	11:47	Buzzard	1	Off site	0	275	0	0	Mobbed by 2 Kestrel off site.	PR
45	3	26/05/2023	14:16	Buzzard	1	Off site	0	38	0	0	Flying SE	PR
50	4A	25/05/2023	11:24	Buzzard	1	On site	0	50	250	0	Interaction with sparrowhawk	AD
52	4A	25/05/2023	12:00	Buzzard	1	On site	0	45	0	0	Fly over	AD
53	4A	25/05/2023	12:08	Buzzard	1	On site	10	15	0	0	Fly over	AD
54	4A	25/05/2023	15:19	Buzzard	1	On site	0	0	120	0	Fly over	AD
59	4B	25/05/2023	11:24	Buzzard	1	On site	0	180	274	0	Flying / gliding moving N then over valley to E	JD
61	4B	25/05/2023	12:07	Buzzard	1	On site	0	65	0	0	Flying over forestry dropped down behind trees out of view	JD
63	4B	25/05/2023	13:38	Buzzard	1	On site	150	165	0	0	Soared up and out over valley moved E towards VP before dropping into valley	JD
64	4B	25/05/2023	13:52	Buzzard	1	Off site	0	130	0	0		JD
65	4B	25/05/2023	14:01	Buzzard	1	On site	185	0	0	0		JD
66	4B	25/05/2023	14:27	Buzzard	1	On site	552	0	0	0	Hunting flying along Tauberg for extended period	JD

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
67	5	26/05/2023	10:01	Buzzard	1	On site	0	0	264	0	W 2nd bird 5 of VP soaring moved W out over valley soaring	JD
68	5	26/05/2023	10:01	Buzzard	1	On site	0	366	0	0	Initially W before moving back through site, soaring to SE	JD
69	5	26/05/2023	10:01	Buzzard	1	On site	0	366	0	0	Soaring on E side moved east into valley	JD
72	5	26/05/2023	12:30	Buzzard	1	On site	0	0	75	0	Soaring NE of VP	JD
80	2	21/06/2023	10:16	Buzzard	1	On site	0	155	0	0	Hunting along forestry S of VP moved W	JD
81	2	21/06/2023	10:20	Buzzard	1	On site	0	372	0	0	Hunting, moving W	JD
82	2	21/06/2023	10:32	Buzzard	1	On site	0	125	0	0	Soaring/hunting S of VP	JD
83	2	21/06/2023	10:52	Buzzard	1	On site	23	0	0	0	Briefly S of VP same place	JD
85	2	21/06/2023	13:55	Buzzard	1	Off site	0	420	0	0	Soaring S of site	JD
87	4A	22/06/2023	11:30	Buzzard	1	Off site	55	0	0	0	Hovering	PR
89	4A	22/06/2023	11:58	Buzzard	1	On site	200	0	0	0	Hovering showed again briefly same area @12:03	PR
90	4A	22/06/2023	12:45	Buzzard	1	Off site	0	46	0	0	Soaring then stooping	PR
91	4A	22/06/2023	13:01	Buzzard	1	Off site	0	110	0	0	Soaring hovering	PR
92	4A	22/06/2023	13:01	Buzzard	1	Off site	0	222	0	0	Soaring hovering number 5 different bird	PR
93	4A	22/06/2023	14:18	Buzzard	1	Off site	0	198	0	0	Soaring hovering moving north	PR
95	4A	22/06/2023	14:46	Buzzard	1	Off site	0	125	0	0	Soaring hovering	PR
97	4B	22/06/2023	11:55	Buzzard	1	On site	0	300	0	0	Hunting	AD
98	4B	22/06/2023	12:13	Buzzard	1	On site	4	0	0	0	Commuting	AD
99	5	21/06/2023	09:35	Buzzard	1	Off site	49	0	0	0	Soaring	NL

Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
101	5	21/06/2023	10:20	Buzzard	1	Off site	220	0	0	0	Hunting small area	NL
102	5	21/06/2023	10:31	Buzzard	1	Off site	139	0	0	0	Hunting seen also from VP2	NL
103	5	21/06/2023	10:57	Buzzard	1	Off site	88	0	0	0	Hunting	NL
116	1	18/07/2023	13:01	Buzzard	1	Off site	87	0	0	0	Flying around trees/hunting along forestry W of VP3	NL
118	1	18/07/2023	13:21	Buzzard	1	Off site	0	136	0	0	Soaring SSE of VP	JD
124	1	18/07/2023	14:15	Buzzard	1	Off site	0	57	0	0	Soaring N of VP	JD
126	1	18/07/2023	14:28	Buzzard	1	On site	0	97	0	0	Hunting mobbed by kestrel x2	JD
172	1	29/08/2023	09:54	Buzzard	1	Off site	40	0	0	0	Circling low and hunting briefly perched within nearby forestry before dropping out of sight	MK
175	1	29/08/2023	13:48	Buzzard	1	Off site	15	0	0	0	With kestrel buzzard @50m heading north along hill east getting mobbed by kestrel dropping to 50m then out of sight	MK
176	1	29/08/2023	13:57	Buzzard	2	Off site	0	80	0	0	2 birds slowly soaring then heading north before grappling together and heading to ground out of sight	MK
189	2	29/08/2023	13:00	Buzzard	1	Off site	0	60	0	0	Talons mobbing each other N of site moved W and down	JD
207	4B	29/08/2023	10:04	Buzzard	1	Off site	180	0	0	0	Soaring near VP 4B then heading SW	PR
209	4B	29/08/2023	10:39	Buzzard	1	Off site	34	0	0	0	Hovering	PR
230	5	25/08/2023	13:57	Buzzard	2	On site	55	0	0	0		MS
231	5	25/08/2023	14:02	Buzzard	2	Off site	40	0	0	0		MS
237	1	07/10/2023	10:24	Buzzard	1	Off site	0	45	0	0	Circling and calling along hill crest heading south	MK
269	4A	28/09/2023	12:57	Buzzard	1	Off site	0	82	0	0	Flying to W, S of VP across valley into forestry	JD
284	5	28/09/2023	10:34	Buzzard	1	On site and Off site	45	0	0	0	Hunting	NL

Table 7 - 4 - 11-2 Buzzard Vantage Point Survey Data 2024 (MKO)

Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
BZ001	VP1	01/02/2024	13:07	Buzzard	1	65	40	25	0	0	0	improved agricultural grassland; flying, mobbed, initially flying low, then mobbed by four hooded crows	CMC
BZ002	VP3	05/03/2024	15:13	Buzzard	1	240	0	0	240	0	0	conifer plantation and buildings and artificial surfaces; flying, hovering, only hovered very briefly while travelling slowly, dropped behind conifers out of sight.	CMC
BZ003	VP1	22/03/2024	10:36	Buzzard	2	120	0	0	0	0	120	improved agricultural grassland and upland blanket bog; soaring, calling	EC
BZ004	VP1	16/04/2024	18:11	Buzzard	1	300	0	0	0	300	0	upland blanket bog and improved agricultural grassland; flying, soaring	EC
BZ005	VP3	10/05/2024	11:04	Buzzard	1	30	0	0	0	0	30	conifer plantation and upland blanket bog; soaring	EC
BZ006	VP1	31/05/2024	05:05	Buzzard	1	30	30	0	0	0	0	upland blanket bog; flying, hovering	EC
BZ007	VP3	12/06/2024	10:34	Buzzard	1	180	0	0	180	0	0	conifer plantation; soaring	EC
BZ008	VP3	12/06/2024	14:06	Buzzard	2	600	0	0	0	0	600	conifer plantation and upland blanket bog; flying, calling	EC
BZ009	VP1	13/06/2024	12:14	Buzzard	1	600	0	0	600	0	0	upland blanket bog; flying, hovering	EC
BZ010	VP1	13/06/2024	13:22	Buzzard	1	1200	0	0	600	600	0	upland blanket bog; flying, hovering	EC
BZ011	VP3	02/07/2024	14:14	Buzzard	2	120	0	0	120	0	0	upland blanket bog and conifer plantation; flying	EC
BZ012	VP4	30/07/2024	13:18	Buzzard	1	20	0	10	10	0	0	improved agricultural grassland and conifer plantation; flying, mobbed, flew out of viewshed	CMC
BZ013	VP3	07/08/2024	12:28	Buzzard	1	120	0	0	120	0	0	conifer plantation and improved agricultural grassland; flying, hovering	EC
BZ014	VP1	27/08/2024	09:11	Buzzard	1	30	0	30	0	0	0	upland blanket bog and improved agricultural grassland; flying, hovering	EC
BZ015	VP1	27/08/2024	13:49	Buzzard	1	30	0	30	0	0	0	upland blanket bog; flying, mobbed hen harrier	EC

Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
BZ016	VP4	28/08/2024	14:18	Buzzard	1	240	240	0	0	0	0	conifer plantation and improved agricultural grassland; flying, hovering	EC
BZ017	VP4	28/08/2024	14:42	Buzzard	1	180	0	0	0	180	0	conifer plantation; flying, soaring	EC
BZ018	VP1	10/09/2024	07:25	Buzzard	1	120	0	0	120	0	0	upland blanket bog and improved agricultural grassland; flying, hovering	EC
BZ019	VP1	10/09/2024	07:43	Buzzard	1	30	0	0	30	0	0	upland blanket bog and improved agricultural grassland; flying, hovering	EC
BZ020	VP4	25/09/2024	08:15	Buzzard	1	30	30	0	0	0	0	upland blanket bog; flying	EC

Table 7 - 4 - 11-3 Buzzard Breeding Walkover Survey Data 2024 (MKO)

Ref.	Date	Time	Transect	Species	Number	Habitat and activity	Surveyor
BZ001	28/06/2024	09:40	T1	Buzzard	1	bogs and improved grassland; hunting (suitable nesting habitat; possible breeder)	CR

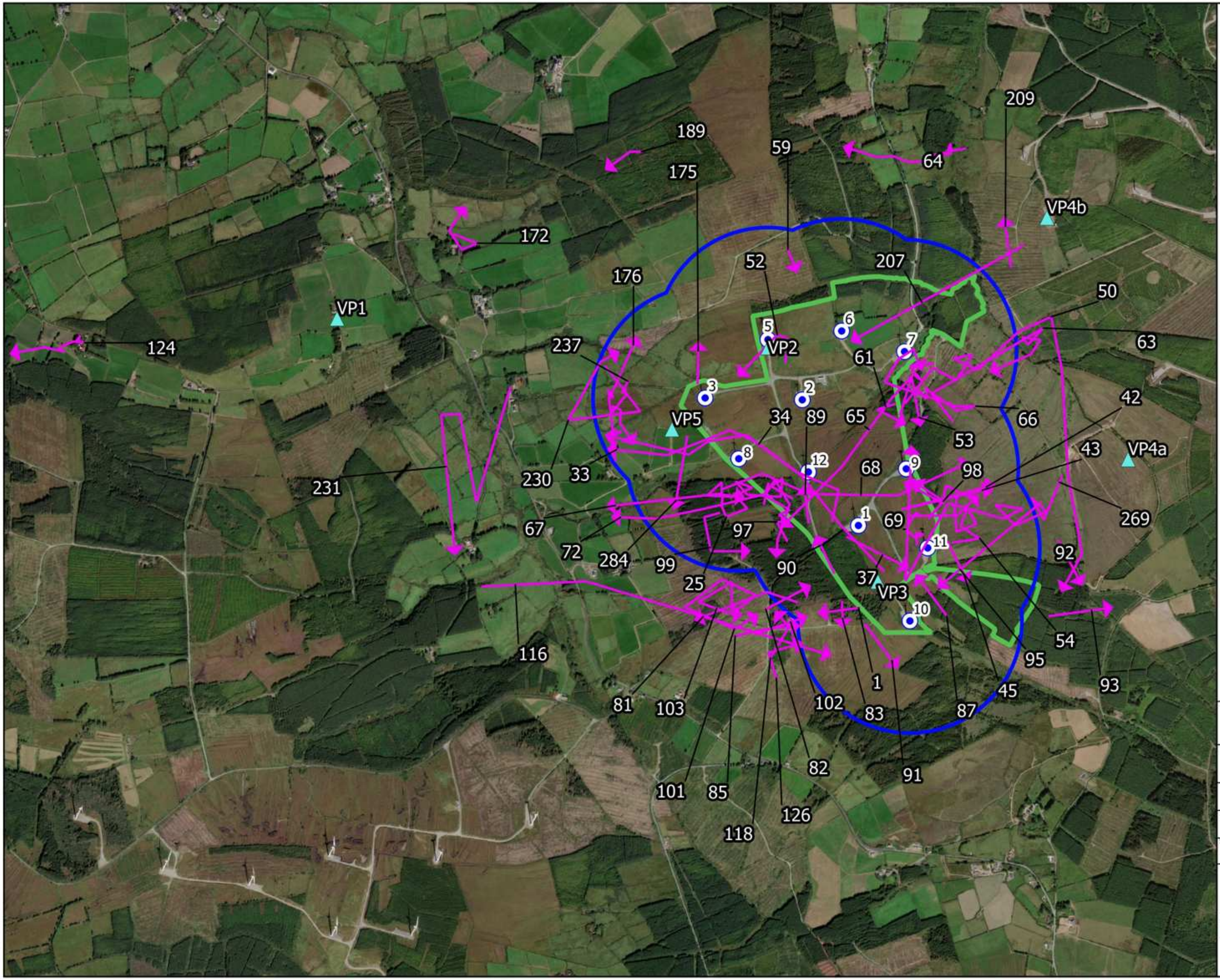
Table 7 - 4 - 11-4 Buzzard Breeding Raptor Survey Data 2024 (MKO)

Ref.	BR	Date	Time	Species	Number	Habitat and activity	Breeding status	Surveyor
BZ001	BR3	26/04/2024	12:13	Buzzard	1	conifer plantation, flying, circling	suitable nesting habitat; possible breeder	CMC
BZ002	BRT3	23/05/2024	12:03	Buzzard	1	upland blanket bog and conifer plantation, flying, hovering	suitable nesting habitat; possible breeder	EC
BZ003	BRT2	28/05/2024	13:17	Buzzard	1	upland blanket bog and conifer plantation, flying, hovering	suitable nesting habitat; possible breeder	EC
BZ004	BR2	30/05/2024	11:50	Buzzard	1	upland blanket bog, flying, hovering	suitable nesting habitat; possible breeder	EC
BZ005	BR3	11/06/2024	12:52	Buzzard	1	upland blanket bog and conifer plantation, soaring, flying, hovering	suitable nesting habitat; possible breeder	EC
BZ006	BR3	11/06/2024	13:05	Buzzard	1	upland blanket bog and improved agricultural grassland, flying, hovering	suitable nesting habitat; possible breeder	EC
BZ007	BRT3	19/06/2024	12:16	Buzzard	1	conifer plantation, soaring, calling	suitable nesting habitat; possible breeder	EC
BZ008	BRT2	26/06/2024	12:01	Buzzard	1	upland blanket bog, flying, hovering	suitable nesting habitat; possible breeder	EC

Ref.	BR	Date	Time	Species	Number	Habitat and activity	Breeding status	Surveyor
BZ009	BR3	03/07/2024	12:18	Buzzard	2	conifer plantation, improved agricultural grassland and upland blanket bog, flying, hovering	suitable nesting habitat; possible breeder	EC
BZ010	BR3	03/07/2024	13:22	Buzzard	1	upland blanket bog, flying	suitable nesting habitat; possible breeder	EC
BZ011	BR5	04/07/2024	12:57	Buzzard	1	conifer plantation, flying	suitable nesting habitat; possible breeder	EC
BZ012	BR5	04/07/2024	13:17	Buzzard	1	conifer plantation, flying, hovering	suitable nesting habitat; possible breeder	EC

Table 7 - 4 - 11-5 Buzzard Incidental Records (MKO)

Ref.	Location	Date	Time	Species	Number	Habitat and activity	Surveyor
BZ001	Breeding Raptor Survey; Knockacummer	18/04/2024	12:34	Buzzard	3	conifer plantation and buildings and artificial surfaces; soaring, circling	CMC



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Map Legend

- 🟩 Site Boundary
- ● Turbine Locations
- ▭ 500m Radius of Turbine Locations
- ▲ EcologyIreland VP Locations
- → Flight Observation

Drawing Title	
Buzzard Observations Vantage Point Surveys 2023 (undertaken by EcologyIreland)	
Project Title	
Taurbeg Wind Farm Extension of Operational Life	
Drawn By	Checked By
D. Woods	P. Cregg
Project No.	Drawing No.
231030	Fig. 7.4.11.1
Scale	Date
1:22,000	13.12.2024

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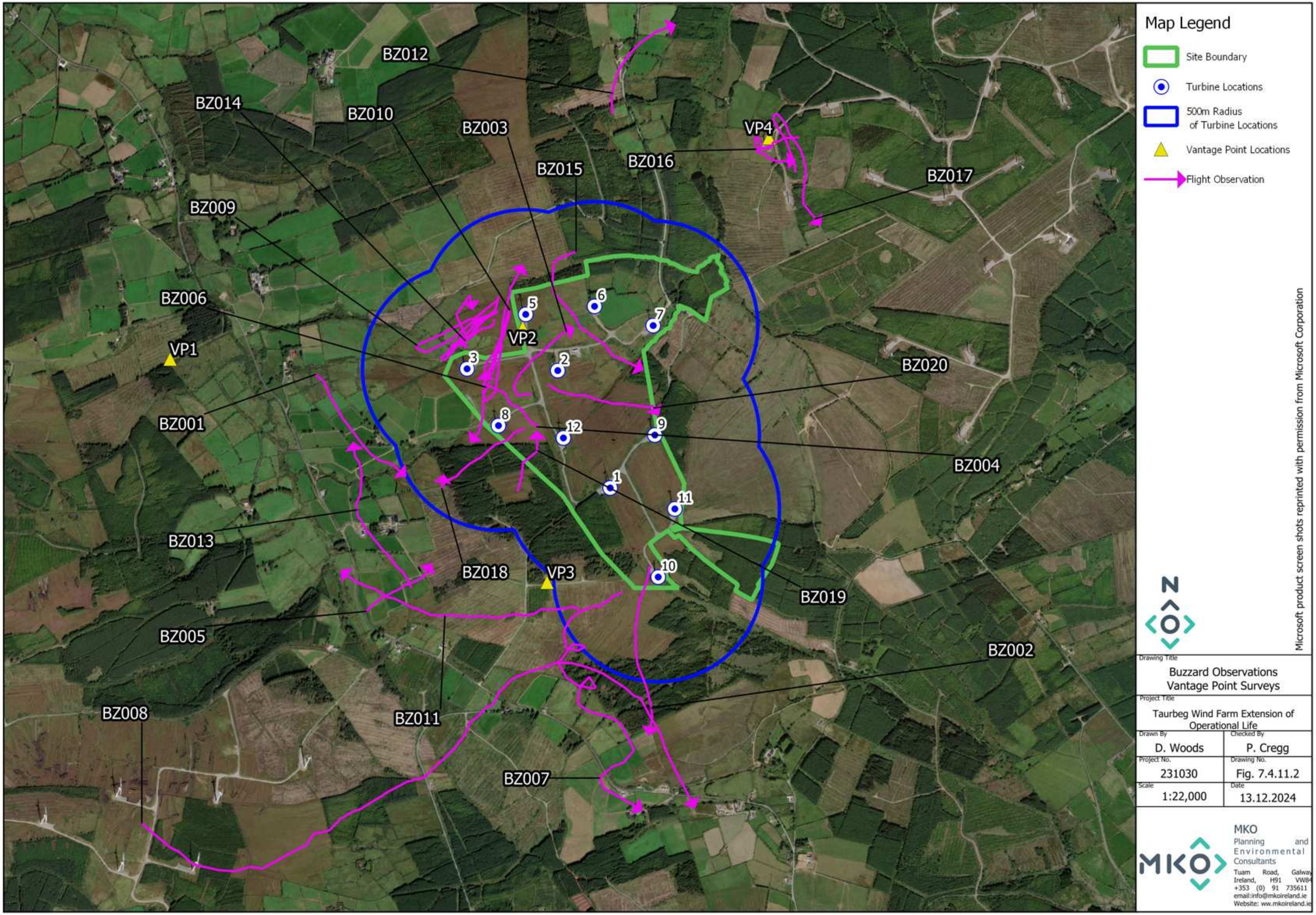

Drawing Title

Buzzard Observations
Vantage Point Surveys

Project Title

Taurbeg Wind Farm Extension of Operational Life

Drawn By	Checked By
D. Woods	P. Cregg
Project No.	Drawing No.
231030	Fig. 7.4.11.2
Scale	Date
1:22,000	13.12.2024

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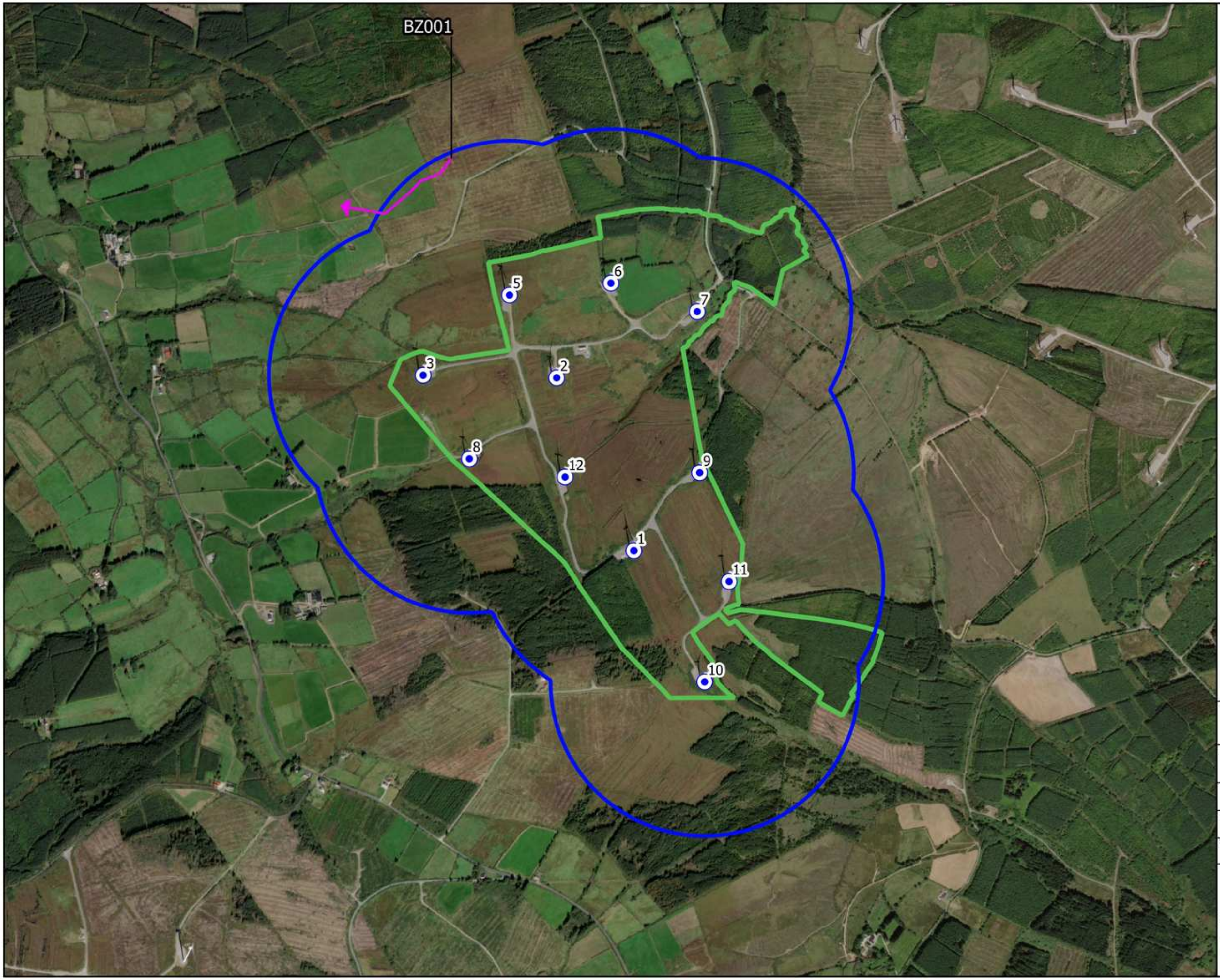

Map Legend

🟩	Site Boundary
●	Turbine Locations
🟦	500m Radius of Turbine Locations
→	Observation

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Drawing Title
Buzzard Observations
Breeding Walkover Surveys

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By	Checked By
D. Woods	P. Cregg
Project No.	**Drawing No.**
231030	Fig. 7.4.11.3
Scale	**Date**
1:16,000	13.12.2024

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Drawing Title
Buzzard Observations
Breeding Raptor Surveys

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By	Checked By
D. Woods	P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.11.4
Scale 1:32,000	Date 13.12.2024

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Map Legend

- 🟩 Site Boundary
- ● Turbine Locations
- → Observation

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Drawing Title

Buzzard Incidental Records

Project Title

Taurbeg Wind Farm Extension of Operational Life

Drawn By	Checked By
D. Woods	P. Cregg
Project No.	Drawing No.
231030	Fig. 7.4.11.5
Scale	Date
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12. SPARROWHAWK

Table 7 - 4 - 12-1 Sparrowhawk Vantage Point Survey Data 2023 (EcologyIreland)

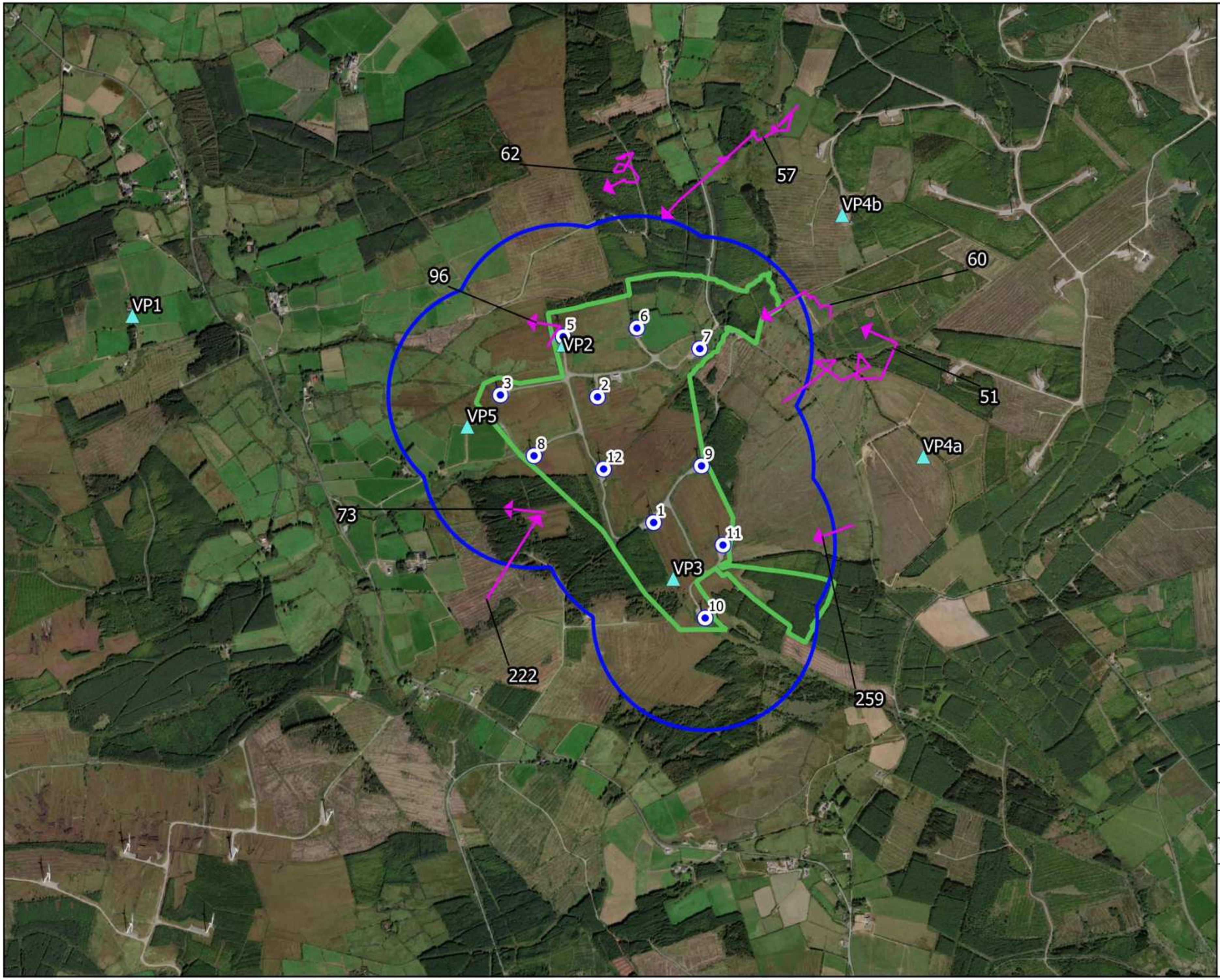
Ref.	VP	Date	Time	Species	Number	On-site / Off-site	Band 1 (0-25m)	Band 2 (25-100m)	Band 3 (100-150m)	Band 4 (>150m)	Comments	Surveyor
51	4A	25/05/2023	11:27	Sparrowhawk	1	On site	0	0	40	0	Interaction with buzzard	AD
57	4B	25/05/2023	11:15	Sparrowhawk	1	Off site	0	270	0	0	Soaring over valley N of VP moved across valley	JD
60	4B	25/05/2023	11:27	Sparrowhawk	1	On site	0	240	0	0	Soaring between VP4A + 4B moved back down into valley	JD
62	4B	25/05/2023	12:43	Sparrowhawk	2	Off site	0	166	0	0	Flying around and forestry before soaring up and moving off.	JD
73	5	26/05/2023	13:11	Sparrowhawk	1	Off site	0	50	0	0	Soaring over forestry W of VP mobbed by passerines (prob swallows)	JD
96	4B	22/06/2023	10:41	Sparrowhawk	1	On site	8	0	0	0	Commuting	AD
222	5	25/08/2023	10:49	Sparrowhawk	1	Off site	0	40	0	0		MS
259	4A	28/09/2023	08:33	Sparrowhawk	1	Off site	13	0	0	0	hunting past VP1	JD

Table 7 - 4 - 12-2 Sparrowhawk Vantage Point Survey Data 2024 (MKO)

Ref.	VP	Date	Time	Species	Number	Duration of flight (s)	Band 1 (0-15m)	Band 2 (15-26m)	Band 3 (26-108m)	Band 4 (108-200m)	Band 5 (>200m)	Habitat and activity	Surveyor
SH001	VP2	28/11/2023	13:20	Sparrowhawk	1	60	0	0	60	0	0	conifer plantation; flying, mobbed by raven 50m height over conifer plantation	EC
SH002	VP4	19/04/2024	17:12	Sparrowhawk	1	30	0	0	30	0	0	improved agricultural grassland and conifer plantation; flying	EC

Table 7 - 4 - 12-3 Sparrowhawk Incidental Records (MKO)

Ref.	Location	Date	Time	Species	Number	Habitat and activity	Surveyor
SH001	Hen Harrier Roost Survey; Glasheenanargid	17/01/2024	16:23	Sparrowhawk	1	bogs; flying	CMC



Map Legend

🟩 Site Boundary

● Turbine Locations

🟦 500m Radius of Turbine Locations

▲ EcologyIreland VP Locations

→ Flight Observation

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Drawing Title
Sparrowhawk Observations Vantage Point Surveys 2023 (undertaken by EcologyIreland)

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By	Checked By
D. Woods	P. Cregg
Project No. 231030	Drawing No. Fig. 7.4.12.1
Scale 1:22,000	Date 13.12.2024

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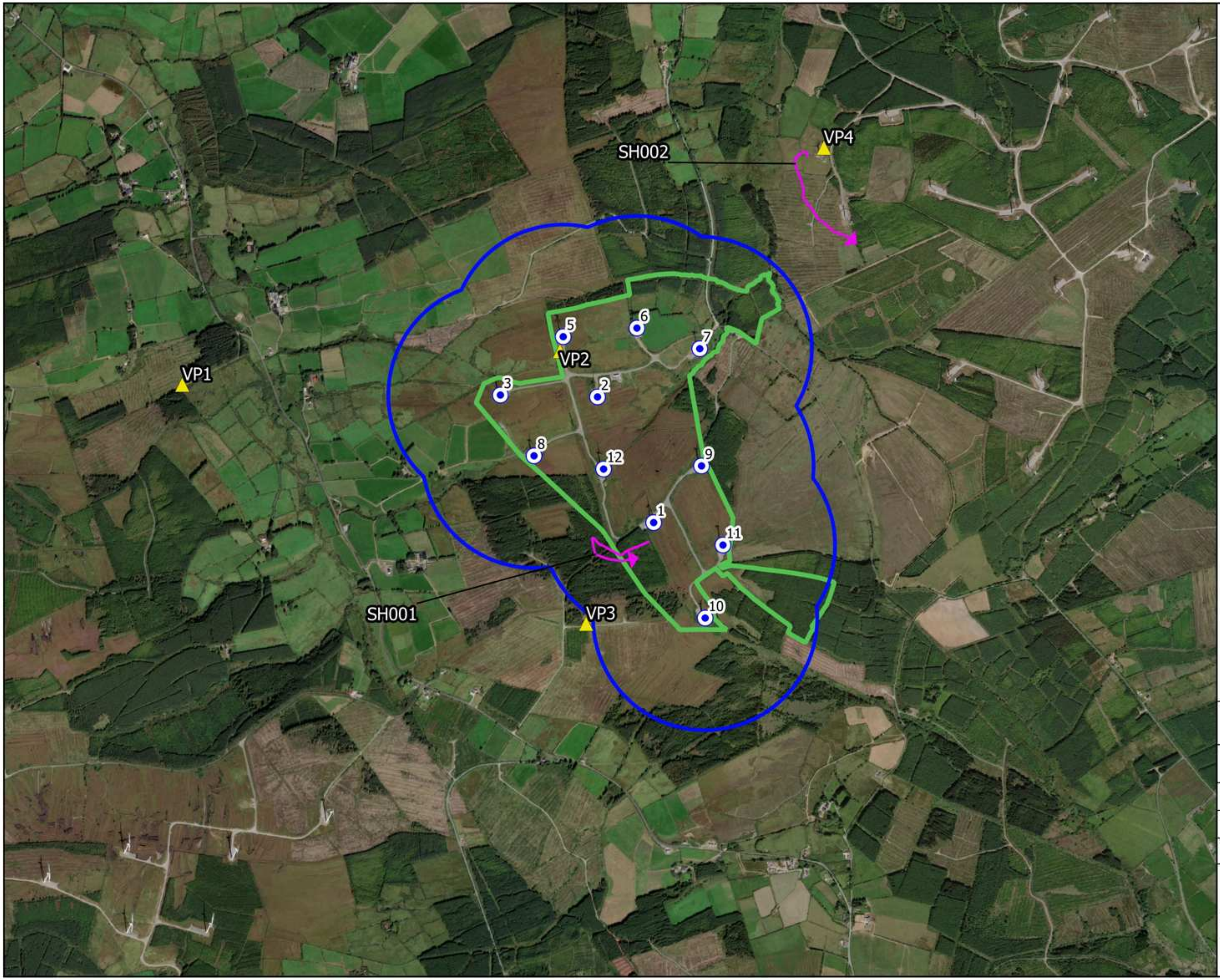

Map Legend

- 🟩 Site Boundary
- ◉ Turbine Locations
- 🟦 500m Radius of Turbine Locations
- ▲ Vantage Point Locations
- → Flight Observation

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Drawing Title	
Sparrowhawk Observations Vantage Point Surveys	
Project Title	
Taurbeg Wind Farm Extension of Operational Life	
Drawn By	Checked By
D. Woods	P. Cregg
Project No.	Drawing No.
231030	Fig. 7.4.12.2
Scale	Date
1:22,000	13.12.2024

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Map Legend

🟩 Site Boundary

● Turbine Locations

→ Observation

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Drawing Title
Sparrowhawk Incidental Records

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By
D. Woods

Checked By
P. Cregg

Project No.
231030

Drawing No.
Fig. 7.4.12.3

Scale
1:16,000

Date
13.12.2024

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APPENDIX 7-6

Collision Monitoring Report

Appendix 7-6 - Collision Monitoring Report

Taurbeg Wind Farm Extension of Operational Life

DOCUMENT DETAILS

Client:	**Taurbeg Ltd.**
Project Title:	**Taurbeg Wind Farm Extension of Operational Life**
Project Number:	**231030-f**
Document Title:	**Appendix 7-6 Collision Monitoring Report**
Document File Name:	**Appendix 7-6 Collision Monitoring Report**
Prepared By:	**MKO** **Tuam Road** **Galway** **Ireland** **H91 VW84**

Rev	Status	Date	Author(s)	Approved By
01	Final	30.06.2025	AL	CB

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1. INTRODUCTION

MKO was commissioned by Taurbeg Ltd. to complete dog-led collision monitoring surveys as part of an application for the continued operation of the existing Taurbeg Wind Farm, Rockchapel, Co. Cork, as permitted by Cork County Council (Pl. Reg. Ref: N/2002/3608), for a further period of 10 years from the date of the expiry of the current planning permission (2026). The 'Proposed Lifetime Extension' is described in detail in Chapter 4 of the Environmental Impact Assessment Report (EIAR). In this report, the "Site" is defined as the existing Taurbeg Wind Farm site.

The surveys outlined in this report were conducted to monitor any potential turbine related bird or bat fatalities at the site, and to provide an estimate of potential turbine collision related mortality associated with the Proposed Lifetime Extension.

This report provides details of the surveys undertaken, including survey design, methods used to carry out those surveys, and results of those surveys. Surveys presented in this report were undertaken between January 2024 and May 2025 and included carcass searches, searcher efficiency trials and scavenger activity trials on site. Surveys are being continued on-site. Any recommendations that may inform additional mitigation measures during the extended operational phase of the wind farm are prescribed below.

1.1 Background

Traditionally, carcass searches were carried out by human observers by means of walking transects and visually identifying the carcasses. Their effectiveness, however, was affected by a variety of variables, such as size, colour and decomposition of the carcass, topography, weather conditions, vegetation type and density in the environment, and finally observer competency in detecting the carcasses. Hence, according to earlier studies, human searches are frequently carried out with low efficiency rates, which causes a significant bias in mortality estimates.

According to Bernardino *et al.* (2012), the employment of dogs and their olfactory capabilities may boost carcass detection rates. Numerous studies have shown and proven that dogs have a superior ability to detect bird and bat carcasses in respect to humans, particularly with small carcasses or when the carcasses are located in dense vegetation (Arnett 2006, Horman 2001, Mathews F.M. 2013, Paula 2011, Reed 2011, Rafael Barrientosa 2018).

While the guidelines provide recommendations in relation to methodologies, dog-led searches require flexibility while conducting surveys: *"the dog and handler must adapt their survey technique to the current site conditions"*, Bennet (2015). Additionally, the usage of transects should only be used as a guide, with freedom to stray from it if necessary. Bennet also states that a trained dog should be able to pick up the target smells prior to the survey starting, highlighting the importance of allowing the dog the opportunity to "follow the nose" and look for the desired odours somewhat independently. Dog teams are deployed to carry out searches at turbines bases starting at dawn each morning to reduce the possibility of carcasses being removed by scavengers.

It should be emphasized that the dog's ability to find carcass odour can be significantly influenced by wind conditions, as the scent travels with the wind. Hence, each search should ideally start downwind on the outer edge of the search area, and the transect walked horizontally across the wind while also moving upwind. Bennet (2015) lists a number of environmental variables that affect search efficiency rates, which can be seen in Table 1-1.

Table 1-1 Factors influencing a dog's ability to detect carcasses.

Consideration	Issue	Management
Relationship between dog and handler	Handler must be able to monitor the dog's performance to determine interest and likely success on a day-by-day, and hour-by-hour basis	Handlers should be appropriately experienced with dog training and behaviour
	Handler must recognise when the dog has detected a scent to enable them to go off transect	Dog and handler should live together and have a strong relationship outside of work
		Regularly use roadkill to stimulate success and monitor performance
Wind speed: Still	On days with no wind there is nothing to carry the scent of the carcass to the dog and detection will be more difficult	Identify days as low wind
		Reduce the distance between transects to allow the dog to cover more ground and be closer to the source of the scent
Wind speed: Low-Medium	Ideal scenting conditions for dogs	Maximum spacing between transects
Wind speed: High	Dogs will become overloaded with scents from much further than the survey area	Reduce spacing between transacts on downwind side of turbine. Allow the dog freedom to follow scents off transects
Wind speed: Extreme	It is more difficult for dogs to locate sources of scents in extreme wind conditions	Allow the dog freedom to follow scents. Maintain constant spacing along transects. Encourage the dog more frequently. Use roadkill to simulate success and monitor performance
1Temperature: Cold (<8°C approximately)	Scents are reduced in cold conditions	Reduce the distance between transects to allow the dog to cover more ground and be closer to the source of the scent
Temperature Mildly cool to warm (<30°C approximately)	As scents warm up, they become more readily detected	Maintain recommended transect distances (dependent upon wind and precipitation)
Topography: flat	Scents are readily carried from one side of the survey area to the other	Maximum transect spacing
Topography:	Undulating Scents may not be uniformly detected across the site	Ensure transects encompass depressions as well as rises
Topography: Steep	Steep sites may reduce exposure to scents depending upon the interaction with the wind	Ensure transects are crossing the direction of wind from the survey area
Vegetation: low (<5cm)	Detection is based on vision and scent	Maximum transect spacing
Vegetation: medium to tall grass	Dogs may be below the optimum scenting area and vegetation may reduce the exposure of the scent to wind	Ensure the dog has the freedom to "hop/bounce" through the survey area to reach the scents above the vegetation height
Vegetation: dense heath land	Vegetation may reduce the exposure of the scent to wind	Ensure dogs are adequately target trained to eliminate confounding scents. Reduce transects to cover more terrain
	Scented vegetation (i.e. flowers) may increase the time to find target scents	
Vegetation: Trees/Scrub	Reduction in wind speed	Reduce distance between transects
Target Species	Large carcasses are more readily detected than small carcasses	Ensure dogs are adequately target trained to eliminate confounding scents
	Carcasses from species not of interest (i.e. lambs, rabbits) can provide additional scents	

1.2 Statement of Authority

Collision Monitoring Surveys were undertaken by MKO Conservation Detection Dog Handlers Cathal Bergin (BSc.) and Jessica Sara Barbara (BSc., MSc.). They were assisted by Dr. Caroline Finlay (PhD), Patrice Kerrigan and Lucy Wilde of Conservation Detection Dogs Northern Ireland. All surveyors are LANTRA [1] accredited handlers with relevant expertise in undertaking the ecological surveys utilised to inform this collision monitoring effort.

The dogs employed in the surveys were Clay (fox-red Labrador), Taio (Springer Spaniel), Kizzy (Springer Spaniel), Niffler (Sprocker), Cain (Labrador), Monty (Springer Spaniel), Ivy (Springer Spaniel), Jasper (Springer Spaniel) and Ziba (German Shorthaired Pointer) and have been specially trained in the detection of bird and bat carcasses.

The Collision Monitoring Report was prepared by Aoife Lyster (BSc). Aoife Lyster has 7 months experience within the MKO Research team, with a focus on conducting carcass efficiency trials. This report has been reviewed by Cathal Bergin (BSc), Aoife Joyce (BSc., MSc.) and John Hynes (BSc., MSc. MCIEEM). Cathal has over 5 years' experience in ecological consultancy and 3 years LANTRA accreted conservation detection dog handler experience. Aoife Joyce has 6 years' experience in advanced bat survey techniques and ecological impact assessments. John is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM) and has over 10 years' professional ecological consultancy experience.

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[1] *LANTRA as one of the leading awarding bodies for land-based industries in both the UK and the Republic of Ireland have combined with Kryus Ltd a specialized detection dog provider to provide a specialised course aimed to train handlers in the use of detection dogs for conservation purposes.*

2. PROJECT DESCRIPTION

Planning permission is sought for the continued operation of the existing Taurbeg Wind Farm, as permitted by Cork County Council (Pl. Reg. Ref: N/2002/3608), for a further period of 10 years from the date of the expiry of the current planning permission (2026) as per Condition no. 7 of the consent issued (the “Proposed Lifetime Extension”).

The Proposed Lifetime Extension does not comprise any alterations to the existing operational wind farm.

Details of the Proposed Project are described in full in Chapter 4 of this Environmental Impact Assessment Report (EIAR).

Map Legend

▭ Proposed Lifetime Extension Site Boundary

N

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Drawing Title Proposed Lifetime Extension Site Boundary	
Project Title Taurbeg Wind Farm Extension of Operational Life	
Drawn By NS	Checked By EMcC
Project No. 231030	Drawing No. Figure 2-1
Scale 1:7,000	Date 2025-06-05

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3. METHODS

3.1 Collision Monitoring

3.1.1 Search Area

At the time of designing the scope and carrying out the surveys, there was no standardised boundary surrounding a wind turbine for the detection of bird and bat fatal collisions. The search distance from turbine bases was calculated using a variety of techniques. Recommendations on search areas are listed below.

- Atienza (2011) states “the ground search area has to be at least 10% more than the rotor diameter”.
- According to Edkins (2014) “search width should be equal to the maximum rotor tip height”.
- Rodrigues (2015) advises a search area with “a radius equal to the total height of the wind turbine, as bats that collide can be blown away from the turbine by strong winds”, but due to the impracticality of a 250mx250m search area “it is advisable to search a smaller area (not less than 50m radius)”.
- Smallwood (2020) suggests a 50m search area surrounding turbine bases.
- Young (2003) demonstrates how that the majority of bird strikes on wind turbines occur 63 meters or less from the turbine base. And that the chance of carcasses being found outside of this area has recently increased due to the steadily rising turbine height.

The existing Taurbeg Wind Farm consists of 11 Bonus (now Siemens) SWT-2.3-82 turbines with a rotor diameter of 82.4m. A search area covering a minimum search radius of 50m from the base of each turbine was applied in accordance with guidance recommended by Rodrigues 2015.

All carcasses found within the search area, regardless of species, are recorded.

Collision Monitoring Surveys were designed to identify and establish the number and species of bird and bat fatalities suspected to have been brought about by collision with wind turbines. For carcasses where the cause of death was uncertain, the fatality was, according to Johnson *et al.* (2003), assigned to the wind farm. Furthermore, when species identification is questionable, like the case of decaying remains or feather spots, samples are submitted for DNA analysis.

Surveys were undertaken monthly at the site between January 2024 and May 2025. Monthly searches allowed for results to be gathered for bird and bat casualties year-round. Dog-led searches for bird and bat carcasses were conducted by a dog and trainer team, as laid out in Table 3-1 below. The search methodology and trials used to inform carcass detection probability are also described below.

Table 3-1 Detection Dog Teams

Date	Surveyor	Dogs
Jan-24	Cathal Bergin & Jessica Sara Barbara	Cain, Clay, Kizzy, Niffler and Taio
Feb-24	Cathal Bergin & Jessica Sara Barbara	Cain, Clay, Kizzy, Niffler and Taio
Mar-24	Cathal Bergin & Jessica Sara Barbara	Cain, Clay, Kizzy, Niffler and Taio
Apr-24	Cathal Bergin & Jessica Sara Barbara	Cain, Clay, Kizzy, Niffler and Taio

May-24	Cathal Bergin & Jessica Sara Barbara	Cain, Clay, Kizzy, Niffler and Taio
Jun-24	Cathal Bergin & Jessica Sara Barbara	Cain, Clay, Kizzy, Niffler and Taio
Jul-24	Cathal Bergin & Jessica Sara Barbara	Cain, Clay, Kizzy, Niffler and Taio
Aug-24	Cathal Bergin & Caroline Finlay	Clay, Taio, Kizzy, Cain, Niffler, Jasper, Monty & Ziba
Sep-24	Cathal Bergin & Lucy Wilde	Cain, Clay, Kizzy, Niffler and Taio
Oct-24	Cathal Bergin & Caroline Finlay	Clay, Taio, Kizzy, Cain, Niffler, Monty & Ziba
Nov-24	Cathal Bergin	Cain, Clay, Kizzy, Niffler and Taio
Dec-24	Cathal Bergin & Caroline Finlay	Clay, Taio, Kizzy, Cain, Niffler, Monty & Ziba
Jan-25	Cathal Bergin & Patrice Kerrigan	Clay, Taio, Kizzy, Cain, Ivy
Feb-25	Cathal Bergin & Caroline Finlay	Clay, Taio, Kizzy, Niffler, Monty, Ivy & Ziba
Mar-25	Cathal Bergin & Caroline Finlay	Clay, Taio, Kizzy, Cain, Niffler, Monty, Ivy & Ziba
Apr-25	Cathal Bergin	Clay, Taio, Cain, Kizzy and Niffler
May-25	Cathal Bergin	Clay, Taio and Niffler

3.1.2 Dog-led Searches

Searches were conducted through dog-led surveys, broadly following the methodologies recommended by Bennet (2015).

Before each survey, meteorological data (temperature and wind speed) and ground cover details (habitat) were recorded. When a carcass was discovered, the GPS location, a photograph, the distance from the turbine and the date and time were recorded. The carcass condition was assessed and assigned to one of the following categories:

- Intact (carcass that is completely intact or not badly decomposed);
- Scavenged (evidence that the carcass was fed upon by a predator); or
- Feather spot (ten or more feathers indicating predation or scavenging or two or more primary feathers must be present to consider the carcass a casualty).

Carcass searching work was calibrated to account for the ability of the search dog to find bird and bat carcasses and likelihood of scavenging by predators (see Section 3.5 below), this ensured a more accurate estimation of the total number of collisions.

3.2 Scavenger Removal Trials

The scavenger removal trials are conducted monthly by leaving a carcass (facing a camera trap) in plots located within the search radius, on a variety of habitats, for a minimum of 21 days, or until scavenger(s) removed the carcasses, before retrieving them. A maximum of two camera traps with carcasses were placed on site per month during the duration of the survey with locations being moved each month. Browning Strike Force Trail Camera model BTC-5PX-1080 along with 64GB SD cards were chosen for use. Low numbers of carcasses are placed at a time on a site to avoid scavenger swarming i.e. when high number of carcasses on site attract higher than usual numbers of scavengers. A determination on carcass removal was made when no body parts containing flesh or bone or >10 disarticulated feathers could be found. Scavenger removal rate was then determined by the amount of scavenging that occurred in the intervening period.

3.3 Searcher Efficiency

To ensure a more accurate estimation of the total number of fatalities, dog-led searches were calibrated to account for the dog's ability to find bird and bat carcasses (searcher efficiency) and the likelihood of carcasses not being found due to scavenging by other animals (scavenger removal).

The searcher efficiency trials were carried out at randomly chosen times during the survey cycle by planting a mixture of bird and bat carcasses within the site and allowing the dog and trainer team(s) to search for them. Searcher efficiency was then based on the percentage retrieval success. One worker left carcasses within the various habitats proportional to habitat representativity in the search area, and the dog and trainer team searched for them in the following hours. This time period aided in hiding any scent of the worker laying the carcasses and allowed a double-blind test to be conducted where the detection team is unaware of the carcasses location or number of carcasses placed in order to simulate as accurately as possible a survey without handler's bias.

3.4 Collision Rates

Collision-related mortality at the Site was estimated using the GenEst software package (version 1.4.9; Dalthorp *et al.,* 2023). The results of carcasses found during collision monitoring surveys was inputted into a model, along with information on the wind farm and survey, such as the number of turbines, the area surveyed and the survey effort. This generated an estimate of mortality at the Site, which was then corrected for searcher efficiency, scavenger removal and detection probability, based on the results of the trials.

4. RESULTS

4.1 Collision Monitoring

4.1.1 Dog-led Carcass Searches

Throughout the Collision Monitoring Surveys undertaken from January 2024 to May 2025, seven fatalities were discovered. As outlined in Section 3.2, for carcasses where the cause of death was uncertain, the fatality was assigned to the wind farm (Johnson, 2003).

The results of the carcasses found are outlined in Table 4-1 below. Further detailed results are outlined in Appendix 1 to this report.

Table 4-1 Details and photographs of each fatality recorded.

Date	Surveyor	Details	Surrounding Habitat	Photograph
16/05/24	Cathal Bergin and Clay	Corvid feather spot found 23m from T2 on recently felled woodland on 16/05/2024.	WS4	
20/06/2024	Jessica and Kizzy	Intact female pheasant found 1m from T11, on hardstand on 20/06/24	BL3	
20/06/24	Jessica and Cain	Intact-decomposed chaffinch found 36m from T11 on hardstand on 20/06/24.	BL3	

20/06/24	Jessica and Cain	Scavenged small passerine found 19m from T7 on hardstand on 20/06/24.	BL3	
12/03/2025	Cathal and Niffler	Featherspot of skylark found 35m from T5 on heath on 12/03/2025	HH	
03/04/2025	Cathal and Taio	Meadow pipit found 23m from T7 on road.	Bl3	
03/04/2025	Cathal and Kizzy	Feather spot of female pheasant found 35m from T6 in scrub.	WS1	

*WS1 (Scrub), **GA1 (Improved Agricultural Grassland), ***BC1 (Arable Crop), ****BL3 (Buildings and Artificial Surfaces)

4.2 Scavenger Removal Trial

Scavenger removal trials conducted over the duration of the survey cycle sought to gain an insight into scavenger activity levels on site. Results from the scavenger removal trials, represented in Table 4-2, show that predation time varies on the Site. It should be noted that on occasion the predation event was not seen, although the carcass was gone upon retrieval. In these cases, days from time of placement until collection were attributed. The median number of days a carcass persisted on site for was 5.6 days, suggesting high predation. Predators recorded were predominantly foxes and hooded crows.

Table 4-2 Scavenger Removal Trial Results

Turbine	Carcass	Date and time laid	Date and time scavenged/recovered	Predator
11	Mouse	23/01/2024 09:05	24/01/2024 09:02	Hooded Crow
1	Mouse	25/01/2024 12:05	20/02/2024 10:53	n/a Carcass present
12	Mouse	20/02/2024 12:28	01/03/2024 02:24	Pine martin
7	Mouse	20/02/2024 13:33	03/03/2024 08:01	Hooded Crow
8	Pinky	13/03/2024 09:55	04/04/2024 23:59	Fox
6	Pinky	13/03/2024 09:55	15/03/2024 09:44	Hooded crow
5	Mouse	18/04/2024 11:10	20/04/2024 23:49	Fox
2	Pinky	18/04/2024 12:30	16/05/2024 11:00	Carcass absent, unknown predator
3	Pinky	16/05/2024	29/05/2024	Fox
9	Pinky	16/05/2024 08:00	20/06/2024 07:35	Carcass absent, unknown predator
8	Pinky	20/06/2024 11:15	20/06/2024 11:10	CT malfunction, event not captured
6	Pinky	20/06/2024 11:20	20/06/2024 10:30	Scavenger event not seen; cattle moved CT
7	Baby mouse	19/07/2024 11:30	05/08/2024 17:32	Hooded crow
5	Mouse	19/07/2024 10:39	26/07/2024 13:11	Carcass absent, unknown predator
8	Large white rat	20/08/2024 11:00	26/08/2024 10:00	Fox
2	Mouse	20/08/2024 12:00	26/08/2024 10:30	Carcass absent, unknown predator
5	Mouse	27/09/2024 11:25	01/10/2024 09:47	Fox
7	Mouse	27/09/2024 11:45	07/10/2024 09:08	Hooded crow
2	Baby mouse	17/10/2024 14:05	17/10/2024 15:58	Hooded crow
6	Mouse	17/10/2024 14:02	05/11/2024 03:27	Fox
12	Rat	30/11/2024 10:35	03/12/2024 03:09	Fox

7	Mouse	30/11/2024 13:15	01/12/2024 15:43	Hooded crow
3	Mouse	19/12/2024 12:20	29/01/2024 8:00	CT fell over, event not seen
10	Mouse	29/01/2025 12:30	20/02/2025 9:25	CT malfunctioned, event not seen
9	Chick	19/02/2025 11:02	12/03/2025 8:35	Carcass present
11	Chick	13/03/2025 12:00	03/04/2025 7:35	Carcass present
1	Mouse	03-04-2025 10:00	28-05-2025 08:50	Absent CT malfunctioned

*WS1 (Scrub), **GA1 (Improved Agricultural Grassland), ***BC1 (Arable Crop), ****BL3 (Buildings and Artificial Surfaces)

4.3 Searcher Efficiency Trial

During surveys on the 19/12/2024, 19/02/2025, 02/04/2025, 03/04/2025, 27/05/2025 and 28/05/2025 numerous carcasses were randomly placed throughout the site without the dog and handler team being aware of location or number of carcasses placed. Of the carcasses lain for the dog searcher efficiency trial, none were predated on. All were found by the dog and handler team apart from one carcass, thus the efficiency rate for Taurbeg Wind Farm was 96%. Details shown in Table 4-3.

Table 4-3 Efficiency Trial Results

Turbine	Date	Carcass	Condition	Habitat	Trial results
T10	19/12/2024	Kestrel	Feather spot	GA1	Found
T10	19/12/2024	Meadow pipit	Intact fresh	BL3	Found
T11	19/12/2024	Rook	Intact fresh	HH	Found
T1	19/12/2024	Corvid	Scavenged	GA1	Found
T8	19/12/2024	House martin	Scavenged	GA1	Found
T6	19/12/2024	Rook	Intact fresh	GA1	Found
T5	19/12/2024	Rook	Scavenged	HH	Found
T9	19/02/2025	Black-headed gull	Intact fresh	HH	Found
T8	19/02/2025	Rook	Intact decomposed	HH1	Found
T2	19/02/2025	Kestrel	Intact fresh	GA1	Found
T7	19/02/2025	Corvid	Feather spot	GA1	Found
T5	19/02/2025	Chaffinch	Intact decomposed	GA1	Found
T9	2025-04-02	Rook	intact fresh	WS1	Found
T1	2025-04-02	Sparrowhawk	feather spot	GA1	Found
T12	2025-04-02	Snipe	intact fresh	HH	Found
T8	2025-04-02	Soprano Pipistrelle	intact decomposed	GA1	Found
T2	2025-04-03	Rook	intact decomposed	HH	Found
T6	2025-04-03	Lesser Black Backed Gull	feather spot	HH	Found
T2	2025-04-03	Bat	intact decomposed	HH	Found
T7	2025-05-28	Kestrel	feather spot	HH	Missed
T2	2025-05-28	Rook	intact decomposed	WS1	Found
T11	2025-05-27	Thrush	scavenged	WS1	Found
T1	2025-05-27	Pipistrelle Spp.	intact decomposed	WS1	Found
T1	2025-05-27	Magpie	intact fresh	WS1	Found
T5	2025-05-28	Pheasant	intact fresh	GA1	Found

4.4 Collision Rates

Collision-related mortality at the wind farm was estimated using the GenEst software package (version 1.4.9; Dalthorp *et al.,* 2023). The results of carcasses found during collision monitoring surveys was input into a model, along with information on the existing wind farm and survey effort, such as 1) number of turbines, 2) the area surveyed and the 3) survey effort. This generated an estimate of mortality at the existing wind farm, which was then corrected for 4) searcher efficiency, 5) scavenger removal and 6) detection probability, based on the results of the trials.

Results

Results for Taurbeg Wind Farm, with 1) 11 turbines. The search area at each turbine base comprised a 2) 50m circle and 3) 100% of searchable area was surveyed. Surveys were conducted by trained dogs Clay, Taio, Niffler, Kizzy, Cain, Ivy, Jasper, Monty, and Ziba, with handlers Jessica Sara Barbara, Caroline Finlay, Lucy Wilde, Patrice Kerrigan and Cathal Bergin (LANTRA Qualified).

- 4) Searcher efficiency was 96% (median = 0.96 [CI 0.82-0.99]).
- 5) The median number of days a carcass persisted was 5.6.
- 6) Detection probability was 0.31 [CI 0.2-0.43]).

Birds

The model estimates with 90% confidence that between 11 and 41 bird fatalities occurred over the study period at the wind farm (estimated mortality = 22 birds [confidence intervals 10.87-40.56]. This scales to 1.83 [CI 0.91-3.38] birds per turbine per year or 0.87 [CI 0.43-1.6] birds per megawatt hour.

Bats

There were no bat fatalities found during collision monitoring surveys.

5. DISCUSSION AND CONCLUSION

Fatalities recorded at the Site were infrequent during the surveys carried out between January 2024 and May 2025. In total, seven fatalities (all birds) were recorded over a 17-month period. Bird species recorded included a corvid, chaffinch, two pheasants and an unidentified small passerine, which are all green listed in Birds of Conservation Concern in Ireland. A Skylark feather spot was found on the 12/03/2025, skylarks are amber listed in Birds of Conservation Concern in Ireland. A meadow pipit was found on the 03/04/2025, meadow pipits are red listed in Birds of Conservation Concern in Ireland.

GenEst results provided above estimated that no more than 41 bird fatalities could occur over a 17-month period on the entire site.

No bat fatalities were recorded over the 17 months of surveys at site.

Continued post-consent monitoring is proposed as part of the Proposed Lifetime Extension. The information gathered in this report has been used to inform the impact assessment in the EIAR.

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APPENDIX A

Appendix A. All data of Collision Monitoring Surveys from January 2024 to May 2025 included.

Turbine	Staff	Date	Start Time	Finish Time	T°C	Wind Speed	Wind Direction	Rain	Visibility	Area covered	Carcass Found	Comments
1	CB	25/01/2024	11.15	12:00	10	Moderate breeze	SSW	Moderate	Good	100%	No	
2	JSB	23/01/2024	10:40	11:15	11	Near gale	SW	Moderate	Good	100%	No	
3	CB	25/01/2024	09:35	10:25	10	Fresh breeze	SSW	Drizzle/mist	Good	100%	No	
5	CB	25/01/2024	08:45	09:30	10	Fresh breeze	SSW	Drizzle/mist	Good	100%	No	
6	JSB	23/01/2024	09:40	10:25	11	Strong breeze	SW	Heavy	Good	95%	No	
7	JSB	23/01/2024	08:55	09:35	11	Strong breeze	SW	Moderate	Good	85%	No	
8	CB	25/01/2024	10:30	11:10	10	Moderate breeze	SSW	Drizzle/mist	Good	100%	No	
9	CB	23/01/2024	10:40	11:25	11	Strong breeze	SW	Moderate	Good	80%	No	
10	CB	23/01/2024	10:00	10:35	10	Strong breeze	SW	Moderate	Good	80%	No	
11	CB	23/01/2024	09:10	09:55	11	Strong breeze	SW	Moderate	Good	95%	No	
12	CB	25/01/2024	12:05	13:00	10	Moderate breeze	SSW	Drizzle/mist	Good	100%	No	
1	JSB	20/02/2024	10:50	11:35	10	Moderate breeze	SW	Moderate	Good	95	No	
2	CB	20/02/2024	09:45	10:35	9	Fresh breeze	SW	Light	Good	95	No	
3	CB	20/02/2024	11:35	12:30	9	Fresh breeze	SW	Light	Good	100	No	
5	CB	20/02/2024	10:40	11:30	9	Fresh breeze	SW	Moderate	Good	100	No	
6	CB	20/02/2024	09:00	09:40	10	Fresh breeze	SW	Light	Good	95	No	
7	CB	20/02/2024	08:05	08:55	10	Moderate breeze	SW	Showers	Good	95	No	
8	CB	20/02/2024	12:35	13:30	8	Moderate breeze	SW	Drizzle/mist	Good	100	No	

Turbine	Staff	Date	Start Time	Finish Time	T˚C	Wind Speed	Wind Direction	Rain	Visibility	Area covered	Carcass Found	Comments
9	JSB	20/02/2024	09:55	10:45	9	Moderate breeze	SW	Light	Good	65	No	
10	JSB	20/02/2024	09:05	09:55	10	Moderate breeze	SW	Drizzle/mist	Good	80	No	
11	JSB	20/02/2024	08:15	09:00	10	Moderate breeze	W	None	Good	95	No	
12	JSB	20/02/2024	11:40	12:35	10	Moderate breeze	SW	Moderate	Good	95	No	
1	JSB	13/03/2024	08:05	08:50	8	Light breeze	WSW	Drizzle/mist	Good	95	No	
2	CB	13/03/2024	10:25	11:15	9	Light breeze	WSW	Drizzle/mist	Good	100	No	
3	CB	13/03/2024	09:30	10:20	9	Light breeze	WSW	Drizzle/mist	Good	100	No	
5	JSB	13/03/2024	10:00	10:55	9	Light breeze	WSW	Drizzle/mist	Good	100	No	
6	JSB	13/03/2024	11:05	12:20	9	Light breeze	WSW	Drizzle/mist	Good	95	No	
7	CB	13/03/2024	11:20	12:10	9	Light breeze	WSW	Drizzle/mist	Good	95	No	
8	JSB	13/03/2024	08:55	09:55	8	Light breeze	WSW	Drizzle/mist	Good	100	No	
9	CB	13/03/2024	07:55	08:35	9	Light breeze	WSW	Drizzle/mist	Good	70	No	
10	JSB	13/03/2024	07:15	08:00	9	Light breeze	WSW	Drizzle/mist	Good	85	No	
11	CB	13/03/2024	07:00	07:50	11	Light breeze	WSW	Light	Good	95	No	
12	CB	13/03/2024	08:40	09:25	8	Light breeze	WSW	Light	Good	90	No	
1	CB	18/04/2024	07:55	08:55	7	Light breeze	WNW	Drizzle/mist	Good	95	No	
2	JSB	18/04/2024	10:55	11:50	11	Light breeze	WNW	Drizzle/mist	Good	100	No	
3	JSB	18/04/2024	09:50	10:45	9	Gentle breeze	NW	None	Good	100	No	
5	CB	18/04/2024	09:55	10:50	10	Moderate breeze	WNW	None	Good	100	No	
6	CB	18/04/2024	10:55	11:55	10	Moderate breeze	WNW	None	Good	95	No	
7	JSB	18/04/2024	12:00	12:55	11	Light breeze	WNW	None	Good	95	No	
8	CB	18/04/2024	09:00	09:50	9	Gentle breeze	NW	None	Good	100	No	

Turbine	Staff	Date	Start Time	Finish Time	T°C	Wind Speed	Wind Direction	Rain	Visibility	Area covered	Carcass Found	Comments
9	JSB	18/04/2024	07:50	08:45	8	Light breeze	NNW	None	Good	65	No	
10	CB	18/04/2024	07:00	07:50	5	Light breeze	NW	Drizzle/mist	Good	95	No	
11	JSB	18/04/2024	06:55	07:45	7	Gentle breeze	WNW	None	Good	95	No	
12	JSB	18/04/2024	08:50	09:45	10	Gentle breeze	NW	None	Good	100	No	
1	JSB	16/05/2024	07:05	08:10	12	Gentle breeze	E	None	Good	95	No	
2	CB	16/05/2024	09:45	10:30	18	Moderate breeze	NE	None	Good	100	Yes	
3	CB	16/05/2024	08:50	09:40	19	Gentle breeze	NE	None	Good	100	No	
5	JSB	16/05/2024	09:00	09:40	16	Gentle breeze	ESE	None	Good	100	No	
6	JSB	16/05/2024	09:50	10:30	17	Gentle breeze	ENE	None	Good	90	No	
7	CB	16/05/2024	10:40	11:40	18	Gentle breeze	ENE	None	Good	90	No	
8	JSB	16/05/2024	08:10	08:55	15	Gentle breeze	E	None	Good	90	No	
9	CB	16/05/2024	07:03	07:45	12	Gentle breeze	NE	None	Good	70	No	
10	JSB	16/05/2024	06:15	07:05	9	Gentle breeze	ESE	None	Good	70	No	
11	CB	16/05/2024	06:15	07:00	9	Gentle breeze	NE	None	Good	90	No	
12	CB	16/05/2024	07:50	08:45	15	Gentle breeze	NE	None	Good	95	No	
1	CB	20/06/2024	07:05	08:00	11	Light breeze	SW	None	Good	90	No	
2	-	-	-	-	-	-	-	-	-	-	-	Cattle and calves in area, unable to survey
3	JSB	20/06/2024	08:40	09:30	15	Gentle breeze	SW	None	Good	100	No	
5	CB	20/06/2024	08:10	09:20	12	Gentle breeze	SW	None	Good	100	No	
6	CB	20/06/2024	09:25	10:30	13	Gentle breeze	SW	None	Good	90	No	
7	JSB	20/06/2024	09:35	10:35	18	Light breeze	SW	None	Good	90	Yes	Small passerine
8	JSB, CB	20/06/2024	10:40	11:10	13	Moderate breeze	SSW	None	Good	90	No	

Turbine	Staff	Date	Start Time	Finish Time	T˚C	Wind Speed	Wind Direction	Rain	Visibility	Area covered	Carcass Found	Comments
9	JSB	20/06/2024	07:35	08:30	12	Light air	SW	None	Good	65	No	
10	CB	20/06/2024	06:10	07:00	10	Light breeze	WSW	None	Good	80	No	
11	JSB	20/06/2024	06:20	08:00	10	Light breeze	WSW	None	Good	90	Yes	Pheasant, Chaffinch
12	JSB, CB	20/06/2024	05:30	06:20	8	Light Breeze	WSW	None	Good	90	No	
1	JSB	19/07/2024	07:40	08:45	12	Moderate breeze	SW	None	Good	80	No	
2	CB	19/07/2024	09:25	10:20	15	Fresh breeze	SSW	None	Good	100	No	
3	CB	19/07/2024	08:20	09:20	14	Fresh breeze	SSW	None	Good	100	No	
5	JSB	19/07/2024	09:50	10:30	15	Moderate breeze	SSW	None	Good	95	No	
6	JSB	19/07/2024	10:40	11:40	16	Moderate breeze	SW	None	Good	95	No	
7	CB	19/07/2024	10:25	11:30	16	Moderate breeze	SSW	None	Good	90	No	
8	JSB	19/07/2024	09:50	09:50	14	Moderate breeze	WSW	None	Good	90	No	
9	CB	19/07/2024	07:35	08:15	13	Moderate breeze	S	None	Good	30	No	
10	JSB	19/07/2024	06:40	07:40	12	Moderate breeze	SW	None	Good	80	No	
11	CB	19/07/2024	06:45	07:30	12	Moderate breeze	S	None	Good	90	No	
12	JSB, CB	19/07/2024	05:50	06:40	12	Moderate breeze	SW	None	Good	85	No	
1	CF	20/08/2024	07:42	08:44	11	Fresh Breeze	W	None	Good	75	No	
2	CF	20/08/2024	09:52	10:32	12	Fresh Breeze	W	Showers	Good	100	No	
3	CF	20/08/2024	10:40	11:33	12	Fresh Breeze	W	None	Good	80	No	
5	CB	20/08/2024	11:05	11:35	13	Strong Breeze	W	None	Good	40	No	Cattle in search area, limited coverage

Turbine	Staff	Date	Start Time	Finish Time	T˚C	Wind Speed	Wind Direction	Rain	Visibility	Area covered	Carcass Found	Comments
6	CF	20/08/2024	11:39	12:14	12	Strong Breeze	W	None	Good	95	No	
7	CB	20/08/2024	09:10	10:05	12	Strong breeze	W	None	Good	95	No	
8	CB	20/08/2024	08:35	09:05	11	Fresh breeze	W	Showers	Good	25	No	
9	CF	20/08/2024	08:52	09:42	11	Strong breeze	W	None	Good	50	No	
10	CB	20/08/2024	07:45	08:30	10	Fresh breeze	W	None	Good	90	No	
11	CB, CF	20/08/2024	07:00	07:40	10	Moderate breeze	W	None	Good	90	No	
12	CB	20/08/2024	10:10	11:00	12	Fresh breeze	W	None	Good	100	No	
1	LW	27/09/2024	08:32	09:05	7	Strong breeze	NNW	None	Good	70	No	
2	CB	27/09/2024	08:50	09:35	7	Strong breeze	NNW	None	Good	100	No	
3	LW	27/09/2024	10:20	10:51	8	Strong Breeze	NNW	None	Good	90	No	
5	LW	27/09/2024	10:52	11:50	11	Strong Breeze	NNW	None	Good	90	No	
6	CB	27/09/2024	09:40	10:20	7	Strong Breeze	NNW	None	Good	95	No	
7	CB	27/09/2024	10:30	11:35	10	Strong Breeze	NNW	None	Good	80	No	
8	LW	27/09/2024	09:10	10:10	7	Strong Breeze	NNW	None	Good	80	No	
9	CB	27/09/2024	08:25	08:45	6	Strong Breeze	NNW	None	Good	25	No	
10	LW	27/09/2024	07:34	08:29	6	Strong Breeze	NNW	None	Good	60	No	
11	CB	27/09/2024	07:45	08:20	6	Strong Breeze	NNW	None	Good	90	No	
12	LW,CB	27/09/2024	07:15	07:40	6	Strong Breeze	NNW	None	Good	95	No	
1	CB	17/10/2024	10:45	11:30	13	Fresh breeze	W	Showers	Good	90	No	
2	CB	17/10/2024	12:45	01:35	14	Fresh breeze	W	Showers	Good	95	No	
3	CB	17/10/2024	11:35	12:40	13	Fresh breeze	W	Showers	Good	100	No	
5	CF	17/10/2024	11:19	12:10	13	Fresh breeze	W	Showers	Good	90	No	
6	CF	17/10/2024	12:16	13:05	13	Fresh breeze	W	Showers	Good	85	No	
7	CF	17/10/2024	13:09	14:00	14	Fresh breeze	W	Showers	Good	75	No	

Turbine	Staff	Date	Start Time	Finish Time	T˚C	Wind Speed	Wind Direction	Rain	Visibility	Area covered	Carcass Found	Comments
8	CF	17/10/2024	-	-	-	-	-	-	-	-	-	Livestock present, unable to survey
9	CF	17/10/2024	10:16	10:52	13	Fresh breeze	W	Showers	Good		No	
10	CB	17/10/2024	08:50	10:30	11	Moderate breeze	W	None1	Good	80	No	
11	CF	17/10/2024	09:16	10:04	11	Moderate breeze	W	None	Good	90	No	
12	CB, CF	17/10/2024	08:00	08:45	11	Moderate breeze	W	Drizzle/mist	Good	90	No	
1	CB	29/11/2024	10:05	10:45	12	Strong breeze	SSE	Moderate	Good	70	No	
2	CB	30/11/2024	08:10	09:00	12	Strong breeze	S	Drizzle/mist	Good	100	No	
3	CB	30/11/2024	09:05	10:00	12	Strong breeze	S	Drizzle/mist	Good	100	No	
5	CB	29/11/2024	11:36	12:25	12	Strong breeze	SE	Light	Good	90	No	
6	CB	29/11/2024	12:30	13:30	13	Strong breeze	S	Moderate	Good	80	No	
7	CB	30/11/2024	10:55	11:45	12	Strong breeze	S	Moderate	Good	90	No	
8	CB	29/11/2024	10:50	11:30	12	Strong breeze	SSE	Moderate	Good	80	No	
9	CB	29/11/2024	08:30	08:50	11	Strong breeze	SSE	Heavy	Good	30	No	Garmin not tracking
10	CB	29/11/2024	08:52	09:25	12	Strong breeze	SSE	Heavy	Good	60	No	
11	CB	29/11/2024	09:27	10:00	12	Strong breeze	SSE	Heavy	Good	60	No	
12	CB	30/11/2024	10:05	10:50	12	Strong breeze	S	Drizzle/mist	Good	90	No	
1	CF	19/12/2024	11:22	12:00	3	Strong breeze	NW	Showers	Good	95	No	
2	CB	19/12/2024	12:30	13:30	6	Strong breeze	NW	Showers	Good	100	No	
3	CB	19/12/2024	11:35	12:25	5	Strong breeze	NW	Showers	Good	100	No	
5	CF	19/12/2024	13:32	14:11	6	Strong breeze	NW	Showers	Good	100	No	
6	CF	19/12/2024	14:15	15:10	6	Strong breeze	NW	Showers	Good	95	No	
7	CB	19/12/2024	13:40	14:45	6	Strong breeze	NW	Showers	Good	95	No	

Turbine	Staff	Date	Start Time	Finish Time	T˚C	Wind Speed	Wind Direction	Rain	Visibility	Area covered	Carcass Found	Comments
8	CF	19/12/2024	12:12	13:04	4	Strong breeze	NW	Showers	Good	95	No	
9	CB	19/12/2024	11:00	11:30	5	Strong breeze	NW	Showers	Good	30	No	
10	CF	19/12/2024	10:21	11:10	2	Strong breeze	NW	Showers	Good	50	No	
11	CB	19/12/2024	10:10	10:55	4	Strong breeze	NW	Showers	Good	80	No	
12	CB	19/12/2024	09:30	10:05	4	Strong breeze	NW	Showers	Good	80	No	
1	PK	29/01/2025	09:29	09:58	4	fresh breeze	N	None	Good	95	No	
2	PK	29/01/2025	10:49	11:20	4	fresh breeze	N	None	Good	95	No	
3	CB	29/01/2025	11:40	12:30	4	fresh breeze	N	None	Good	100	No	CT on ground looks like it was lifted and thrown on ground
12	PK/CB	29/01/2025	09:00	09:30	3	fresh breeze	N	None	Good	95	No	
5	CB	29/01/2025	12:40	13:40	4	fresh breeze	N	None	Good	100	No	
6	PK	29/01/2025	12:21	12:50	4	fresh breeze	N	None	Good	85	No	
7	PK	29/01/2025	11:40	12:05	4	fresh breeze	N	None	Good	85	No	
8	CB	29/01/2025	10:45	11:35	4	fresh breeze	N	None	Good	100	No	
9	CB	29/01/2025	10:15	10:40	4	fresh breeze	N	None	Good	30	No	
10	PK	29/01/2025	10:06	10:32	4	fresh breeze	N	None	Good	50	No	CT Deployed
11	CB	29/01/2025	09:35	10:10	4	fresh breeze	N	None	Good	95	No	
1	CB	19/02/2025	10:00	10:45	8	strong breeze	SSE	None	Good	90	No	
2	CB	19/02/2025	11:40	12:20	9	strong breeze	SSE	Light	Good	95	No	
3	CB	19/02/2025	10:50	11:35	9	fresh breeze	SSE	None	Good	100	No	
12	CF/CB	19/02/2025	08:50	09:20	8	strong breeze	SSE	None	Good	90	No	
5	CF	19/02/2025	12:05	12:45	9	fresh breeze	SSE	Light	Good	100	No	
6	CF	19/02/2025	12:50	13:20	9	strong breeze	SSE	Light	Good	95	No	

Turbine	Staff	Date	Start Time	Finish Time	T˚C	Wind Speed	Wind Direction	Rain	Visibility	Area covered	Carcass Found	Comments
7	CB	19/02/2025	12:23	13:30	9	fresh breeze	SSE	Light	Good	80	No	
8	CF	19/02/2025	11:08	11:59	9	strong breeze	SSE	None	Good	95	No	
9	CF	19/02/2025	10:10	10:59	8	strong breeze	SSE	None	Good	40	No	
10	CB	19/02/2025	09:25	09:55	8	strong breeze	SSE	None	Good	90	No	
11	CF	19/02/2025	09:19	09:59	8	strong breeze	SSE	None	Good	90	No	
12	CB/CF	12/03/2025	07:20	07:50	3	moderate breeze	N	None	Good	90	No	
11	CB	12/03/2025	07:55	08:30	3	moderate breeze	N	None	Good	90	No	
9	CB	12/03/2025	08:35	09:00	4	fresh breeze	N	None	Good	25	No	CT collected carcass still there
8	CB	12/03/2025	09:15	10:00	4	fresh breeze	N	None	Good	100	No	
5	CB	12/03/2025	10:05	10:55	5	fresh breeze	NNE	None	Good	95	Yes	
2	CB	12/03/2025	11:00	11:50	5	fresh breeze	NNE	None	Good	95	No	
7	CF	12/03/2025	11:06	11:47	5	fresh breeze	NNE	None	Good	80	No	
1	CF	12/03/2025	10:22	11:01	4	moderate breeze	NNE	None	Good	90	No	
6	CF	12/03/2025	09:51	10:19	2	moderate breeze	N	None	Good	95	No	
3	CF	12/03/2025	08:53	09:46	2	moderate breeze	N	None	Good	100	No	
10	CF	12/03/2025	08:01	08:41	2	moderate breeze	N	None	Good	90	No	
1	CB	2025-04-02	08:50	09:40	8	fresh breeze	ese	none	good	90	n	CT deployed
2	CB	2025-04-03	10:55	11:45	11	fresh breeze	ene	none	good	100	n	
3	CB	2025-04-03	09:55	10:50	5	moderate breeze	ene	none	good	100	n	
12	CB	2025-04-02	09:45	10:45	9	fresh breeze	ese	none	good	90	n	

Turbine	Staff	Date	Start Time	Finish Time	T˚C	Wind Speed	Wind Direction	Rain	Visibility	Area covered	Carcass Found	Comments
5	CB	2025-04-03	07:55	08:45	6	moderate breeze	ene	none	good	95	n	not operating
6	CB	2025-04-03	08:50	09:50	6	fresh breeze	ene	none	good	95	y	
7	CB	2025-04-03	07:00	07:50	4	Fresh breeze	ne	none	good	90	y	
8	CB	2025-04-02	10:50	11:45	10	fresh breeze	ese	none	good	95	n	
9	CB	2025-04-02	08:20	08:45	7	fresh breeze	ese	none	good	30	n	
10	CB	2025-04-02	07:00	07:30	6	fresh breeze	ese	none	good	80	n	
11	CB	2025-04-02	07:35	08:15	6	fresh breeze	ese	none	good	90	n	CT recovered carcass still there
11	CB	2025-05-27	06:30	07:15	9	moderate breeze	s	moderate	good	90	n	turbines no operating
10	CB	2025-05-27	07:18	08:00	9	moderate breeze	ssw	moderate	good	70	n	vegetation thick limiting access
9	CB	2025-05-27	08:13	08:46	10	moderate breeze	ssw	heavy	good	30	n	
1	CB	2025-05-27	08:50	09:54	11	fresh breeze	ssw	heavy	good	80	n	
12	CB	2025-05-27	10:00	10:45	12	moderate breeze	wsw	showers	good	80	n	
8	CB	2025-05-28	05:55	06:45	10	moderate breeze	w	showers	good	90	n	all turbines spinning apart from t3
3	CB	2025-05-28	06:48	07:35	10	moderate breeze	w	showers	good	100	n	
5	CB	2025-05-28	07:43	08:25	11	fresh breeze	w	none	good	95	n	
2	CB	2025-05-28	08:27	09:20	11	fresh breeze	w	none	good	100	n	
6	CB	2025-05-28	09:22	09:45	12	fresh breeze	w	none	good	40	n	Cows and calves in survey area reduced coverage
7	CB	2025-05-28	09:50	10:50	12	fresh breeze	w	none	good	80	n	turbines no operating

APPENDIX 7-7

Hen Harrier Offsetting Plan

Appendix 7-7 - Hen Harrier Offsetting Plan

Taurbeg Wind Farm Extension of Operational Life

DOCUMENT DETAILS

Client:	**Taurbeg Ltd.**
Project Title:	**Taurbeg Wind Farm Extension of Operational Life**
Project Number:	**231030**
Document Title:	**Hen Harrier Offsetting Plan**
Document File Name:	**Appendix 7-7 Hen Harrier Offsetting Plan**
Prepared By:	**MKO** **Tuam Road** **Galway** **Ireland** **H91 VW84**

Rev	Status	Date	Author(s)	Approved By
F	Final	2025.07.03	DW	PC

Table of Contents

1. INTRODUCTION

1.1 Overview

Taurbeg Limited, the applicant, are applying to Cork County Council (CCC) for planning permission to extend the operational period of the existing Taurbeg Wind Farm (the 'Proposed Lifetime Extension') for an additional 10 years to 2036 after the expiry of its current planning permission in 2026. The existing wind farm development lies within the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA (hereafter "the SPA"), designated for Hen harrier (*Circus cyaneus*).

This Hen Harrier Offsetting Plan contains proposed measures to offset the identified *likely medium-term constant significant negative effect* to hen harrier as a result of (indirect) habitat loss due to avoidance of turbines during the Proposed Lifetime Extension. The comprehensive Offsetting Plan has been specifically designed to target the two key threats/pressures of *High Importance* of forestry and agricultural intensification to offset for the potential for impacts associated with the Proposed Lifetime Extension of the wind farm (*Medium Importance* - as per Article 12 reporting of the Birds Directive (Directive 2009/147/EC[1])). This document provides supporting information on how the hen harrier habitat loss was calculated, the rationale for selecting the offsetting lands and further discussion on how the management prescriptions of the Proposed Offsetting Plan will be implemented.

It is noted that this Proposed Offsetting Plan includes for permanent deforestation to offset in large part for a 10-year Proposed Lifetime Extension. In the event of a successful grant of permission, after the 10-year period the wind farm would be decommissioned but the Proposed Offsetting Lands will continue to be managed for the benefit of hen harrier. This offers considerable benefits to hen harrier in the long term.

1.2 Background

The Proposed Lifetime Extension has the potential for the ongoing displacement of hen harrier from the Site, in the absence of offsetting measures there is the potential for an ongoing *likely medium-term constant significant negative* (indirect) habitat loss effect, as detailed in Section 7.5.3.2 of Chapter 7 Birds of the EIAR. Accordingly, a comprehensive offsetting strategy is proposed. The Proposed Offsetting lands are located in Knockatee and Coom, Co. Kerry, approximately 11.5km east from the Taurbeg Wind Farm site and are situated entirely within the SPA.

The hen harrier population in Ireland is in decline[2]. In Ireland hen harrier prefer to hunt within pre-thicket forestry (Wilson *et al.* 2006; Wilson *et al.* 2010; Irwin *et al.* 2012), heath/bog (Wilson *et al.* 2010) and rough/marginal or low-intensity agricultural grassland habitats (Wilson *et al.* 2006; Irwin *et al.* 2012). Passerines are the predominant source of prey for hen harrier in Ireland, with the meadow pipit being the most commonly taken prey species[3]. The factors implicated in the population decline include human-related habitat modification and loss. Such habitat modification includes afforestation, agricultural intensification (*High Importance*) and the proliferation of turbines (*Medium Importance*) in the upland regions inhabited by breeding hen harrier, as outlined in Article 12 Reporting 2013-2018 (EU, 2022) and

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[1] *https://www.npws.ie/status-and-trends-ireland%E2%80%99s-bird-species-%E2%80%93-article-12-reporting*

[2] *Ruddock, M., Wilson-Parr, R., Lusby, J., Connolly, F., J. Bailey, & O'Toole, L. (2024). The 2022 National Survey of breeding Hen Harrier in Ireland. Report prepared by Irish Raptor Study Group (IRSG), BirdWatch Ireland (BWI), Golden Eagle Trust (GET) for National Parks & Wildlife Service (NPWS). Irish Wildlife Manuals, No. 147. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.*

[3] *O'Donoghue, B. G. (2010) The Ecology and Conservation of Hen Harriers (Circus cyaneus) in Ireland. PhD Thesis submitted to University College Cork.*

reiterated in the Hen Harrier Threat Response[4]. The Existing Taurbeg Wind Farm is located within the Stack's to Mullaghereirk Mountains, West Limerick Hills and Mount Eagle SPA, where the population is declining. The national threats/pressures of afforestation, agricultural intensification and the proliferation of turbines are also evident in these uplands, with afforestation in particular noted during the 2022 national survey as "*a substantial factor affecting the distribution and abundance of hen harrier in this region*".

The EU Biodiversity Strategy's objective is to put EU's biodiversity on the path to recovery by 2030 and that by 2050, all of the EU's ecosystems will be restored, resilient and adequately protected. It is noted that among other things, climate change is a key underlying driver of biodiversity loss. While the Proposed Lifetime Extension has the potential to negatively impact hen harrier, renewable energy plays a key role in counteracting climate change. It is this dichotomy that necessitates the consideration of reasonable alternatives that limit biodiversity loss while facilitating the retention of renewable energy developments such as the existing Taurbeg Wind Farm. To that end, the Offsetting Plan that accompanies this application aims to ensure that the retention of the existing Taurbeg turbines is not at the expense of suitable hen harrier habitats. This opportunity for the wind farm industry to fund the restoration of hen harrier habitat was highlighted in the most recent National Survey of Breeding Hen Harrier (2022) report. Section 4.6.7 states:

> "*There are opportunities for the wind energy industry to increase levels of land management certainty, and regulation/management of the activities within and surrounding windfarms (e.g. recreational users, dog walkers etc) and identify opportunities for the retention and restoration of habitats suitable for breeding (and wintering) hen harrier within and surrounding renewable energy developments.*"

At a national level the Hen Harrier Threat Response Plan (HHTRP) (2024-2028) identifies a need for innovation and collaboration to achieve the goals of the plan. Section 7 of the HHTRP sets out the actions that need to be taken to realise the objectives of the plan between 2024 and 2028. Collaboration with non-governmental stakeholders is identified as a key to the delivery of the plan.

The following Offsetting Plan is based on the best available scientific knowledge.

A key premise of the Offsetting Plan is that forestry is a net negative for hen harrier. Forestry is generally accepted to be a habitat that is a net negative for hen harrier, as it is only available to hen harrier for a short period while young (i.e. pre thicket). The majority of commercial forestry's lifecycle is spent as close canopy forestry, a habitat type of little to no ecological value to hen harrier. At a national level, as highlighted in Article 12 reporting, afforestation is a threat/pressure of high importance for hen harrier. Similarly, as per the Natura 2000 Data Form which lists site-specific threats and pressures for the SPA, '*sylviculture, forestry*' is allocated the highest rank. The forestry proposed for deforestation as part of this Offsetting Plan is at thicket stage and is therefore not useful to hen harrier. A key element of the Offsetting Plan is permanent deforestation to create optimal foraging habitat in its place for the benefit of hen harrier. While hen harrier do nest in forestry, deforestation as part of this Offsetting Plan will not significantly reduce the availability of nesting habitat within the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA. This SPA is heavily afforested. Thus, removing forestry to create hen harrier foraging habitat is a net positive.

Following the permanent removal of approximately 105.5ha of forestry and the restoration of a further 17.8ha of agricultural land for the benefit of hen harrier, residual impacts of no greater than negligible are predicted as a result of the Proposed Lifetime Extension.

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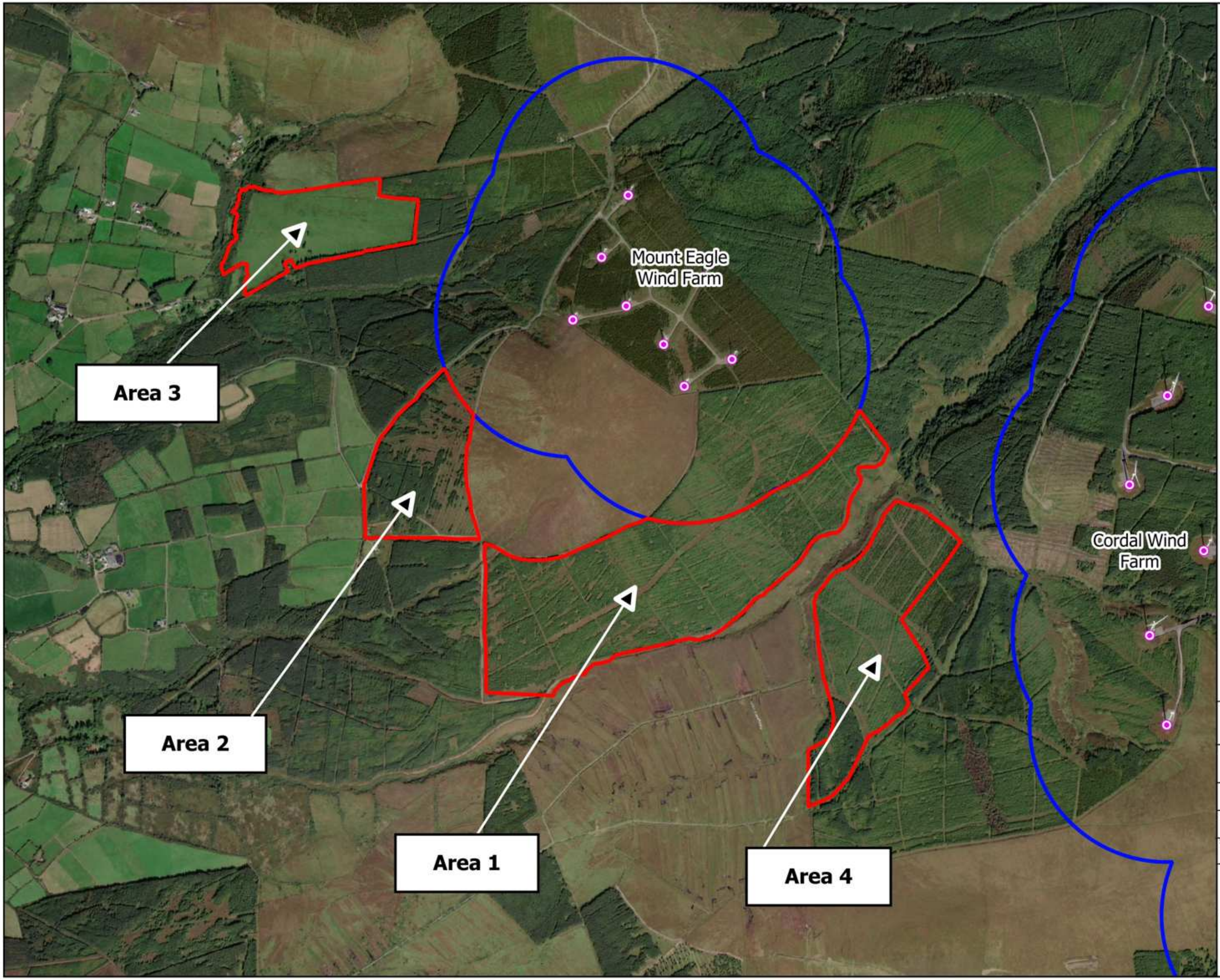
[4] *It is noted that this document does not rank the importance of these threats/pressures, although they are listed in the same order as here.*



Map Legend

🟥 Proposed Offsetting Lands

● Existing Turbines

🟦 500m Radius of Existing Turbines

N

Microsoft product screen shots reprinted with permission from Microsoft Corporation

Drawing Title Proposed Offsetting Lands	
Project Title Taurbeg Wind Farm Extension of Operational Life	
Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 1-1
Scale 1:18,000	Date 13.03.2025

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2. IDENTIFICATION OF OFFSETTING LANDS

The following sections outline the methodology used to firstly calculate habitat loss and secondly identify the offsetting lands.

2.1 Habitat Loss Calculation and Identification of Offsetting Lands

2.1.1 Assessment of potential foraging (indirect) habitat loss for Hen Harrier

The habitat loss calculation was undertaken with reference to the suitability of the habitats surrounding existing turbine locations and the likely distance turbines will be avoided by hen harrier.

The majority of the foraging recorded onsite was recorded during the breeding season and these records are likely associated with hen harrier breeding in the wider SPA. All turbines within the Site are included in this habitat loss calculation as the location of these turbines overlaps with potential foraging habitat.

The decline in hen harrier populations in Ireland is a result of human-related pressures, in particular habitat modification and loss. Research carried out by the University College Cork identified a 'possible' reduction in breeding success within 1km of turbines. The conclusion of a 'possible' reduction in breeding success rather than one of greater certainty was due to the analysis of breeding success being found to be statistically non-significant (Wilson *et al.,* 2015). Notwithstanding this, if it is assumed that hen harrier shows some level of avoidance of turbines with the associated habitat loss, it reasonably follows that avoidance would be more pronounced the closer the hen harrier was to the turbine. This was found to be the case in a multi-site study at twelve wind farms in Britain (Pearce-Higgins *et al.*, 2009). This study investigated the distance turbines were avoided by various species including hen harrier. It was reported in hen harrier that there was a reduction of 52.5% in activity within 500m of operating wind turbines and significant avoidance within 250m.

In this habitat loss calculation, it was conservatively assumed that there would be total avoidance of a buffer zone within a 250m radius of the existing wind turbines (in line with the result of Pearce-Higgins *et al.*, 2009)[5]. The assumption of 100% avoidance within 250m of wind turbines has been previously proposed in other recent planning permission applications for wind farm developments in the Republic of Ireland, following consultation with the National Parks and Wildlife Service, most notably on an application by DP Energy Ireland Ltd. for a proposed six-turbine wind farm in Buttevant, Co. Cork (Pl. Ref. No. 13/05885) and an application for a six-turbine extension to a previously permitted eight-turbine development by Esk Windfarm Ltd. on a site near Nad, Co. Cork (Pl. Ref. No. 14/05602).

Closed canopy forestry does not provide suitable habitat for hen harrier. As such, areas of this habitat within 250m of the existing turbines have not been included in the calculation of habitat loss. As the amount of closed canopy forestry within 250 metres of the existing turbines varies with the rotational cycle of forestry, calculations have been made using felling plans for the relevant folios as provided by SWS Forestry to determine the average amount of potentially available hen harrier habitat that will be unavailable on an annual basis throughout the proposed ten-year extension of the wind farm. These calculations are presented in Appendix A.

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[5] *Pearce-Higgins et al., (2009) noted significant avoidance of turbines to 250m. Figure 1 of Pearce-Higgins et al., (2009) shows that the reductions in hen harrier density mainly occur within 250m of a turbine. The statistical model from this paper assumes a linear relationship between bird density and distance from a turbine in 500m distance bands. This means that if the avoidance effect extends for less than 500m the model is likely to overpredict the displacement effect at 500m. There is therefore a sound scientific basis for using a 250m buffer rather than 500m for estimating the hen harrier displacement effect.*

Based on the precautionary assumption that hen harrier will avoid all areas within 250 metres of a turbine and having calculated the amount of foraging habitat available on an annual basis (taking into account standard forestry management practices for forested areas), the estimated quantum of habitat from which hen harrier will be displaced is **122.43 hectares**.

Taking into consideration this predicted impact and the Site's significance to foraging hen harrier; a habitat Offsetting Plan has been devised to create suitable foraging and breeding habitat for the species within the area.

2.1.2 The Rationale for Selecting Offsetting Lands

The Offsetting Plan aims to provide an increase in the availability of passerine prey (e.g. meadow pipits (please see Section 3.2.1 for further details)) within the Proposed Offsetting Lands to offset for the indirect loss of the foraging habitat due to avoidance through the ongoing operation of the existing Taurbeg Wind Farm. The Offsetting Plan aimed to identify forestry plots, occurring on peatland that could be converted to more suitable upland habitats for foraging hen harrier by deforestation, and farmlands that offer opportunities to significantly improve their ecological value to foraging hen harrier.

The land chosen for offsetting fulfils the requirement to maintain the overall coherence of the Natura 2000 network. The two key elements that have been addressed are the proportionality and ecological functionality of the Proposed Offsetting lands. The justification for the choice of the Proposed Offsetting lands includes the following:

- To address the requirement for proportionality, Proposed Offsetting lands have been proposed at a (slightly greater than) 1:1 ratio. In addition, the approximate 105.5ha of deforested lands will be restored to optimal hen harrier habitat and **permanently** managed as such.
- Offsetting is proposed within the SPA for which the hen harrier is the qualifying interest as this is preferable where ecological coherence and network functionality exist as per C(2021) 6913 part2/2[6] Section 3.3.3. These criteria are fulfilled as follows:
    - There is suitable habitat that runs in a contiguous block between the site of impact (Taurbeg Wind Farm) and the Proposed Offsetting lands. This same area likely hosts a single population with an exchange of individuals.
    - A plan is in place to create optimal hen harrier foraging habitat within the Proposed Offsetting lands. Please see Section 3 of this report for a detailed description of measures.
    - The Proposed Offsetting lands are proposed for the benefit of the SPA hen harrier population and ensure no loss of foraging habitat within the SPA due to the Proposed Lifetime Extension.
- Like-for-like habitat will be created within the SPA (i.e. foraging habitat will replace the foraging habitat indirectly lost through avoidance).
- The conservation objectives of the SPA that relate to forestry concern the maintenance of a diverse age class, therefore the proposed offsetting measures are not already foreseen in the SPA's specific conservation objectives and are thus additional.
- The deforestation in particular will increase the amount of contiguous open habitat and link two areas of optimal (heath/bog) foraging habitat to the north and south, as outlined in Figure 1-1 above and shown in Plate 2-1 below.

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[6] *Commission notice: Assessment of plans and projects in relation to Natura 2000 sites - Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC*

- The plan ensures the removal of closed-canopy forestry, that would not otherwise have been felled until maturity (and subsequently replanted) without intervention. Thus increasing '*spatial utilisation'* locally. Noting afforestation as a threat/pressure of high importance (as per Article 12 reporting).
- The removal of forestry will reduce negative edge effects through deforestation, e.g. predation.
- There is a high likelihood of the Proposed Offsetting lands being encountered by hen harrier as breeding hen harrier occur locally. As extrapolated from the results of the most recent National Hen Harrier Survey (Ruddock *et al.*, 2024), hen harrier were confirmed to have bred in all four 10km grid squares which overlap with the Proposed Offsetting lands in 2022 (i.e. R00, R01, R10 & R11) in 2022. Previous to this, hen harrier were confirmed to have bred in the 10km grid squares R10 and R11 as per the Bird Atlas 2007-11. There is therefore longstanding breeding activity locally.

Plate 2-1. Area 1 of Proposed Offsetting Lands viewed from the south, with open habitat of Mount Eagle summit visible behind and area of existing open habitat in the foreground to be joined into one contiguous area as part of Proposed Offsetting Plan.

2.2 Existing Baseline Condition

Habitat surveys of the Proposed Offsetting Lands were undertaken in October 2024 and January 2025. As shown in Figure 1-1, the Proposed Offsetting lands are divided into 4 areas, referred to as Area 1, Area 2, Area 3 and Area 4. Areas 1, 2 and 4 are dominated by Conifer Plantation (WD4) habitat. Other habitats such as Upland Blanket Bog and Wet Heath are located in small proportions and along the margins of Areas 1, 2 and 4. Area 3 is dominated by wet grassland (GS4) habitat with an area of (Mixed) broadleaved woodland (WD1) present within the western end. Other habitats such as hedgerows (WL1) and treelines (WL2) are present along the periphery of Area 3.

A full description of habitats recorded within the Proposed Offsetting Lands is provided in Section 6.6.2 of Chapter 6 Biodiversity of the EIAR, including a habitat map and location of rhodendron stands recorded.

3. HEN HARRIER OFFSETTING PLAN

The Proposed Offsetting Plan involves a combination of permanent deforestation and restoration of farmland habitat, specifically designed to offset the identified potential *likely medium-term constant significant negative effect* to hen harrier as a result of (indirect) habitat loss due to avoidance of turbines during the Proposed Lifetime Extension. The combined area totals 123.2ha.

3.1 Main Objectives

The main objective of this hen harrier Offsetting Plan is to create, maintain and improve habitats for the benefit of hen harrier. It is recognised that anything that benefits potential prey species is of benefit to the hen harrier. The Offsetting Plan (following this principle) aims to provide an increase in the availability of passerine prey within the Proposed Offsetting lands to offset for the loss of the foraging habitat due to the ongoing operation of the existing Taurbeg Wind Farm. A key principle of the plan is the more diverse the plant species within the restored habitats the greater the diversity and abundance of passerines. For example, a monoculture of commercial forestry is likely to be significantly less diverse and hold far fewer passerines than the same area of dry heath. Hen harrier also favours open habitats for foraging over closed canopy forestry, as, among other things, prey is more accessible in open habitats.

Four parcels of land, totalling 123.2ha, are proposed to offset for the predicted (indirect) habitat loss due to avoidance. Please see Figure 1-1 further above for location details. Offsetting Areas 1, 2 and 4 are currently commercial forestry. Area 3 comprises agricultural land, classified as wet agricultural grassland which has evidence of past improvement (please see Section 2.2 above for further details). These areas are currently of low ecological value and all provide opportunities to significantly improve their ecological value to foraging hen harrier. The key points recommending these lands for restoration measures are as follows:

- Forestry is a net negative for hen harrier as it is only available to the species while young (>10-12 years typically) and after canopy closure is of no ecological value. As previously outlined, afforestation is identified by Article 12 reporting as a key threat/pressure of high importance.
- The wet improved grassland of Area 3, has considerable potential to be restored to a biodiverse meadow with significantly more passerines than are currently present. As previously outlined, agricultural intensification is identified by Article 12 reporting as a key threat/pressure of high importance.

The following text provides an outline of the rationale underpinning the Offsetting Plan, what measures are proposed, how and who will implement them and a timeline to their likely success. This is outlined firstly for the forestry land and secondly the wet grassland with signs of improvement.

3.2 Forestry Removal (Areas 1, 2 & 4)

It is proposed to permanently remove c. 105.5 hectares of forestry and to create more biodiverse upland habitats suitable for foraging hen harrier. This measure ensures the provision of high-quality replacement peatland habitat to offset for the loss of onsite habitat through avoidance. Commercial forestry is associated with lower breeding success, is only of limited value to hen harrier while young and is of little to no ecological value once its canopy closes at c.12 years old. Please refer to Figure 1-1 for location details.

The habitats recorded within these areas are detailed in Section 6.6.2 of Chapter 6 Biodiversity of the EIAR. In summary, much of the Offsetting Areas 1, 2 & 4 are comprised of conifer plantations and include areas which did not take well to the wet, peaty soils resulting in patchy mosaics of conifer plantations (WD4) and areas in which the species composition is characteristic of upland blanket bogs (PB2) and wet heath (HH3). Sections within the forestry plantations of the central and southern Proposed Offsetting lands including firebreaks as well as areas in which the forestry failed had species compositions which were characteristic of upland blanket bog (PB2). There are also areas of dense conifer plantations (WD4 – Fossitt habitat codes), with sitka spruce (*Pichea sitchensis*) dominating these areas. Gaps in these dense plantations come in the form of access paths and fire breaks allowing light and in turn more plant growth in some sections.

The small areas of remnant wet heath and upland blanket bog vegetation within Areas 1, 2 & 4, and upslope of these lands (i.e. Mount Eagle summit) will act as the (passive) donor seed bank post-felling. Passerine prey is already abundantly present in the adjacent heath to the north and south of the Proposed Offsetting lands (as noted during site visits in October 2024 and January 2025). There is therefore no foreseen barrier to entry for passerines to populate the Proposed Offsetting lands once created.

3.2.1 Overview

The first task of the Offsetting Plan was to identify the target habitat the Proposed Offsetting lands would be restored to. The target habitat for the currently afforested lands was wet heath due to the nature of the sloping site and the occurrence of the habitat locally. Its occurrence nearby was taken to indicate that the habitat could be created within these lands given similar conditions. The first and most important step to facilitate the restoration of the underlying peatland of the Offsetting Areas 1, 2 and 4, will be to permanently remove the forestry. All three areas are sloping and are likely to transition (following deforestation) into heather-dominated wet heath. To aid this transition to wet heath several key steps are required to promote/avoid inhibiting the growth of the key target species of *Calluna vulgaris* (ling heather). To that end, the following information from a literature review will inform the restoration of the three areas (Areas 1, 2 and 3).

A 2023 Norwegian study (Iren Saure *et al.*, 2023) on the restoration of heathland after deforestation found that *Calluna* established immediately after clear-felling. This was considered to be “most likely due to germination from a persistent *Calluna* soil seed bank, facilitated by clear-felling and soil disturbance by forestry machines (*Walker et al.* 2004, Allison & Ausden 2006, Henning *et al.* 2017) and favourably acidic and nutrient-poor soil conditions (Pywell *et al.* 2002, Walker *et al.* 2004). It is known that seed longevity of *Calluna* may exceed 60 years in the soil (Bakker *et al.* 1996).” The literature also states that each restoration project likely needs to be considered on its own merits. Notwithstanding this, there are commonalities among projects that are unsuccessful, which include a lack of a seed bank of the target *Calluna* species, the re-encroachment of conifers and tramping/overgrazing. In the present case, conditions are favourable for the establishment of *Calluna vulgaris* (ling heather). As there is likely a vast seed bank of *Calluna vulgaris* (ling heather) seed under the forestry of the Offsetting land from the abundant adjoining ling heather upslope, and from the understory of the conifer plantation currently in Areas 1, 2 and 4. Forestry will be removed and the machinery involved in the deforestation will provide the necessary soil disturbance to facilitate germination. The soil is likely acidic and nutrient-poor due to the recent cultivation of the commercial forestry on the land. Additionally, the following further interventions are considered necessary - seedling conifers will be removed and livestock-proof fencing will be installed to prevent tramping and overgrazing.

The forestry of Areas 1 and 4 will be permanently felled to waste owing to the difficulty in removing the timber from the sloping land. A Peat Stability Risk Assessment undertaken at the Proposed Offsetting lands by Gavin and Doherty Geosolutions (GDG) in January 2025 advised against the removal of this timber from these lands. The timber will be piled in windrows at 50m intervals. This practical requirement has been assessed for its implications on the distribution and abundance of avian prey species. The likelihood is that the presence of wood debris piles might change the composition of the passerines present, but the areas will remain of good ecological value to foraging hen harrier. A 2010 study found that wood debris piles benefited avian species (e.g. warbler spp., robin, chaffinch etc.) in burnt and logged Mediterranean pine forests (Rost et al., 2010). The habitat heterogeneity created by the inclusion of the wood debris piles allows for the coexistence of avian species with different habitat requirements, in the present case, this would likely include warbler spp. in the wood piles and more open habitat species in the large areas of open habitat between wood piles, e.g. meadow pipits and skylark.

The timber in Area 2 will be removed from site due to the easy access to the adjoining road network in this location. Optimal habitat locally includes heather-dominated wet heath on sloping ground with areas of patchy willow-dominated scrub. To mirror such habitat in the surrounding landscape, it is also proposed to plant a patchwork of scrub within Areas 1 and 4. The aim is to increase habitat heterogeneity and thus create more favourable hen harrier habitat. There are existing patches of self-seeded scrub within Area 2 where forestry has failed. These will be retained as part of the proposed measures.

Tables 3-1 to 3-3 provide an outline of the timeline of the works and key responsibilities.

Table 3-1. Area 1 restoration timeline.

Phase	Timing	Habitat	Habitat Value	Actions	Responsibility
Preparation	Immediately Post-Consent	Commercial forestry with wet heath in firebreaks. Sloping ground.	Low ecological value. The good quality dry heath is being devalued by the presence of adjoining forestry, i.e. prey accessibility diminished as hen harrier avoid forestry when foraging.	Permanent felling to waste	Taurbeg Ltd will commission a suitable forestry consultant) to undertake the required deforestation.
	Immediately Post-Consent	Open/bare ground (forestry felled), with good quality dry heath in firebreaks. Sloping ground.	Low-moderate ecological value.	Timber to be stacked in windrows at 50m intervals. Approximately 28 No. plots of 0.2ha patches of scrub planted, scrub species planted at 2m intervals, please see Figure 3-2 for details. Erect livestock-proof fencing to prevent overgrazing.	Taurbeg Ltd will commission a suitable forestry consultant to undertake the required works.
Operation	Within 1 year post-consent	Revegetating dry heath, with a patchwork of scrub. Sloping ground likely to favour ling heather proliferation.	Moderate ecological value.	Passive action: revegetation in progress, the recolonising monitored at a series of relevés.	Taurbeg Ltd will commission an ecologist with relevant experience to undertake the habitat survey.

Phase	Timing	Habitat	Habitat Value	Actions	Responsibility
	For remainder of Extension of Operational Life	Dry heath, with a patchwork of scrub. Sloping ground.	Good ecological value. Heather dominated dry heath (typical of sloping dry heath).	Area revegetated, the evolving species composition will be monitored at a series of relevés. Self-seeded conifers hand-pulled/cut to ground level in year 5 (September to December 2030). Forestry drains were not maintained recently, and no further maintenance is proposed.	Taurbeg Ltd will commission an ecologist with relevant experience to annually undertake the habitat survey.
After decommissioning	Ongoing (permanent)	Dry heath, with a patchwork of scrub. Sloping ground.	Good ecological value	Area revegetated, the evolving species composition will be monitored at a series of relevés.	Taurbeg Ltd will commission an ecologist with relevant experience to undertake the habitat survey at 5-year intervals with a key focus on identifying conifer seedlings for removal.

Table 3-2. Area 2 restoration timeline.

Phase	Timing	Habitat	Habitat Value	Action	Responsibility
Preparation	Immediately Post-Consent	Commercial forestry with large areas of failed forestry with patches of	Forestry of low ecological value. Failed forestry includes willow-dominated scrub that is being	Deforestation with timber removed from site.	Taurbeg Ltd will commission SWS (forestry consultant) to

Phase	Timing	Habitat	Habitat Value	Action	Responsibility
		mature scrub and vegetation characteristic of wet heath. Sloping ground.	devalued by the presence of adjoining forestry i.e. prey accessibility diminished as hen harrier avoid forestry when foraging.		undertake the required deforestation.
	Immediately Post-Consent	Open/bare ground (forestry felled), with good quality dry heath with patches of mature scrub. Sloping ground.	Moderate ecological value: with the removal of the forestry the existing mature scrub is opened up/made available to foraging hen harrier.	Timber, brash and stumps removed from area. Erect livestock-proof fencing to prevent overgrazing.	Taurbeg Ltd will commission a suitable forestry consultant to undertake the required works.
Operation	Within 1 year Post-Consent	Revegetating dry heath, with a patchwork of mature scrub. Sloping ground likely to favour ling heather proliferation.	Good ecological value.	Passive action: revegetation in progress, the recolonising monitored at a series of relevés.	Taurbeg Ltd will commission an ecologist with relevant experience to undertake the habitat survey.
	For Remainder of Extension of Operation Life	Dry heath, with a patchwork of scrub. Sloping ground.	Good ecological value. Heather dominated dry heath (typical of sloping dry heath).	Area revegetated, the evolving species composition will be monitored at a series of relevés. Self-seeded conifers hand-pulled/cut to ground level in year 5 (September to December 2030).	Taurbeg Ltd will commission an ecologist with relevant experience to annually undertake the habitat survey.

Phase	Timing	Habitat	Habitat Value	Action	Responsibility
				Forestry drains were not maintained recently, and no further maintenance is proposed.	
After decommissioning	Ongoing (permanent)	Dry heath, with a patchwork of scrub. Sloping ground.	Good ecological value. Heather dominated dry heath (typical of sloping dry heath).	Area revegetated, the evolving species composition will be monitored at a series of relevés.	Taurbeg Ltd will commission an ecologist with relevant experience to undertake the habitat survey at 5-year intervals with a key focus on identifying conifer seedlings for removal.

Table 3-3. Area 4 restoration timeline

Phase	Timing	Habitat	Habitat Value	Action	Responsibility
Preparation	Immediately Post-Consent	Commercial forestry with wet heath in firebreaks. Sloping ground.	Low ecological value. The good quality dry heath is being devalued by the presence of adjoining forestry i.e. prey accessibility diminished as hen harrier avoid forestry when foraging.	Permanent felling to waste	Taurbeg Ltd will commission a suitable forestry consultant) to undertake the required deforestation.
	Immediately Post-Consent	Open/bare ground (forestry felled), with good quality dry heath in firebreaks. Sloping ground.	Low-moderate ecological value	Timber to be stacked in windrows at 50m intervals. Approximately 14 No. plots of 0.2ha patches of scrub planted, scrub	Taurbeg Ltd will commission a suitable forestry consultant to undertake the required works.

Phase	Timing	Habitat	Habitat Value	Action	Responsibility
				species planted at 2m intervals, please see Figure 3-2 for details. Erect livestock-proof fencing to prevent overgrazing.	
Operation	Within 1 year Post-Consent	Revegetating dry heath, with a patchwork of scrub. Sloping ground likely to favour ling heather proliferation.	Moderate ecological value.	Passive action: revegetation in progress, the recolonising monitored at a series of relevés.	Taurbeg Ltd will commission an ecologist with relevant experience to undertake the habitat survey.
	For remainder of Extension of Operational Life	Dry heath, with a patchwork of scrub. Sloping ground.	Good ecological value. Heather dominated dry heath (typical of sloping dry heath).	Area revegetated, the evolving species composition will be monitored at a series of relevés. Self-seeded conifers hand-pulled/cut to ground level in year 5 (September to December 2030). Forestry drains were not maintained recently, and no further maintenance is proposed.	Taurbeg Ltd will commission an ecologist with relevant experience to annually undertake the habitat survey.

Phase	Timing	Habitat	Habitat Value	Action	Responsibility
After decommissioning	Ongoing (permanent)	Dry heath, with a patchwork of scrub. Sloping ground.	Good ecological value	Area revegetated, the evolving species composition will be monitored at a series of relevés.	Taurbeg Ltd will commission an ecologist with relevant experience to undertake the habitat survey at 5-year intervals with a key focus on identifying conifer seedlings for removal.

In practise the Propose Offsetting Measures will be achieved as outlined in the next section.

3.2.2 Deforestation Measures

- The identified areas of existing forestry will be permanently felled, i.e. Areas 1, 2 and 4. These areas will be allowed to revert to heath habitat. A Peat Stability Risk Assessment was undertaken at the Proposed Offsetting Lands by Gavin and Doherty Geosolutions (GDG) in January 2025. The results of this study have informed the forestry removal measures outlined in this plan. Machinery movements within the area will be minimised to limit disturbance to existing heath vegetation and peat soils.

- Forestry drains were not maintained recently, and no further maintenance is proposed (unless required as part of the felling license).

- There are three areas within the Offsetting Plan where deforestation is proposed, i.e. Areas 1, 2 and 4. The timber will be permanently felled to waste in Areas 1 and 4, whereas the timber will be removed from the site in Area 2 due to the easy access to the adjoining road network in this location. All relevant Forest Service Archaeological, Environmental and Water Quality guidelines will be adhered to.

    - **Areas 1 and 4**

        - The timber in Areas 1 and 4 will be permanently felled to waste. The timber and brash emanating from deforestation will be collected and stacked in windrows approximately 50m apart (see Figure 3-1 below). Stumps will be left in situ. This has the benefit of avoiding excessive machinery movements which would be required to remove felled material off-site. The ground will be supported by brash in areas where machinery movements are required to facilitate deforestation. Timber will be cut and stacked and compressed by the tracked machinery to keep the windrows tight and narrow. The windrows will be c. 2-3m wide.

        - A tracked excavator machine with shears/ harvester head (Machine 1) will cut the trees, and following this, the harvesting operator will swing around and drop the entire tree as far as needed (typically up to 12m from where it was cut)

        - From here, the cut tree will be picked up by a second tracked excavator machine (Machine 2) with a dyke/rock bucket or grab.

        - The tracked excavator machine will swing around again (c. 12m away) resulting in a windrow being located *c.*24 meters from where furthest away trees were cut.

        - The process would then be replicated from the other side so that a windrow (c. 2-3 m wide) comprising approximately 50m of crop is created.

        - The tracked excavator machine will, using its attachment, compress the material so as to keep the windrows tight and as narrow as possible.

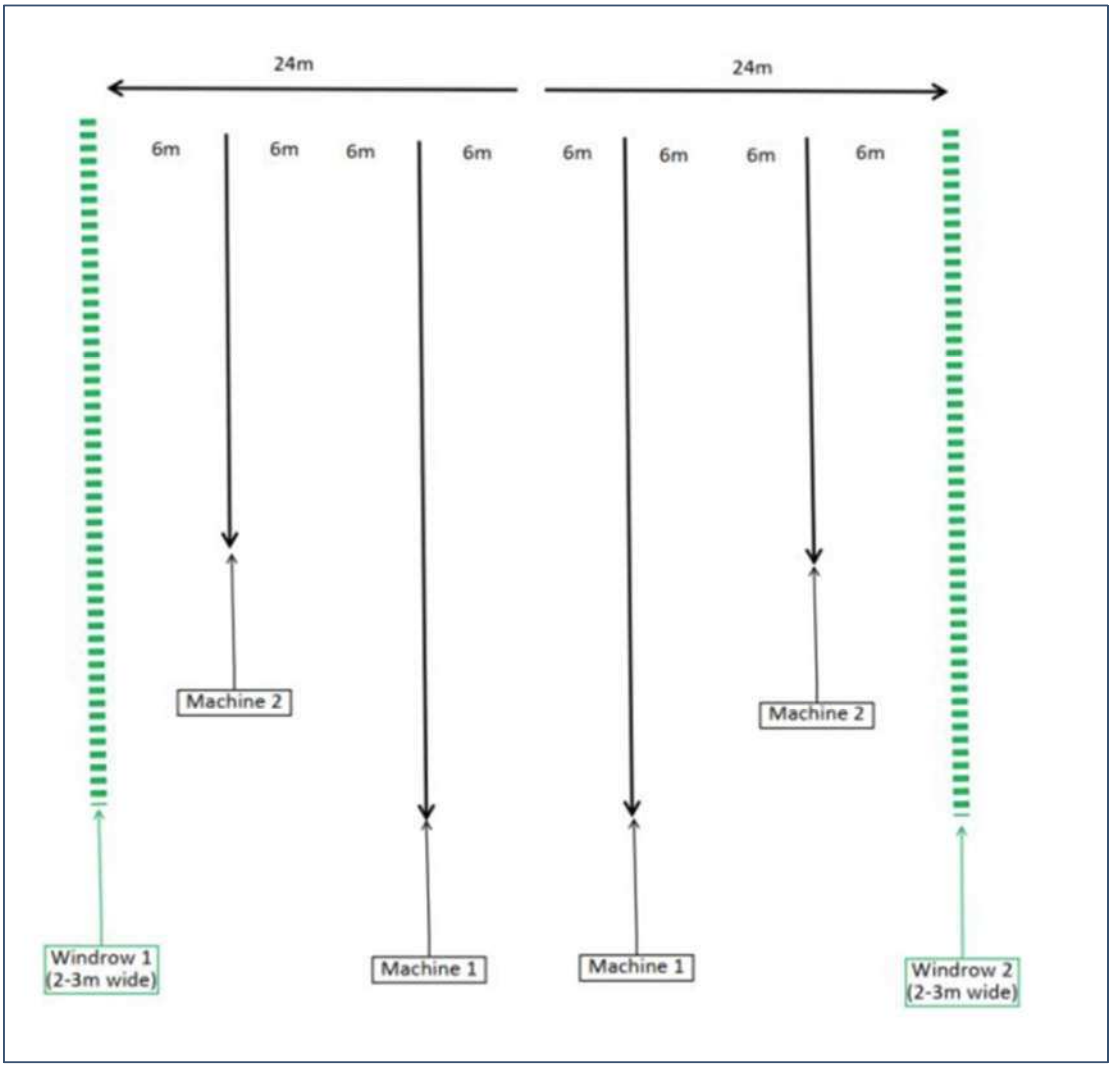

Figure 3-1. Windrows proposed at the Proposed Offsetting lands.

- Area 2
  - The timber in Area 2 will be removed from site. The stands of timber are adjacent to the road network and as such the existing good quality heath habitat that occurs on the opposite side of this site at the Mount Eagle summit will be avoided by machinery. The machinery entering/exiting the site will make use of the existing tracks to minimise disturbance to the peat soils. The ground will be supported by brash in areas where tracked machinery movements are required to facilitate deforestation. Timber will be stacked at the entrance to dry before being removed from the site.
  - The forestry crop will be cut using shears or a harvesting head on a tracked excavator.
  - A forwarder will then draw all material (whole trees) to a temporary storage area near the existing entrance off the public road network (L10750).
  - The forwarder will use temporary brash tracks to support the ground upon which it is travelling, bringing approximately 5 ton loads of entire trees to the storage area at a time.

  - Brash will be replenished as required, should ground conditions disimprove in order to minimise the impact of machinery causing rutting.
  - Permanently felled forestry (estimated total volume c. 2,000 ton) will be left on site at the storage area for 4-6 months to dry out.
  - Following this, a chipping machine will be brought on site, with the felled trees being chipped and blown into lorries for onward delivery to biomass plants.

- The existing areas dominated by remnant heath vegetation within firebreaks and along access tracks will be preserved by cordoning them off as 'no go' zones for machinery by a suitably qualified Ecological Clerk of Works (ECoW). No vehicle movements will take place within the existing large central firebreak of Area 1 (see Figure 3-2). This area comprises conifer plantation with some remnant wet heath habitat in the understory and failed areas of forestry. These areas will be retained as part of the Offsetting Plan. Vehicle movements will be restricted within the small north-south existing firebreaks.

- Self-seeding conifers originating as windblown seedlings from adjacent and nearby commercial conifer plantations, are a threat to the viability of the Proposed Offsetting. They gradually take hold, and if unmanaged, would eventually make the area unsuitable for nesting/foraging hen harrier. Habitat maintenance of the area will involve the eradication of self-seeding conifers, and removal off-site. It is envisaged that the Proposed Offsetting lands will require maintenance twice during the Proposed Lifetime Extension period, once after approximately 5 and 10 years. Similarly should birch spp. self-seed into these Proposed Offsetting lands they will be coppiced during the same visits. The monitoring outlined in Section 5 below will monitor the level of encroachment by self-seeding conifers and will bring the scheduled removal forward as required.

- Some small stands of rhododendron (*Rhododendron Ponticum)* were recorded within Areas 1, 2 & 4 of the Proposed Offsetting Lands during site visits in January 2025 (see Section 6.6.2 of Chapter 6 Biodiversity of the EIAR for locations). Measures for the management of rhododendron within the Proposed Offsetting Lands are outlined below.

  - A pre-commencement survey for Rhododendron will be carried out within Areas 1, 2 and 4 of the Proposed Offsetting Lands to determine the extent and locations of Rhododendron prior to the Proposed Offsetting Measures taking place.
  - All Rhododendron plants will be geolocated.
  - A cut will be made at the base of each stem of each Rhododendron plant, after which a herbicide (glyphosate) will be applied to cut.
  - Plants will be left in place and revisited for repeat treatment after 6 months.
  - Rhododendron plants will not be interfered with during the deforestation operations in Areas 1, 2 and 4.
  - After 1 year all, Rhododendron plants will be revisited to assess the effectiveness of treatment.
  - If Rhododendron plants are dead, they will be cut at the base and left on site to decompose.
  - If Rhododendron plants are alive then another treatment cycle as outlined above will be undertaken.

  - An invasive species survey of Areas 1, 2 and 4 of the Proposed Offsetting Lands will be carried out each year following the Proposed Offsetting Measures for 10 years (2026-2036). This survey will be carried out by a competent ecologist. Any new areas of Rhododendron will be geolocated and subject to treatment.
  - If seedling Rhododendron are identified during the yearly invasive species surveys, hand removal of emerging seedlings can be conducted in order to deal with any residual rhododendron.
  - After 2036, the Applicant will commission an ecologist with the relevant experience to undertake invasive species surveys at 5-year intervals with a key focus on identifying Rhododendron seedlings or plants for removal.

- Due to soil conditions within Areas 1, 2 & 4, as informed by the Peat Stability Risk Assessment, deforestation will be carried out when ground conditions are dry. It is therefore anticipated that deforestation works will commence in August, in order to both avoid the core bird nesting season (i.e. March – July[7]) and coincide with suitable ground conditions. The works are anticipated to be undertaken over a period of one to two months. Surveys are currently on-going of the Proposed Offsetting Lands in breeding season 2025, and results from these surveys will inform these works. Pre-commencement monitoring is also included as part of this plan, detailed in Appendix 7-8 Bird Monitoring Programme. In summary, surveys will include a thorough walkover survey within a 500m radius of the works areas, where access allows, in addition to breeding raptor surveys undertaken at two vantage points overlooking the Proposed Offsetting Lands. If breeding activity of birds of high conservation concern is identified, no works shall be undertaken within a species-specific buffer in line with best practice (Forestry Commission Scotland, 2006; Goodship and Furness 2022; Ruddock and Whitfield, 2007), until it can be demonstrated that the nest is no longer occupied.
- The felling license for these lands will be applied for prior to any works. The felling license will include management prescriptions for the deforestation. Following deforestation, the Proposed Offsetting lands will be managed for the benefit of hen harrier.
- The Applicant will engage a suitably qualified ornithologist to monitor for nesting hen harrier. If at any point, hen harrier are identified to be nesting on any part of the Proposed Offsetting Lands, the Applicant will provide for the protection of the nest site.
- The use of poisons or stupefying baits is not permitted within Proposed Offsetting Lands. Hen harriers and other birds of prey can fall victim to secondary and direct poisoning.

3.2.3 Creation of Patchy Scrub Habitat

Areas of patchy scrub will be planted within Areas 1 and 4 (as detailed in Tables 3-1 and 3-2) in order to create a diversity of vegetation structures to provide cover and resources for hen harrier prey species.

- Scrub patches will be planted using a mix of bare-root saplings and 2-3 year old potted trees to provide some structural diversity and to maximise establishment success.
- Areas for planting will measure approximately 0.2ha in size and not exceed 10% of the total area of Areas 1, 2, or 4. The scrub will be distributed throughout the deforestation areas.

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[7] *Irwin* et al. *(2011). The breeding biology of Hen Harriers Circus cyaneus in Ireland over a five year period. Irish Birds 9: 165-172.*

- Patches of existing native scrub remaining post- deforestation will be targeted for reinforced through planting.

The following species, which are present locally and are suitable for the upland exposed location with peat soils, will be used:

- Grey willow (*Salix cinerea)*
- Birch (*Betula pendula*)
- Alder (*Alnus glutinosa*)
- Hawthorn (*Crataegus monogyna)*
- Blackthorn (*Prunus spinosa)*
- Holly (*Ilex aquifolium)*
- Hazel (*Corylus avellana)*
- Elder (*Sambucus nigra)*
- Rowan (*Sorbus aucuparia)*

3.2.4 Permanent Predator Exclusion Fencing

Overview

Hen harrier nests are prone to predation by mammalian and avian predators (Baines & Richardson, 2013[8]). The predation of nests has been identified as a threat/pressure to hen harrier in Ireland as per the Hen Harrier Threat Response Plan (*Medium* ranking), with a total of 20% of breeding failures being attributed to predation during the 2015 National Hen Harrier Survey. As such, this Offsetting Plan includes measures to protect potential nesting hen harrier from predation by ground predators. This is to be achieved by the installation of a permanent predator exclusion fence surrounding the identified highest quality nesting habitat within the Offsetting lands. This identified area comprises the entirety of the existing central firebreak within Area 1 (as outlined in Figure 3-2 further below). A representative image of the existing habitat within this area is shown in Plate 3-1 below.

The following measures will be undertaken:

- The Applicant will engage a suitably experienced contractor to supply and install the fence to the specifications detailed in the following section.
- The fence will be installed immediately post- deforestation.
- A monitoring visit will be carried out each year to assess the condition of the fence and identify any areas for repair / replacement, in addition to assessing the habitat within the fenced area. These monitoring visits will inform the need for habitat management (e.g. tree removal, thinning etc,) to ensure the habitat within the fenced area remains viable as nesting habitat for hen harrier.

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[8] *Baines, D. & Richardson, M. 2013. Hen harriers on a Scottish grouse moor: multiple factors predict breeding density and productivity. J. Appl. Ecol. 50: 1397–1405*

Plate 3-1. Representative picture of existing central firebreak within Area 1 where permanent predator exclusion fencing is proposed.

Specification

The fence specification has been chosen in order to successfully exclude ground predators potentially present in this area (e.g. Red Fox, Badger, Otter, American Mink, Irish Stoat and Pine Marten). The NPWS, as part of recent conservation measures within the Termoncarragh Lake and Annagh Marsh SPA, have provided detailed specifications for permanent predator exclusion fencing for this specific purpose[9]. The proposed permanent predator exclusion fencing within the offsetting lands has therefore been designed based on these specifications, as detailed below. Images of example permanent predator exclusion fencing to a comparable specification are provided in Plates 3-2 and 3-3 further below for illustrative purposes.

Construction of the proposed fence structure will be to the following specifications:

- Strainer posts shall be a minimum of 3.5m long, have a minimum diameter of 15cm and shall be driven a minimum of 90cm into the ground. Strainers shall be placed at the beginning and end of every length of fencing and at ever change of direction where the angle is greater than 30°. Strainers must also be used to accommodate any significant change in gradient and be strutted in the line of the fence. Strainers on 90° corners must be H framed and strutted. Maximum distance between strainer posts shall not exceed 100m. Strainers shall be incised (posts to be treated in accordance with IS 436);
- Intermediate posts shall be around 2.5m long, have a minimum diameter of 10cm and shall be driven a minimum of 60cm into the ground.
- Intermediate posts shall be spaced at no more than 2.5m intervals and be H framed on every change of direction. Posts shall be incised (posts to be treated in accordance with IS 436);

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[9] *NPWS (2023). Screening for Appropriate Assessment. Adoption of necessary conservation measures within Termoncarragh Lake and Annagh Marsh Special Protection Area in accordance with Regulation 42A EC (Birds and Natural) Habitats Regulations 2011-2021. Available at https://assets.gov.ie/static/documents/2023-11-07-eau-adoption-of-ncm-termoncarragh-lake-23-134.pdf*

- High tensile 1580mm Tornado badger wire R15/158/5, to a height of 130cm off the ground forms the main body of the fence; the bottom 28cm is to be buried;
- The Tornado badger wire is to be overlain with 16-gauge, hot dipped galvanised 25mm square weld mesh (clipped to the top of the badger wire using hog rings) and both are to be dug in (by pulling back and relaying the sod) to prevent animals digging under the fence.
- Four strands of high tensile 12-gauge electric wire, tensioned and placed along the outside of the fence at 3cm, 15 cm and 25cm height above the top of the badger wire using UV resistant screw insulators. A fourth strand to be attached above these via 20cm UV resistant offset insulators to give total fence height of around 170cm. All strands connected to a single circuit although the second line at 15cm is an Earth wire. An additional live wire, connected to the single circuit, to be attached using UV resistant screw insulators on the inside of the fence at around 100cm to stop stock rubbing on posts;
- All wire to be connected using Gripple wire joiners;
- All access gates should be a minimum of 3.6m wide and at least 1.2 m high. All steel gates shall be hot dip galvanised in accordance with EN 1461 and 12 be overlain with 16-gauge, hot dipped galvanised 25mm square weld mesh, square cornered at bases and with hot dipped galvanised 45° angled brackets attached at top and overlain with same hot dipped galvanised weld mesh. Hot dipped galvanised gate post, concreted in, to be used and these to be independent of any strainer / fence post (two gates already have galvanised gate posts, and these can remain and be used). Gates to be hung using suitably sized proprietary gate hangers and the gate base shall be around 3cm above the ground. The gates also must be fitted with an adequate system which shall securely keep the gate closed. Handle openings must be secured against predators. Each gate to have a poured concrete apron buried (25-30cm) under the gate to prevent digging;
- Insulated underground cable (IB5) is to be buried under each gate, connecting the electric wires either side and ensuring the fence remains live when gates are opened;
- There are no watercourse flow points within the proposed predator exclusion fence area. However, at any gullies or other similar depressions where deemed required, dams to prevent otter / mink access whilst maintaining flow through will be installed. To use a 300mm twin wall corrugated unperforated drainage pipe and 10-15cm or similar crushed rock. Ensure to incorporate buried Tornado badger wire above. At each pipe ends use hot dipped galvanised 25mm square weld mesh in a frame secured to the pipe to prevent animals gaining access but at same time allows for the mesh to be removed easily to clear debris. In addition, fix a section of Tornado badger wire across the watercourse width, around 5m upstream of the drainage pipe to act as a catch point to keep most debris away from the 25mm square weld mesh panel at the pipe end; and,
- Supply and installation of a solar panelled fencer (PEL Unigizers - High Power Solar Fencers - PE406S or similar) and 4 x 1.5m earth bars.

Plate 3-2. Example predator-proof fencing broadly in-line with proposed specifications (for illustrative purposes only)[10].

Plate 3-3. Example predator-proof fencing and access gate broadly in-line with proposed specifications (for illustrative purposes only. source - as per above).

Note: Figure 3-2 overleaf shows the indicative plan of measures for Areas 1, 2 & 4. This is purely for illustrative purposes only in order to broadly present the suite of proposed measures within the context of the Proposed Offsetting Lands. The placement of some of these measures (e.g. proposed scrub patches and windrow placement) will be subject to site-specific assessment prior to implementation and will therefore be subject to change.

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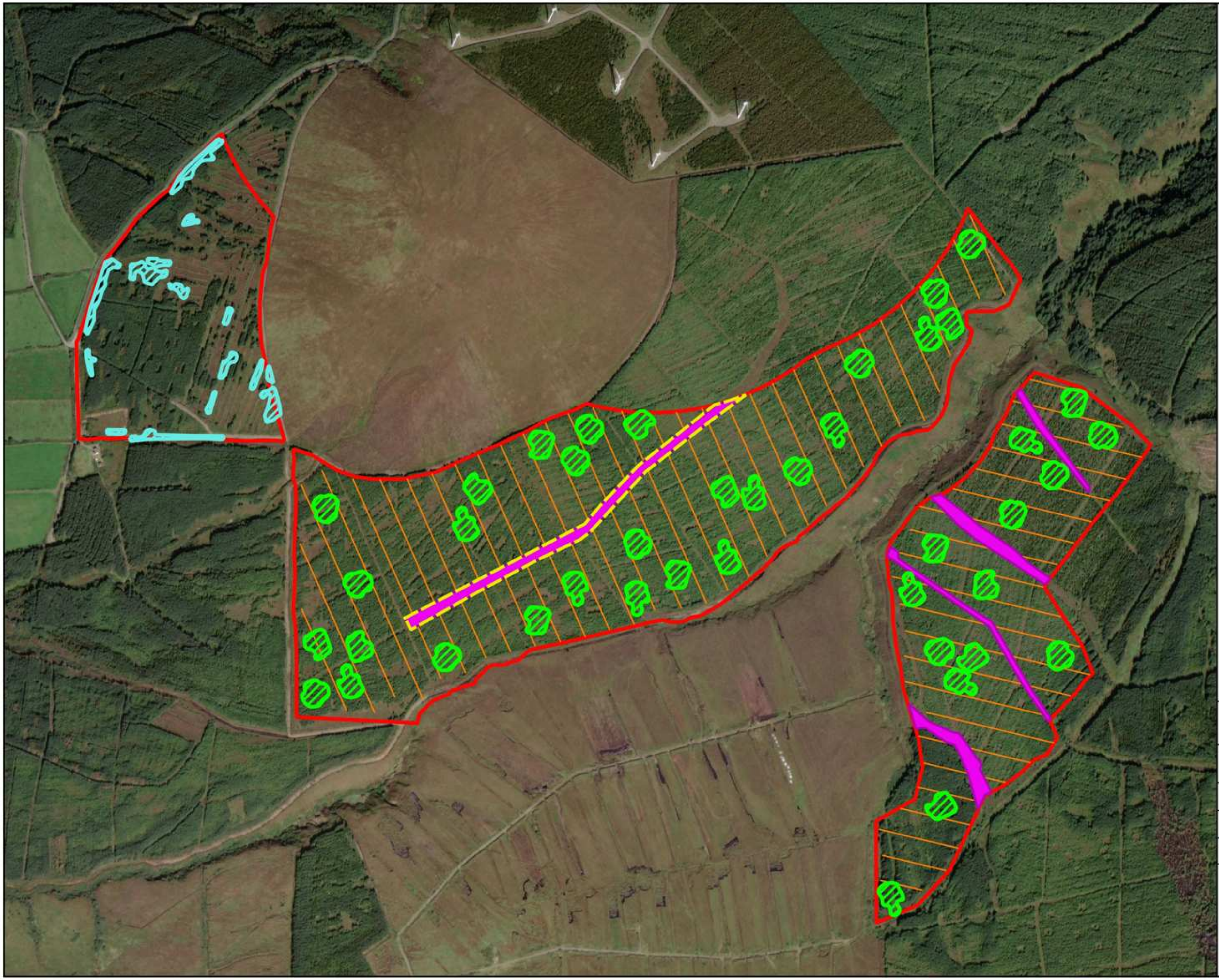
[10] *Source -* https://www.fencingpeople.com/gwts-gallery/predator-proof-fencing-buncrana-co-donegal/



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Drawing Title	Indicative Plan of Measures for Areas 1, 2 & 4
Project Title	Taurbeg Wind Farm Extension of Operational Life
Drawn By D. Woods	Checked By P. Cregg
Project No. 231030	Drawing No. Fig. 3-2
Scale 1:10,000	Date 10.04.2025

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3.3 Restoration of Farmland for Hen Harrier (Area 3)

In addition to the forestry removal areas, local landowners have been engaged to manage their land for the benefit of hen harrier. The farmland is predominantly wet grassland (GS4) with evidence of past improvement with frequent stands of rushes (*Juncus spp.*), gorse and scrub. In addition to the areas of wet grassland, there are also areas which grade in to dry-humid acid grassland (GS3). A full description of existing habitats in Area 3 is provided in Chapter 6 Biodiversity, Section 6.6.2.

The restoration of the farmland to good quality hen harrier foraging habitat will be achieved by diversifying the range and extent of habitats within the identified Proposed Offsetting lands, with a particular focus on habitats that support prey species. This guiding principle will be achieved as detailed in Table 3-4.

Table 3-4. Area 3 restoration timeline

Phase	Year	Habitat	Habitat Value	Action	Responsibility
Preparation	Immediately Post-Consent	Wet grassland with evidence of past improvement. The area has been managed for grazing under a typical continuous grazing regime. Continuous grazing regimes favour vigour species like ryegrass which can dominate at the expense of sward diversity and structure. Hedgerows gappy particularly on the northern boundary.	Low ecological value.	1. Hedgerow species planted	Taurbeg Ltd will commission a contractor to undertake the required actions.
	Immediately Post-Consent	There will be little change to the habitat as the sward will not have had time to recover.	Low ecological value	1. Rotational grazing regime. 2. Wildlife crop sowing 3. Cease fertilising	Taurbeg Ltd will commission a contractor to plant the wildlife crop. The contractor / tenant will implement a rotational grazing regime and cease the application of fertiliser.
Operation	Within 1 year Post-Consent	Wet grassland with good sward structure. Sward structure responds well to management and significant progress can be made in a single growing season. Integrity of hedgerows restored. Wildlife seed crop significantly increasing the abundance and accessibility of passerine prey.	Moderate ecological value. Sward structure restored	1. Rotational grazing regime. 2. Annual wildlife crop sowing. 3. Cease fertilising	Taurbeg Ltd will commission a contractor to plant the wildlife crop. The contractor / tenant will implement a rotational grazing regime and cease the application of fertiliser.
	For remainder of Extension of Operational Life	Wet grassland with good sward diversity and structure. Integrity of hedgerows restored and maturing. Wildlife seed crop significantly increasing the abundance and accessibility of passerine prey.	Good ecological value. Sward diversity and structure restored	1. Rotational grazing regime. 2. Annual wildlife crop sowing. 3. Cease fertilising	Taurbeg Ltd will commission a contractor to plant the wildlife crop. The contractor / tenant will implement a rotational grazing regime and cease the application of fertiliser.

After decommissioning	Ongoing (permanent)	Wet grassland with good sward diversity and structure. Integrity of hedgerows restored and maturing. Wildlife seed crop significantly increasing the abundance and accessibility of passerine prey.	Good ecological value. Sward diversity and structure restored	1. Rotational grazing regime. 2. Annual wildlife crop sowing. 3. Cease fertilising	Taurbeg Ltd will commission a contractor to plant the wildlife crop. The contractor / tenant will implement a rotational grazing regime and cease the application of fertiliser. Taurbeg Ltd will commission an ecologist with relevant experience to undertake the habitat survey at 5-year intervals.

In practice the Proposed Offsetting Measures will be achieved as outlined in the next section.

3.3.1 Grazing Regime

The hen harrier project field guidance[11] states "*Sward structure is an important contributor to both prey numbers and prey accessibility. Rush tussocks create foraging and nesting opportunities for small rodents along with meadow pipits and other ground nesting birds. Sward structure responds well to management and significant progress can be made in a single growing season*". The overall aim of the grassland management will be to create foraging and nesting opportunities for hen harrier prey species through changes to the grazing regime by changes to the length of time lands are grazed, and reduction or increase in stocking density as deemed appropriate to restore foraging habitat for hen harrier. The following measures would be a requirement of the grazing regime:

- A rotational grazing regime.
- In practice, this would mean that the grassland would be allowed to rest between periods of grazing. This measure ensures a diverse sward has a chance to regrow rather than what occurs during a continuous grazing practice where only the most robust and vigorous plant species survive, i.e. avoids ryegrass dominance. How this would be achieved would be to split the c. 17ha of pasture into smaller paddocks with the use of two electric fences. Once the first paddock is grazed animals are moved on to the second paddock and so on.
- As recommended by the Hen Harrier Project, animals should not be in a paddock for more than 4 days. After the fourth day, animals are moved between paddocks. Each vacated paddock must then be rested for 40 days minimum.
- Solar electric fencing can be useful if a mains supply is not available.

3.3.2 Wildlife Seed Crops

Establishing linear strips of wildlife cover to increase the availability of foraging habitat for hen harrier locally. This measure will involve the sowing/planting of a wildlife seed crop.

Wildlife seed crops will be sown by May 31st each year. Recommended crop species include linseed, rye, and triticale. These species have been selected to attract hen harrier passerine prey species. The crop will be planted in a 9-metre-wide strip along the sheltered side of existing hedges. The crop must be left in situ until March 15th the following year, but its location can alternate between years. Crop strip must be a minimum of 100 metres in length and fenced to prevent livestock grazing. The seedbed will need to be tilled once annually with a power harrow on a tractor. A contractor can be hired to undertake this work. A fine firm till is required, this usually takes one to two runs of the machine over the area. The rest of the management measures can be carried out by hand, e.g. seed sowing, fertiliser, and lime application. No herbicide or fungicide application is required.

The wildlife crop is proposed to be planted along the entirety of the western edge of the existing agricultural field in Area 3, on the sheltered side of the existing woodland strip.

The costs of these measures will be borne by the Applicant.

3.3.3 Scrub and Hedgerows

Hen harrier shows a strong preference for foraging in dense hedgerows ideally 3 to 4 metres wide. The individual farm plan will include for the restoration of suitable hedgerows to these conditions. Hedgerows

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[11] *Hen Harrier Programme Field Guidance for scoring Species Rich Grassland Ver. 2 June 2021 http://www.henharrierproject.ie/HHPSRGGuidance.pdf (last accessed 9th May 2024)*

will be widened by parallel planting of native hedgerow species. Restoring hedgerows, where possible, will increase the availability of foraging habitat locally and establish connectivity between otherwise discrete land parcels. To ensure biodiversity; restored hedgerows should contain a minimum of two (woody plant) species per 10 metres. Suggested woody plant species could include hawthorn, blackthorn, willow spp., and holly. Existing vegetation will not be cleared to plant the new hedgerow and under no circumstance will herbicides be used. New hedges will be protected from grazing. Habitat management prescriptions for scrub and hedgerows are outlined below:

- Retain existing areas of scrub and hedgerows;
- Where there is evidence of scrub or hedgerow removal these habitats will be reinstated as part of individual farm plans;
- Hedgerow/liner strips of scrub that occur will be widened to 3-4 metres by parallel planting of native hedgerow species;
- Trim established areas of gorse or willow scrub as the only means of preventing further encroachment onto grassland or access paths and tracks. Repeat annually as necessary;
- Prevent any removal, burning or herbicide use on areas of established scrub;
- If deemed necessary for road safety reasons, cut roadside hedgerows outside of the bird nesting season (March 1st – August 31st);
- If deemed necessary for the protection of overhead electricity lines, cut hedgerows outside of the bird nesting season (March 1st – August 31st);
- Hedgerow maintenance is permitted to prevent the hedge “escaping”. In such cases, hedgerow trees should be left uncut, and the remainder of the hedgerow cut into an “A” shape, i.e. wider at the base than at the top;
- Encroachment of scrub onto grassland can be controlled by cutting on an annual basis if required. Cutting in this case should not come closer than 1 metre from the base of the hedge;
- Herbicides and pesticides will not be used; and
- Hedge cuttings will be piled into heaps and left to decay naturally.

New foraging habitat will not be created at the expense of existing supporting habitat, e.g. those habitats that are likely to support the highest density of prey species: including brambles, bilberry and heather. The entirety of the northern boundary hedgerow of Area 3 is proposed for this intervention.

3.3.4 Rush Management

The objective in managing rushes is to maintain rough grassland in the optimal condition for hen harrier. Optimal condition constitutes as dense a covering of rushes as feasible, but not to the point where rushes are falling over or matting the ground. Rush cover in the 30 – 70% range is ideal. Habitat management prescriptions to be included in the farm management plan for managing rushes on wet grassland are outlined below:

- In general, rush management will not be required unless the rushes are completely dominating the field.
- Where large areas are being dominated by rushes (> 12 hectares), active rush management can be employed through topping.
- The planned rush management will be reviewed on an annual basis to determine if it is having the desired effect. If it is found during an annual inspection that rush recovery has been stronger or weaker than had been originally anticipated, the farm plan will be changed to adjust the cutting sequence for future years and provisions for these amendments will be included in the Farm plan management agreements. These details have been consented to by the relevant landowners.

At present the area is not being dominated by rushes and as such no management is proposed in the short term but this situation will be monitored throughout the period. If rush cover exceeds 70% management will be implemented.

3.3.5 Cessation of Fertiliser Application

This area is currently used for grazing. The requirements for cessation of the application of fertilisers (if an would aim to increase the species and structure diversity of the grassland sward through reduced nitrate application. Nitrate application provides an advantage to the few most vigorous species at the expense of a diverse sward. This measure would also assist in meeting the requirements of the Nitrates Directive and improve the quality of surface water run-off to streams and drains locally.

4. IMPLEMENTATION

As previously discussed, this Proposed Offsetting Plan will be implemented prior to the commencement the Proposed Lifetime Extension. The Proposed Offsetting Lands have been bought by the applicant. The Proposed Offsetting Plan measures will be implemented as follows.

Areas 1, 2 & 4

1. The Applicant will employ a suitably qualified contractor(s) to carry out the measures as detailed in Section 3.2.
2. A meeting will be held with the contractor to outline the general aims, objectives and requirements of the Offsetting Plan for Areas 1,2 & 4.
3. Site-specific felling methods have been devised between SWS Forestry and MKO. Deforestation works within Areas 1, 2 & 4 are anticipated to take approximately one to two months. Due to soil conditions at the site, as informed by the Peat Stability Risk Assessment, deforestation will be carried out when ground conditions are dry. It is therefore anticipated that deforestation works will commence in August, in order to avoid the core bird nesting season (i.e. March – July).

Area 3

1. The Applicant will engage a suitably qualified tenant / contractor to carry out the measures as detailed in Section 3.3.
2. A meeting will be held with the tenant / contractor to outline the general aims, objectives and requirements of the Offsetting Plan for Area 3.

A farm plan will be prepared which will outline the individual prescriptions required to ensure the implementation of this plan. The plan will include a map of the landholding, and a prescriptive list of actions to be undertaken, and the time of year when the necessary works and management measures are to be undertaken. It is proposed that a suitably qualified environmental scientist or ornithologist/ecologist will be engaged by the Applicant to oversee the implementation of this plan generally and the farm management plan in particular. The implementation will likely require the input of agricultural advisors including with regard to appropriate stocking levels.

4.2 Responsibility for Implementing the Measures

Applicant has bought the Offsetting lands that allows them to implement the land management measures to benefit the hen harrier by providing foraging habitat, and additional habitats with increased and improved biodiversity in general in order to support to benefit passerine species, thereby increasing prey for the hen harrier).

The applicant (Taurbeg Ltd) will appoint a group/body to oversee the preparation of the farm/landholding level plans which will be in strict accordance with measures outlined in Sections 3.2 and 3.3. The appointed group/body will operate independently of the developer and will be responsible for providing the landowner with an agricultural consultant and ecologist.

The agents/group appointed by Taurbeg Ltd will be responsible for preparing and overseeing the preparation of the Farm Plan and a specific suite of measures for the areas of forestry. The agents/group will also assume responsibility for auditing the land holdings, determining if the measures are achieving the desired results and, where necessary, amending the Plan to achieve the required results. The Farm Plan and auditing programme will be in place for the Proposed Lifetime Extension.

Taurbeg Ltd will assume overall responsibility for the implementation of the proposed measures through appointing agents/group that includes agricultural and ecological specialists. All of which will be in strict accordance with measures outlined in Sections 3.2 and 3.3. Taurbeg Ltd will be responsible for agreed payments of specialist agents / group and payment for provision of materials etc. as set out in the lease options. Taurbeg Ltd or their agents will also be responsible for ensuring compliance with planning conditions and engaging with statutory bodies and advisory agencies as required.

4.3 Next Steps

Assuming that the Proposed Lifetime Extension receives a grant of planning permission the next steps from the perspective of implementation of the Offsetting Plan are as follows:

1. Prepare the tender documents and issue tender notice for the agricultural and ecological specialists to administrate and implement the Proposed Offsetting Measures.
2. Appoint the successful tenderer and agree final terms including scope of work.
3. Apply for felling licence for forestry in Areas 1, 2 & 4.
4. Appoint forestry company to carry out deforestation upon receipt of licence.
5. Toolbox talk with forestry operators prior to any works to ensure all personnel are fully informed of the methodologies required for operation within the Proposed Offsetting lands.
6. Meeting with the appointed tenant / contractor of Area 3 to detail required measures under the plan.

5. MONITORING

The plans will be the subject of ongoing monitoring to assess the effectiveness of the measures proposed and employed and to contribute to advances in habitat management methods, which can be applied to future similar projects. The monitoring can also aid adaption and implementation of improved methods and measures as they emerge, or the intensification of successful measures.

Full details on the proposed monitoring measures are provided in Appendix 7-8 Bird Monitoring Programme. In summary, the monitoring measures at the Proposed Offsetting Lands will include:

- **Breeding raptor surveys**: The Proposed Offsetting Lands will be the subject of ongoing bird monitoring during Proposed Lifetime Extension to ensure it is offering supporting habitat for breeding hen harrier. The ongoing monitoring will take place during the breeding bird season. The monitoring will seek to identify whether hen harrier are utilising the areas under active management for foraging and will be conducted by way of vantage point surveys. These surveys will be undertaken monthly from March to August, following Hardey *et al.* (2013), each year.

- **Passerine monitoring surveys** will be undertaken over two visits between April to June, following CBS methodology, in each monitoring year at the Proposed Offsetting lands. The monitoring aims to investigate to what extent measures e.g. seed crops, increase the availability of prey species for hen harrier.

- **Habitat mapping**: Areas 1, 2, 3 & 4 of the Offsetting lands should be accurately mapped and should be monitored annually to check that the areas so covered have not altered in size and that the grazing regime that is in place is maintaining the current state of these habitats (i.e. neither poaching nor overgrowth of open areas is occurring). As well as mapping, this monitoring will be recorded by means of fixed-point photography.

- **Habitat scoring**: The lands will be scored based on the Hen Harrier Project scorecards for Bog and Heath (Areas 1, 2 & 4) and Wet Grassland (Area 3). Scoring will be carried out based on the methods outlined in the Hen Harrier Project guidance documents[12] for each habitat type. Scoring will be carried out between May 15th and August 31st as per these methods.

- **Vegetation sampling**: A number of fixed relevé sites (i.e. permanent quadrats) will be set up in the Proposed Offsetting Lands. Data will be recorded prior to the commencement of the Offsetting Plan activities. The character of each relevé will be recorded (e.g. species proportions present using Domin scale, vegetation structure) and photographs will be taken of each relevé from a fixed point. These relevés will then be re-examined yearly following the commencement of the plan in place to establish the extent of habitat improvement resulting from management practices.

The efficacy of the Proposed Offsetting Plan measures employed will be reviewed yearly following the commencement of the plan. Analysis of the data collected will be the basis for a review of the measures and techniques employed. Should any adjustments to the plan be deemed necessary or advisable, these will be undertaken in consultation with the NPWS prior to any alterations to the plan.

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[12] *Wet grassland - Hen Harrier Programme Field Guidance for scoring Wet Grasslands ver 2. June 2021*
Bog and heath - Hen Harrier Programme Field Guidance for scoring Bog and Heath ver 2. June 2021

Reports detailing the monitoring works carried out, the results obtained and a review of their success, along with any suggestions for amendments to the plan will be prepared and submitted to the planning authority yearly following commencement of the plan.

5.1 Auditing

The Applicant will ultimately be responsible for the implementation of the management measures and audits. Audits will be required to ensure the effectiveness of the Offsetting Plan. They are essential to ensure adequate plan quality, compliance, and control. Audits will be based on a field inspection and the assessment of the farm plans and forestry lands.

The farm plan will be audited each year. The audit will assess:

- Objectives of the farm plan;
- Implementation of the plan; and
- Adherence to requirements of the farm plan.

The farm plans and forestry lands will be reviewed annually.

6. CONCLUSION

The successful implementation of the measures outlined above will create favourable foraging habitat for hen harrier. The removal of the forestry will improve connectivity between hen harrier foraging habitats present within the SPA. The dynamic management approach proposed will be monitored to both ensure as many benefits as possible are provided for hen harrier and to contribute to advances in habitat management methods.

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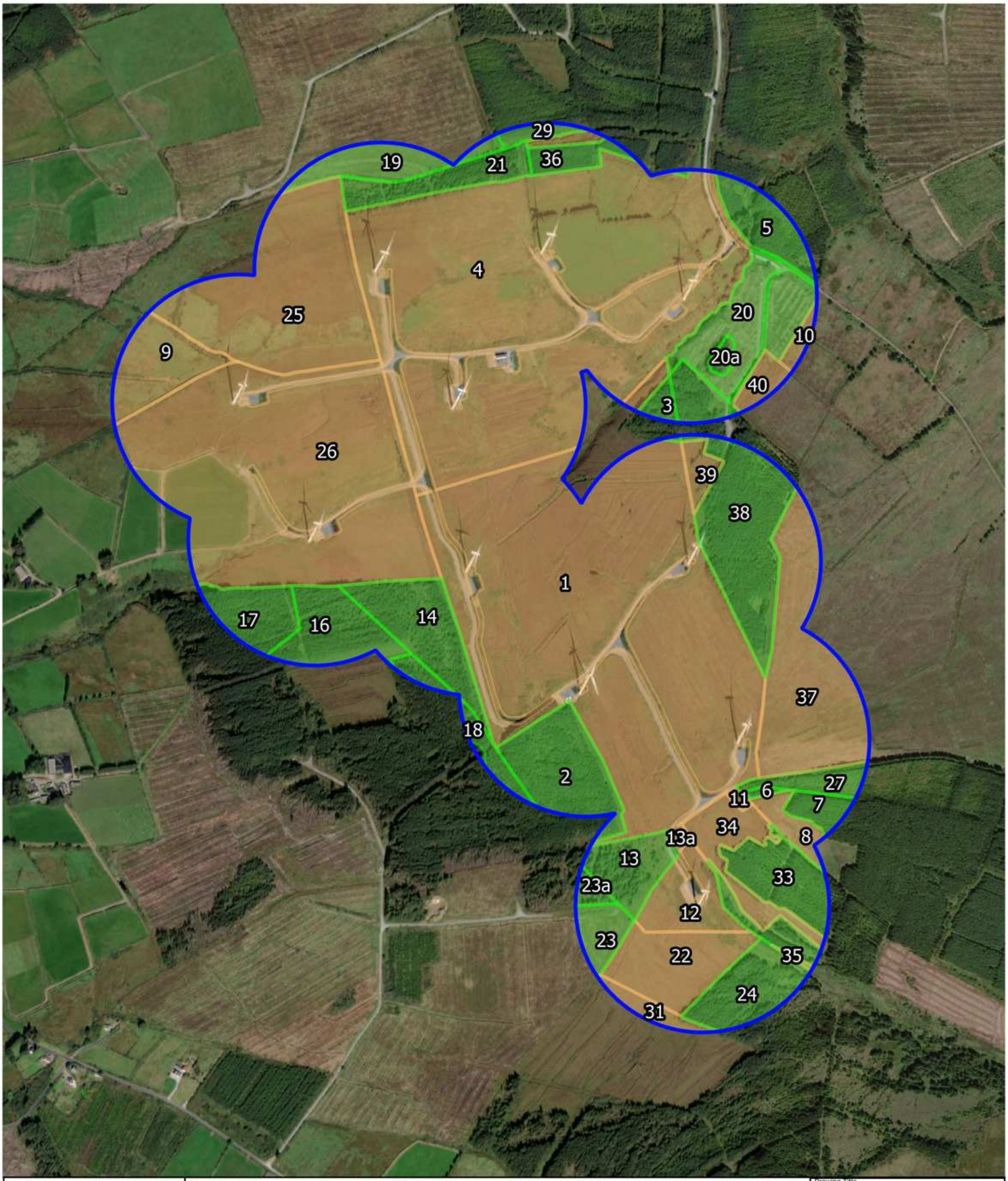
APPENDIX A

HABITAT LOSS CALCULATION

Contents



Map Legend

Lands within 250m
of Existing Turbines

🟩 Forestry

🟧 Open

N

Microsoft product screen shots reprinted with permission from Microsoft Corporation

Drawing Title
Habitat Loss Calculation Lands

Project Title
Taurbeg Wind Farm Extension of Operational Life

Drawn By	Checked By
D. Woods	P. Cregg
Project No.	Drawing No.
231030	Appx. A - Fig. 1
Scale	Date
1:10,000	19.06.2025

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			Forestry Information				10 Year Extension of Operational Life											
Area Reference Number	**Habitat**	**Area (Ha)**	**Forestry Y/N?**	**Planting Year (Where Available)**	**Expected Felling Year**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**Totals (Ha)**
1	Open	32.03	N			32.03	32.03	32.03	32.03	32.03	32.03	32.03	32.03	32.03	32.03	32.03	32.03	
2	Forestry	3.49	Y	1987	c.2040													
3	Forestry	0.40	Y	-	2032									0.40	0.40	0.40	0.40	
4	Open	32.81	N			32.81	32.81	32.81	32.81	32.81	32.81	32.81	32.81	32.81	32.81	32.81	32.81	
5	Forestry	1.77	Y	1989	2034											1.77	1.77	
6	Forestry	0.10	Y	1991	c.2036													
7	Forestry	0.71	Y	1991	c.2036													
8	Open	0.85	N			0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
9	Open	2.57	N			2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	
10	Open	0.36	N			0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	
11	Open	0.11	N			0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	
12	Open	2.03	N			2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	
13	Forestry	1.85	Y	1987	c.2040													
13a	Open	0.09	N			0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	
14	Forestry	3.08	Y	1987	c.2040													
16	Forestry	2.58	Y	2020	c.2055	2.58	2.58	2.58	2.58	2.58								
17	Forestry	1.81	Y	1987	c.2035												1.81	
18	Forestry	1.04	Y	1987	c.2035												1.04	
19	Forestry	1.90	Y	-	2062	1.90	1.90											
20	Forestry	3.71	Y	-	2063	3.71	3.71	3.71										
20a	Forestry	0.24	Y	-	2032									0.24	0.24	0.24	0.24	
21	Forestry	1.89	Y	-	2032									1.89	1.89	1.89	1.89	
22	Open	3.17				3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	
23	Forestry	1.03	Y	2017	c.2050	1.03	1.03											
23a	Forestry	0.34	Y	1987	c.2040													
24	Forestry	2.38	Y	-	2032									2.38	2.38	2.38	2.38	
25	Open	9.59	N			9.59	9.59	9.59	9.59	9.59	9.59	9.59	9.59	9.59	9.59	9.59	9.59	
26	Open	20.47	N			20.47	20.47	20.47	20.47	20.47	20.47	20.47	20.47	20.47	20.47	20.47	20.47	
27	Forestry	0.96	Y	1991	2036													
28	n/a																	
29	Forestry	0.44	Y	-	2048													
31	Open	0.67	N			0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	
32	n/a																	
33	Forestry	3.23	Y	1987	c.2030-2035										3.23	3.23	3.23	
34	Open	2.05	N			2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	
35	Open	0.05	N			0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
36	Forestry	0.88	Y	2003	2036													
37	Open	6.86	N			6.86	6.86	6.86	6.86	6.86	6.86	6.86	6.86	6.86	6.86	6.86	6.86	
38	Forestry	6.18	Y	1987	c.2030							6.18	6.18	6.18	6.18	6.18	6.18	
39	Open	0.62	N			0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	
40	Open	0.65	N			0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	

																	Total of 10 years	**1224.33**
																	Average over 10 years Extension of Life	**122.43**
					Annual Totals		**124.20**	**121.27**	**117.56**	**117.56**	**114.98**	**121.16**	**121.16**	**126.07**	**129.30**	**131.07**		
					Forestry		9.22	6.29	2.58	2.58	0.00	6.18	6.18	11.09	14.32	16.09		**7.45**
					Open		114.98	114.98	114.98	114.98	114.98	114.98	114.98	114.98	114.98	114.98		**114.98**
							124.20	121.27	117.56	117.56	114.98	121.16	121.16	126.07	129.30	131.07		

APPENDIX 7-8

BIRD MONITORING PROGRAMME

Appendix 7-8 Bird Monitoring Programme

Taurbeg Wind Farm Extension of Operational Life

DOCUMENT DETAILS

Client	**Taurbeg Ltd.**
Project Title:	**Taurbeg Wind Farm Extension of Operational Life**
Project Number:	**231030**
Document Title:	**Appendix 7-8 Bird Monitoring Programme**
Document File Name:	**Appendix 7-8 Bird Monitoring Programme**
Prepared By:	**MKO** **Tuam Road** **Galway** **Ireland** **H91 VW84**

Rev	Status	Date	Author(s)	Approved By
01	Final	2025.06.30	D. Woods	P. Cregg

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1. INTRODUCTION

1.1 Background

This Bird Monitoring Programme has been prepared by MKO for the proposed Taurbeg Wind Farm Extension of Operational Life (hereafter 'Proposed Lifetime Extension'). It provides a timeframe and monitoring schedule for the bird population at the Site (and to within 500m of all infrastructure) and at the Proposed Offsetting Lands during the operational and decommissioning phases, informed by desk study and surveys undertaken to date. Bird surveys were undertaken from April 2023 – September 2023 (EcologyIreland) and from November 2023 – September 2024 (MKO). Key ornithological receptors (KORs) in the study area were identified based on these surveys.

The objectives of the Bird Monitoring Programme are:

- To record birds using the study area and their interaction with operating turbines.
- To monitor short-term and long-term effects on bird populations in the study area, with a particular emphasis on birds of high conservation concern (birds listed on Annex I of the EU Birds Directive or on the Red List of Birds of Conservation Concern in Ireland).
- To undertake collision monitoring for potential bird fatalities as a result of a collision with turbine blades.
- To report on the findings of monitoring at the end of each monitoring period of the 10-year extended operational life of the wind farm.
- To ensure any required decommissioning phase monitoring is scheduled to avoid impacts on birds of conservation concern during the decommissioning phase.
- To ensure any required pre-commencement monitoring at the Proposed Offsetting Lands is scheduled to avoid impacts on birds of conservation concern.

1.2 Key Ornithological Receptors

Table 7 - 7 - 1 lists the key ornithological receptors (KORs) recorded within the Wind Farm Study Area during surveys conducted from April 2023 to September 2024 inclusive. These species form the basis of the Bird Monitoring Programme.

Table 7 - 7 - 1 Key ornithological receptors identified during surveys

Species	Scientific Name	Conservation Status
Hen Harrier	*Circus cyaneus*	Annex I of Birds Directive & SCI of Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA
Golden Plover	*Pluvialis apricaria*	Annex I of Birds Directive
Nightjar	*Caprimulgus europaeus*	Annex I of Birds Directive
Short-eared Owl	*Asio flammeus*	Annex I of Birds Directive

Species	Scientific Name	Conservation Status
Kestrel	*Falco tinnunculus*	BoCCI Red Listed
Red Grouse	*Lagopus lagopus hibernicus*	BoCCI Red Listed
Snipe	*Gallinago gallinago*	BoCCI Red Listed
Buzzard	*Buteo buteo*	Species sensitive to wind farm developments (Raptor Species)
Sparrowhawk	*Accipiter nisus*	Species sensitive to wind farm developments (Raptor Species)

2. METHODOLOGY

2.1 Pre-commencement Monitoring

2.1.1 Proposed Offsetting Lands

It is proposed that the deforestation works as part of the Proposed Offsetting Measures will commence in August, in order to 1) avoid the core bird nesting season (March - July), 2) avoid the most sensitive time of the year for most bird species with the potential to use the site and its environs and 3) to coincide with suitable ground conditions for the works. Deforestation works are anticipated to take approximately one to two months.

Pre-commencement confirmatory surveys will be undertaken prior to the initiation of works at the Proposed Offsetting Lands. The surveys will aim to identify sensitive sites (e.g. nests or roosts). Any requirement for works to run into the subsequent season following the commencement of works will be subject to a repeat of the pre-construction bird surveys, however this is not anticipated as felling works are expected to be less than two months in duration.

The pre-commencement monitoring will be undertaken by a suitably qualified ornithologist. The surveys will include a thorough walkover survey within a 500m radius of the works areas, where access allows, in addition to breeding raptor surveys undertaken at two vantage points overlooking the Proposed Offsetting Lands (as detailed below). If winter roosts or breeding activity of birds of high conservation concern is identified, the roost or nest site will be located and earmarked for monitoring. If the roost/nest is found to be active no works shall be undertaken, works will cease within a species-specific buffer of this location in line with best practice guidance (Forestry Commission Scotland, 2006; Goodship and Furness, 2022; Ruddock and Whitfield, 2007). No works shall be permitted within the buffer until it can be demonstrated that the roost or nest is no longer occupied.

Forestry operators and any additional staff and/or subcontractors carrying out works in relation to the Proposed Offsetting Measures will be made aware of any restrictions to be imposed by means of a toolbox talk and a map of the ‘no-work zone’ will be made available to all relevant personnel. The restricted area will also be marked off using hazard-tape fencing to alert all personnel on site to the suspension of works within that area.

2.2 Operational Monitoring

Operational monitoring will be undertaken at both the Taurbeg Wind Farm site and the Proposed Offsetting Lands over the 10 years of the Proposed Lifetime Extension. The surveys that will be undertaken and associated timelines are summarised below:

- Site
    - **Vantage Point Surveys** at the Site undertaken monthly from VP1, VP2, VP3 and VP4 (locations as shown in Figure 7-1 of Chapter 7 of the EIAR) in years 1, 2, 3, 5 and 10.
    - **Breeding Walkover Surveys** (adapted Brown & Shepherd) undertaken at the Site monthly from April to July (locations as shown in Figure 7-4 of Chapter 7 of the EIAR) in years 1, 2, 3, 5 and 10.
    - **Targeted bird collision surveys** (corpse searches) will be undertaken by a trained dog and handler. The surveys will include detection and scavenger trials, to correct for these two biases and ensure the resulting data is robust. Undertaken monthly in in years 1, 2, 3, 5 and 10.
- Proposed Offsetting Lands

- **Breeding Raptor Surveys** at the Proposed Offsetting Lands undertaken monthly from March to August, following Hardey *et al.* (2013), in each year of 10-year Proposed Lifetime Extension.
- **Passerine Monitoring Surveys** at the Proposed Offsetting Lands undertaken over two visits between April to June, following CBS methodology, in each year of 10-year Proposed Lifetime Extension.
- **Habitat Monitoring** at the Proposed Offsetting Lands undertaken in each of the 10 years of the Extension of Life.

2.2.1 Taurbeg Wind Farm Site

2.2.1.1 Vantage Point Surveys

Vantage point surveys will be undertaken at the Site in Years 1, 2, 3, 5, & 10 of the Proposed Lifetime Extension. The methodology for vantage point watches will follow guidelines issued by the NatureScot (2009) and NatureScot (2017). The proposed vantage point watches will adhere to a minimum of 36 hours/VP per season as per guidelines issued by NatureScot.

During each visit, six-hour vantage point watches (with a 30-minute break after the first three hours) will be undertaken from each fixed vantage point location that offers an uninterrupted view of the study area. Vantage points will be undertaken from the same locations that pre-planning surveys which informed the EIAR application of the proposed development (i.e. VPs 1, 2, 3 & 4). The adequacy of the vantage point viewsheds will be monitored throughout the lifetime of the wind farm. Vantage point surveys will be timed to provide a spread over the full daylight period including dawn and dusk watches to coincide with the highest periods of bird activity. Behavioural categories for the observation of bird interactions with operational wind farms will be in line with the terminology outlined by Meredith et al., (2002).

2.2.1.2 Breeding Walkover Surveys

Breeding walkover surveys will be undertaken at the Site in Years 1, 2, 3, 5 and10 of the Proposed Lifetime Extension and will follow the adapted Brown & Shepard survey methods. The survey methodology will be similar to methods employed for baseline EIAR surveys which will allow a comparison of data to be made for each monitoring year.

The timing of visits will follow the recommendations of Calladine et al. (2009). Transects should ensure all areas of suitable breeding/ foraging habitat are approached to within 100m. Target species will include waders, raptors, waterbirds, gulls and other birds of conservation concern. Along with target species, all additional species observed will be recorded to inform the evaluation of supporting habitat. These surveys will follow the same routes that were followed during pre-planning surveys.

A total of four site visits will be undertaken during the breeding season for each monitoring year and timed to coincide with the core breeding period of April - July. Notes will be recorded on nesting and territorial behaviour and breeding signs using standard BTO codes. Non-breeding behaviour such as birds flying over the site will also be recorded.

2.2.1.3 Collision Monitoring

Carcass searches for bird casualties as a result of collision with turbines will follow survey methods broadly based on guidelines issued by NatureScot (SNH, 2009) and search methods adopted by Duffy and Steward (2008). The study area will be visited once per month during operational Years 1, 2, 3, 5, 10 and 5 of the lifetime of the wind farm. During each visit, the base of each operating turbine will be searched for bird carcasses. The area to be searched will be based on the turbine size and the surrounding landscape. A trained dog and handler should be used to locate carcasses.

If a bird carcass is found, the following details will be recorded: GPS location of each bird carcass, photographic record, carcass condition (intact - carcass that is completely intact or not badly composed; scavenged - evidence that the carcass was fed upon by a scavenger/predator; or feather spot - ten or more feathers indicating predation or scavenging or two or more primary feathers must be present to consider the carcass a casualty), distance from the turbine, date and time.

Carcass removal trials and searcher efficiency trials will be undertaken to account for the ability of the dog to find bird carcasss and the likelihood of scavenging of carcasss by animals. This is done to ensure a more accurate estimation of the total number of collision victims. During carcass removal trials, a carcass is placed in a study area periodically and is monitored for a set number of days or until scavengers remove the carcass. A determination on carcass removal is made when no body parts containing flesh or bone or >10 disarticulated feathers can be found. During searcher efficiency trials, a number of carcasses are placed in a study area by one worker, then searched for by the dog two days later. A 24-48 hour period between laying carcasses and searching for them will prevent the dog following the scent of the layer rather than the carcasses. The result of these trials is a correction factor that can be applied to the results of the carcass searches.

2.2.2 Proposed Offsetting Lands

2.2.2.1 Breeding Raptor Surveys

The breeding raptor surveys will seek to identify whether hen harrier are utilising the areas under active management for foraging and will be conducted by way of vantage point surveys. These surveys will be undertaken once a month March to August inclusive, each year, at two locations overlooking the Proposed Offsetting Lands. Survey methodology will follow Hardey *et al.* (2013) for breeding hen harrier, i.e. comprising 6-hour watches from suitable vantage points carried out in the morning (06:00h or earlier to midday) or evening (16:00 to 20:00h or later), as the male may not visit the female during the afternoon (midday until 16:00h).

All raptor species observed will be recorded and mapped and breeding status will be assigned following BTO breeding status codes.

2.2.2.2 Passerine Monitoring Surveys

Passerine abundance surveys will be undertaken monthly from April to September inclusive in each monitoring year at the Proposed Offsetting Lands. The monitoring aims to investigate to what extent measures e.g. seed crops, increase the availability of prey species for hen harrier. Surveys will follow the Countryside Bird Survey (CBS) methodology[1].

Transects will be established in each of the Areas 1-4 of the Proposed Offsetting Lands. These will comprise two approximately parallel transects each approximately 1km in length[2]. Surveys will be carried out over two early morning visits between April and June, Surveys should commence between 06:00am and 07:00am where possible, and latest before 09:00am. Visits will be undertaken approximately four weeks apart, with the first visit being carried out between 1st April and 15th May, and the second visit between 15th May and 30th June. Transects will be walked and all birds seen and heard recorded. Records will be allocated to 200m sections of the transect routes and assigned one of four categories: 1 Out to 25m on either side of transect, 2 Between 25m and 100m either side of the transect, 3 More than 100m either side of transect, F Birds flying over (but not landing).

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[1] *Further information available at https://birdwatchireland.ie/publications/cbs-counter-manual/*

[2] *Where achievable – transects that are exactly parallel or 1km in length may not be possible due to terrain and access limitations.*

2.2.2.3 Habitat Monitoring

Habitat mapping: Areas 1, 2, 3 & 4 of the Proposed Offsetting Lands should be accurately mapped and should be monitored annually to check that the areas so covered have not altered in size and that the grazing regime that is in place is maintaining the current state of these habitats (i.e. neither poaching nor overgrowth of open areas is occurring). As well as mapping, this monitoring will be recorded by means of fixed-point photography.

Habitat scoring: The lands will be scored based on the Hen Harrier Project scorecards for Bog and Heath (Areas 1, 2 & 4) and Wet Grassland (Area 3). Scoring will be carried out based on the methods outlined in the Hen Harrier Project guidance documents[3] for each habitat type. Scoring will be carried out between May 15th and August 31st as per these methods.

Vegetation sampling: A number of fixed relevé sites (i.e. permanent quadrats) will be set up in the Proposed Offsetting lands. Data will be recorded prior to the commencement of the offsetting plan activities. The character of each relevé will be recorded (e.g. species proportions present using Domin scale, vegetation structure) and photographs will be taken of each relevé from a fixed point. These relevés will then be re-examined yearly following the commencement of the plan in place to establish the extent of habitat improvement resulting from management practices.

2.2.3 Summary

Table 7 - 7 - 2 summarises the proposed bird monitoring schedule.

Table 7 - 7 - 2 Proposed bird monitoring schedule

Survey	Phase	Period	Visits	Survey Method
Taurbeg Wind Farm Site				
Vantage Point Surveys	Years 1, 2, 3, 5 and 10	Commencing at the beginning of the breeding or non-breeding season and continuing for 12 months thereafter	1 visit to each of the 4no. VP locations each month for each monitoring year.	Four fixed, 6-hour, Vantage Point Surveys as per NatureScot (2017)
Breeding Walkover Surveys	Years 1, 2, 3, 5 and 10	Commencing at the beginning of the breeding season and continuing for four months thereafter.	1 visit per month (April – July) for each monitoring year.	Adapted Brown & Shepherd Surveys
Collision Monitoring	Years 1, 2, 3, 5 and 10	Commencing at the beginning of the breeding or non-breeding season and	1 visit per month for each monitoring year	Targeted corpse searches at turbine bases.

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[3] *Wet grassland - Hen Harrier Programme Field Guidance for scoring Wet Grasslands ver 2. June 2021*
Bog and heath - Hen Harrier Programme Field Guidance for scoring Bog and Heath ver 2. June 2021

Survey	Phase	Period	Visits	Survey Method
		continuing for 12 months thereafter.		
Proposed Offsetting Lands				
Breeding Raptor Surveys	Each year of 10-year Proposed Lifetime Extension	Commencing at the beginning of the breeding season and continuing for six months thereafter.	1 visit per month (March – August) for each monitoring year.	Two fixed, 6-hour vantage point watches as per Hardey *et al.* (2013)
Passerine Monitoring Surveys	Each year of 10-year Proposed Lifetime Extension	Commencing at the beginning of the breeding season and continuing for three months thereafter	2 visits per year approximately four weeks apart (April – June) for each monitoring year.	Countryside Bird Survey (CBS) methodology
Habitat Mapping	Each year of 10-year Proposed Lifetime Extension	Undertaken post Proposed Offsetting Measures and repeated in each monitoring year.	1 visit to each Area per monitoring year.	As per Smith *et al.* (2011)
Habitat Scoring	Each year of 10-year Proposed Lifetime Extension	Undertaken post Proposed Offsetting Measures and repeated in each monitoring year.	1 visit to each Area per monitoring year.	Scored based on the Hen Harrier Project scorecards for Bog and Heath (Areas 1, 2 & 4) and Wet Grassland (Area 3).
Vegetation Sampling	Each year of 10-year Proposed Lifetime Extension	Undertaken prior to the commencement of the Proposed Offsetting Measures and then repeated in each monitoring year.	1 visit per monitoring year to each fixed relevé site.	Character of each relevé will be recorded (e.g. species proportions present using Domin scale, vegetation structure) and photographs will be taken of each relevé from a fixed point.

2.3 Decommissioning Monitoring

2.3.1 Taurbeg Wind Farm Site

It is proposed that decommissioning works will commence outside the bird nesting season (1st of March to 31st of August inclusive) to avoid the most sensitive time of the year for most bird species with the potential to use the site and its environs.

Decommissioning surveys will be undertaken prior to the initiation of works at the Site. The survey will aim to identify sensitive sites (e.g. nests or roosts). Any requirement for decommissioning works to run into subsequent breeding or winter seasons following the commencement of works will be subject to a repeat of the decommissioning bird surveys.

Monitoring will be undertaken by a suitably qualified ornithologist. The survey will include a thorough walkover survey to a 500m radius of the development footprint and/or all works areas. If winter roosts or breeding activity of birds of high conservation concern is identified, the roost or nest site will be located and earmarked for monitoring at the beginning of the first winter or breeding season of the decommissioning phase. If the roost/nest is found to be active during the decommissioning phase no works shall be undertaken, works will cease within a species-specific buffer of this location (Forestry Commission Scotland, 2006; Goodship and Furness 2022; Ruddock and Whitfield, 2007) in line with best practice. No works shall be permitted within the buffer until it can be demonstrated that the roost or nest is no longer occupied.

All site staff and subcontractors will be made aware of any restrictions to be imposed by means of a toolbox talk and a map of the 'no-work zone' will be made available to all construction staff. The restricted area will also be marked off using hazard-tape fencing to alert all personnel on site to the suspension of works within that area.

2.4 Reporting

A report summarising the findings of bird monitoring surveys will be submitted to the Planning Authority at the end of each monitoring year of the Proposed Lifetime Extension. The report will provide the results of the surveys and discuss potential impacts on birds (particularly KORs) and any recommendations that may inform additional mitigation measures during the operational phase of the wind farm project.

For consistency with the Birds Chapter of the EIAR, the results section of the report will include the following information, the average number of flights per hour, the average flock size and the peak counts for each observed target species. This approach is in line with best practice and will facilitate an analysis of results following a before-after experimental design. Maps outlining flight lines of key target species will be produced using GIS software applications to accompany the final report at the end of each monitoring year.

2.4.1 Sharing Ecological Data

As a measure to support conservation research and policy, it is proposed to submit the monitoring survey data and information to the National Biodiversity Data Centre (NBDC) and to BirdWatch Ireland to contribute to the upcoming bird atlas (2027) on relevant ecological records, for example, information on the location of breeding territories and nest sites of bird species of conservation concern (e.g., Red-List Species as per the most recent BoCCI). The submission of the data will follow relevant standards and will be provided in the preferred NBDC excel template. This measure will be fulfilled within three months of each monitoring year, as relevant, in the event of a successful application. This commitment ensures the project is contributing to the aims of Objective Four, Outcome 4B of the Ireland's 4th National Biodiversity Action Plan[4]: *Data relevant to biodiversity and ecosystems, including conservation needs, is widely accessible and standardised.*

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[4] *https://www.npws.ie/sites/default/files/files/4th_National_Biodiversity_Action_Plan.pdf*

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APPENDIX 8-1

Peat Stability Risk Assessment-Proposed Offsetting Lands

Taurbeg WF Proposed Lifetime Extension Offsetting Measures– Peat Stability Risk Assessment (PSRA)

Client	**MKO**
Document Ref.	24161-PSRA-001-02
Project Title	Taurbeg Wind Farm Extension of Operational Life
Date	27/06/2025

Project Title:	Taurbeg Wind Farm Extension of Operational Life
Report Title:	Taurbeg WF Proposed Lifetime Extension Offsetting Measures– Peat Stability Risk Assessment (PSRA)
Document Reference:	24161-PSRA-001-02

Client:	MKO
Ultimate Client:	Taurbeg Limited
Confidentiality	Client Confidential

REVISION HISTORY

Rev	Date	Reason for Issue	Originator	Checker	Reviewer	Approver
00	07/02/2025	First Issue	CE & SR	CE	PQ	TOS
01	13/03/2025	Revision to address client comments	CE	CE	PQ	PQ
02	07/04/2025	Revision to address final client comments	CE	CE	PQ	PQ
03	27/06/2025	Revision to update project terminology	CE & SR	SR	PQ	PQ

DISCLAIMER

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REVISION SUMMARY

Rev	Date	Section(s)	Detail of Change
00	-	-	-
01	13/03/2025	All	Revision to address client comments
02	07/05/2025	All	Revision to address final client comments
03	27/06/2025	Al	Revision to address project terminology

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EXECUTIVE SUMMARY

MKO commissioned Gavin and Doherty Geosolutions (GDG) to undertake a Peat Stability Risk Assessment (PSRA) for the Proposed Offsetting Measures, located in Coom, Co. Kerry, as part of the proposed extension of operational life of the Taurbeg Wind Farm in County Cork. The Proposed Offsetting Lands, which mainly comprise commercial forestry, are located near Mount Eagle Wind Farm in Co. Kerry, refer to Appendix A for the site location. The proposed works comprise deforestation of the commercial forestry to create areas of optimized hen harrier habitat.

The purpose of this report is to outline the potential for peat instability at the Proposed Offsetting Lands and to outline a quantitative peat stability risk assessment rating in line with the *Energy Consents Unit Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments* (ECUBPG, Scottish Government, 2017) for the proposed deforestation works.

The peat stability risk assessment findings showed that the Proposed Offsetting Lands have an acceptable margin of safety and low risk of peat failure and is suitable for the Proposed Offsetting Measures.

Consultation with published GSI maps and the observations from site investigations indicate that significant areas of the Proposed Offsetting Lands consist of commercially afforested blanket peat. Peat is mapped across the lands, with recorded peat thicknesses ranging from 0.2m to 3.2m across the lands, with an average peat depth of 1.6m recorded. In total 23% of recorded peat thicknesses were under 1m, and 72% were under 2m.

A desk study, site walkovers, ground investigation campaigns, stability analyses and a risk assessment were carried out to assess the potential for peat instability within the Proposed Offsetting Lands. The risks were assessed following the principles in *Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments* (Scottish Executive, 2017). The walkover inspections and peat probe campaign were carried out over a larger search area, to assess peat stability risk across the local area immediately adjacent to the Proposed Offsetting Lands, in particular those areas in the immediate vicinity of the existing peat landslides.

Two large peat landslides have been identified as having occurred within 500m of the Proposed Offsetting Lands. The site walkovers, stability analyses and risk assessment findings suggest that the Proposed Offsetting Measures will not increase the current risk profile in the area.

The stability analysis aims to determine the Factor of Safety (FoS) of the peat slopes. The FoS provides a direct measure of the degree of stability of a peat slope. A FoS of less than 1.0 indicates that a slope is unstable; a target FoS for slopes is 1.3 or greater.

A risk assessment was carried out considering the FoS value calculated in the stability analysis and other factors that could influence peat stability, considering how damaging a peat slide would be to the Proposed Offsetting Lands' environment.

Three small areas, referred to as safety buffer (see Appendix L), has been highlighted and will have restricted habitat enhancement activities. A total of 18 areas across the Proposed Offsetting Measures have been identified as Felled Material Restriction areas and should not be used to place felled material.

1 INTRODUCTION

1.1 BACKGROUND

Gavin and Doherty Geosolutions (GDG) was commissioned in October 2024 by MKO to undertake a Peat Stability Risk Assessment (PSRA) for the Proposed Offsetting Lands, located in Coom, Co. Kerry, as part of the proposed extension of the operational life of the Taurbeg Wind Farm in County Cork, hereafter referred to as “the Proposed Offsetting Measures”. Refer to Appendix A for the Proposed Offsetting Lands location. The proposed works comprise the deforestation of commercial forestry to create areas of optimized hen harrier habitat.

1.2 STATEMENT OF AUTHORITY

GDG has been involved in many Peat Stability Risk Assessment projects in both Ireland and the UK at various stages of development, i.e. preliminary feasibility, planning, design and construction. In addition to this, the GDG team, made up of engineering geologists, geomorphologists, geotechnical engineers and environmental scientists, has developed expertise in landslide hazard mapping, including leading a recent national landslide hazard mapping pilot study which included extensive landslide runout and hazard mapping and calculation in Irish blanket peat.

GDG brings together state of the art research and direct industry experience and offers a bespoke engineering service, delivering the most progressive, reliable, and efficient designs across a wide variety of projects and technical areas, including providing forensic engineering and expert witness services to the Insurance and Legal sectors. Our clients include large civil engineering contractors, renewable energy developers, semi-state bodies and engineering and environmental consulting firms.

The members of the GDG team involved in this assessment include:

- **Paul Quigley – Project Director**. Paul is a Chartered Engineer with over 28 years of experience in geotechnical engineering and a UK Registered Engineering (RoGEP) Advisor. He has worked on a wide variety of projects for employers, contractors and third parties, gaining a range of experience, including earthworks for major infrastructure schemes in Ireland and overseas, roads, tunnelling projects, flood protection schemes, retaining wall and basement projects, ground investigations and forensic reviews of failures. Paul is adept at designing creative solutions for complex problems and has published numerous peer-reviewed technical papers. He has gained extensive experience working in developments on peatlands, including the Corrib Gas Terminal, wind farm development and linear infrastructure such as roads, rail, gas pipeline, etc. He has also acted as an independent expert for several legal disputes centred on ground-related issues. He is a reviewer for the ICE Geotechnical Engineering Journal, a member of the Eurocode 7 review panel at NSAI and a former Chairman of the Geotechnical Society of Ireland.
- **Tim O’Shea.** Tim holds an honours degree in Civil and Environmental Engineering from University College Cork and is a Chartered member of Engineers Ireland. He has over 20 years post graduate experience in Civil Engineering. Tim is experienced in onshore wind right through the development and delivery cycle from consenting through to construction. He has worked on the EIA for a number of windfarms on upland peat sites. He has also managed the detailed design of a number of windfarms with significant peat risk.
- **Chris Engleman**. Chris is a Professional Geologist with a Master’s degree in Geological Sciences from the University of Leeds. He is chartered with the Institute of Geologists Ireland (IGI) and European Federation of Geologists. He has five years of industry experience within

the onshore renewables sector and the field of geological mapping with a particular focus on Quaternary geology, predominantly working on projects for peat stability (particularly Peat Stability Risk Assessments) and management, ground investigation, rock and soil logging, GIS mapping and geotechnical design. Chris has worked on several renewable energy projects, particularly wind and solar, for over two years. Chris is the primary author of this report. Chris carried out peat probing, site walkovers, and supervised site investigation works at the Proposed Offsetting Lands in 2024.

- **Johan Van Niekerk**. Johan is a Senior Design Engineer who is part of GDG's Infrastructure team. He holds a Bachelor's degree in civil engineering and an Honours degree in Geotechnical engineering, both from the University of Pretoria. Johan has upward of seven years' experience in civil design and construction, and has been with GDG since 2023. Expertise includes 3D modelling, numerical analysis, ground investigations and earthworks design. Johan carried out peat probing at the Proposed Offsetting Lands in 2024.
- **Daniel Murphy.** Daniel is a Graduate Engineer working in both the GDG Infrastructure team and the Structures team. He has a Masters degree in Civil Structural and Environmental Engineering from University College Cork and has been working with GDG since graduating in 2022. Daniel has worked on a variety of Temporary Works and Permanent Works design projects in Ireland and the UK. Daniel has carried out site inspections, visual assessments of slopes, peat probing and water sampling on a number of projects throughout Ireland. Daniel carried out peat probing at the Proposed Offsetting Lands in 2024.
- **Sowmya Reddy Gudipati**. Sowmya is a graduate engineer at GDG. She has two years of post-graduate experience working in the environmental, civil engineering, and renewables sectors. Sowmya has worked on multiple onshore wind and solar farm projects in the UK and Ireland. Sowmya carried out peat probing at the Proposed Offsetting Lands in 2024 and contributed sections to the desk study of this assessment.

1.3 PROPOSED PROJECT

The Proposed Project is described in detail in the EIAR Chapter 4: Description of the Proposed Project, and will consist of the lifetime extension of the existing Taurbeg Windfarm in North Cork and the Proposed Offsetting Lands.

This PSRA is restricted solely to the assessment of the Proposed Offsetting Measures. For the purposes of this PSRA, the Proposed Offsetting Lands has been divided into four areas, as shown in Figure 1-1, and in Figure A- 1 in Appendix A. Due to a lack of peat, Area 3 has screened out of this PSRA. As no works are proposed within the existing Taurbeg Wind Farm site, a PSRA has not been completed for the Proposed Lifetime Extension of the existing wind farm.

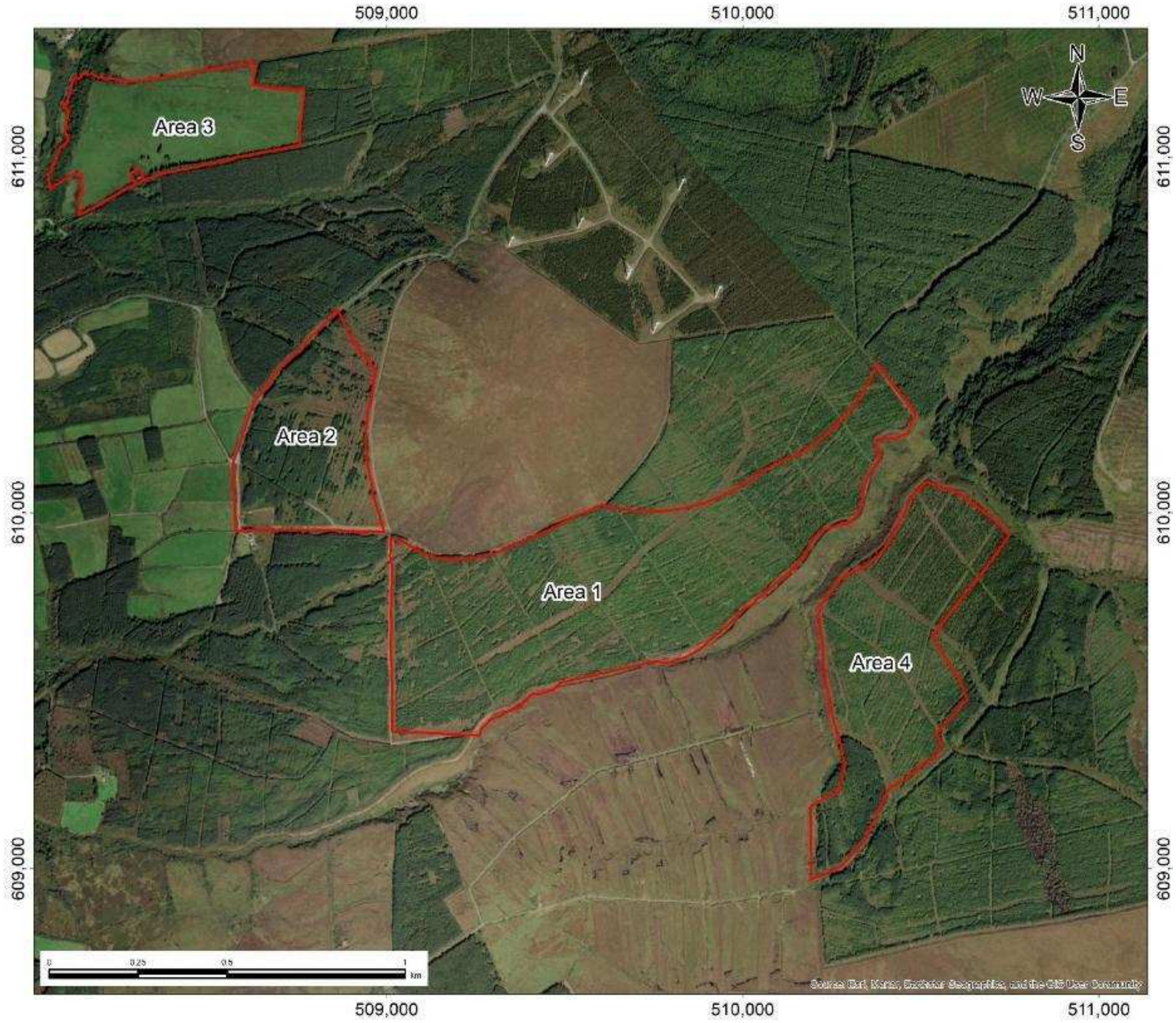

Figure 1-1: Proposed Offsetting Measures Location.

1.4 OVERVIEW OF PEAT LANDSLIDES

1.4.1 PEAT LANDSLIDE TYPES

The literature typically refers to two general groups of peat landslides: peat slides and bog bursts. The term ‘peat slide’ is generally used to describe slab-like shallow translational failures (Hutchinson, 1988) with a shear failure mechanism operating within a discrete shear plane at the peat-substrate interface, below this interface, or more rarely within the peat body (Warburton et al., 2004). Peat landslides are commonly recorded in Ireland, Scotland, Wales and England. The term ‘bog burst’ has been used to describe particularly fluid failures involving rupture of the peat blanket surface or margin due to subsurface creep or swelling, with liquefied basal material expelled through surface tears followed by settlement of the overlying mass (Hemingway and Sledge, 1941-46; Bowes, 1960). Bog bursts are reported almost exclusively in the Republic of Ireland and Northern Ireland.

There is a significant degree of overlap in failure mechanisms and characteristics between these two broad groups. As a result of this, a formal, systematic classification scheme for peat landslides was developed by Dykes and Warburton (2007). This classification scheme is based on a comprehensive database of examples collated from the literature and field studies. The classes of peat landslide reflect:

- The type of peat deposit (raised bog, blanket bog, or fen bog);
- Location of the failure shear surface or zone (within the peat, at the peat-substrate interface, or below);
- Indicative failure volumes;
- Estimated velocity; and
- Residual morphology (or features) left after occurrence.

Descriptions of the failure mode, characteristic slope range and peat thickness of each type are provided in Table 1-1.

Table 1-1: Peat landslide types (after Dykes and Warburton, 2007).

Peat landslide type	Definition	Typical slope range	Typical peat thickness
Bog burst	Failure of a raised bog (i.e. bog peat) involving the break-out and evacuation of (semi-) liquid basal peat.	2 – 5˚	2 – 5m
Bog flow	Failure of a blanket bog involving the break-out and evacuation of semi-liquid highly humified basal peat from a clearly defined source area	2 – 5˚	2 – 5m
Bog slide	Failure of a blanket bog involving sliding of intact peat on a shearing surface within the basal peat.	5 – 8˚	1 – 3m
Peat slide	Failure of a blanket bog involving sliding of intact peat on a shearing surface at the interface between the peat and the mineral substrate material or immediately adjacent to the underlying substrate.	5 – 8˚ (inferred)	1 – 3m (inferred)
Peaty debris slide	Shallow translational failure of a hillslope with a mantle of blanket peat in which failure occurs by shearing wholly within the mineral substrate and at a depth below the interface with the base of the peat such that the peat is only a secondary influence on the failure.	4.5 – 32˚	< 1.5m

Peat landslide type	Definition	Typical slope range	Typical peat thickness
Peat flow	Failure of any other type of peat deposit (fen, transitional mire, basin bog) by any mechanism, including flow failure in any type of peat caused by head-loading.	Any of the above	Any of the above

1.4.2 PROPOSED OFFSETTING MEASURES

The slope angles at the Proposed Offsetting Lands vary from 0.3° to 41°, with an average of 7°. The lands are generally upland, with afforested blanket peat on hill slopes. The topography is discussed in further detail in Section 2.6. Evidence of large past landslides has been identified immediately adjacent to the proposed lands and the near surroundings on the available Google Earth imagery (available from 2010 onwards) and was confirmed during the fieldwork. Additional evidence for potential past relict instability has been identified in the southern portion of the lands and is discussed further in Section 4.3. There is an additional risk that historic landslides may not be identifiable, as Geomorphological features associated with peat landslides (peat slides and bog bursts) are typically softened with time through erosion, drying, and re-vegetation (Feldmeyer-Christe & Küchler, 2002; Mills, 2003). Additionally, human activity (e.g., grassland activity and afforestation/deforestation) may hamper the identification of possible landslides.

1.4.3 CONTROLS OF PEAT INSTABILITY

The spatial and temporal occurrence of landslides, including peat landslides, is controlled by *conditioning* and *triggering factors*. The conditioning factors explain the spatial distribution of landslides and are related to the inherent properties of the terrain, such as soil type, slope angle, curvature (convex/concave) of the slopes, and drainage.

The triggering factors explain the frequency of landslides. They can be distinguished between fast and slow triggers:

- Fast triggers:
    - Intense rainfall (the most frequent trigger);
    - Snowmelt (very frequent trigger; Warburton, 2022);
    - Rapid ground accelerations (e.g. from blasting rock);
    - Undercutting of peat by natural processes (e.g. fluvial) or man-made; or
    - Loading the peat.

- Slow triggers:
    - Low intensity but constant rainfall;
    - Afforestation / Deforestation (wildfires, pollution-induced vegetation change); or
    - Weathering (physical, chemical, biological).

Slow triggers can start landslides by themselves and can also act as *preparatory factors* for fast triggers by lowering their threshold to start landslides.

1.4.4 PRE-FAILURE INDICATORS

The presence of conditioning factors and low-pace triggers before failure is often indicated by ground conditions, features, and morphologies that can be identified remotely or during fieldwork by the geomorphologist or through basic monitoring techniques.

According to the updated guidelines provided by the Scottish Executive (2017), the following critical features are indicative of the susceptibility or proneness to failure in peat environments:

- Presence of historical and recent failure scars and debris;
- Presence of features indicative of tension (e.g. cracks);
- Presence of features indicative of compression (e.g. ridges, thrusts, extrusion features);
- Evidence of peat creep (typically associated with tension and compression features);
- Presence of subsurface drainage networks or water bodies;
- Presence of seeps and springs;
- Presence of artificial drains or cuts down to substrate;
- Presence of drying and cracking features;
- The concentration of surface drainage networks;
- Presence of soft clay with organic staining at the peat and (weathered) bedrock interface; and
- Presence of iron pans or similar hardened layers in the upper part of the mineral substrate.

Other evidence of peat instability unrelated to landslides has been considered, namely quaking peat in horizontal areas with very low bearing capacity.

1.5 PEAT STABILITY RISK ASSESSMENT WORKFLOW

GDG has carried out the PSRA for the Proposed Offsetting Measures following the principles set out in the *Proposed electricity generation developments: peat landslide hazard best practice guide* (Scottish Executive, 2017). This guide has been used in this report as it provides best practice methods to identify, mitigate, and manage peat slide hazards and associated risks concerning consent applications for works on peatlands.

Figure 1-2 shows a workflow diagram showing the general methodology for the PSRA. The methodology can be summarised into the following steps:

1. Completion of the desk study, including:
    - Geology and Quaternary sediments (subsoils);
    - Soils;
    - Moisture;
    - Hydrogeology;
    - Multi-temporal aerial / Satellite imagery;
    - Topography;
    - Landslide inventories and landslide susceptibility;
    - Hydrology;
    - Artificial Drainage;
    - Land cover and land use; and

  - Rainfall
2. Relevant academic literature and publications. Undertaking a walkover and fieldwork to:
   - Carry out geo-investigations including peat probing and hand shear vane testing;
   - Record geological and geomorphological features, including exposures of the soil profile and evidence of peat instability; and
   - Record hydrologic and vegetation features.
3. Risk assessment, including:

   - Interpolation of the peat probe values and generation of the peat depth map;
   - Creation of the Factor of Safety (FoS) maps using a deterministic approach (Bromhead, 1986) for drained and undrained conditions;
   - Qualitative hazard assessment by combining the FoS with observations of the peat condition identified both on aerial imagery and during fieldwork.
   - Qualitative consequences assessment;
   - Calculation of the peat landslide risk by multiplying hazards and consequences;
   - Classification of the risk values into four classes:

     - Negligible;
     - Low;
     - Medium; and
     - Serious.
4. Proposal of actions required for mitigation of any identified peat stability risks.

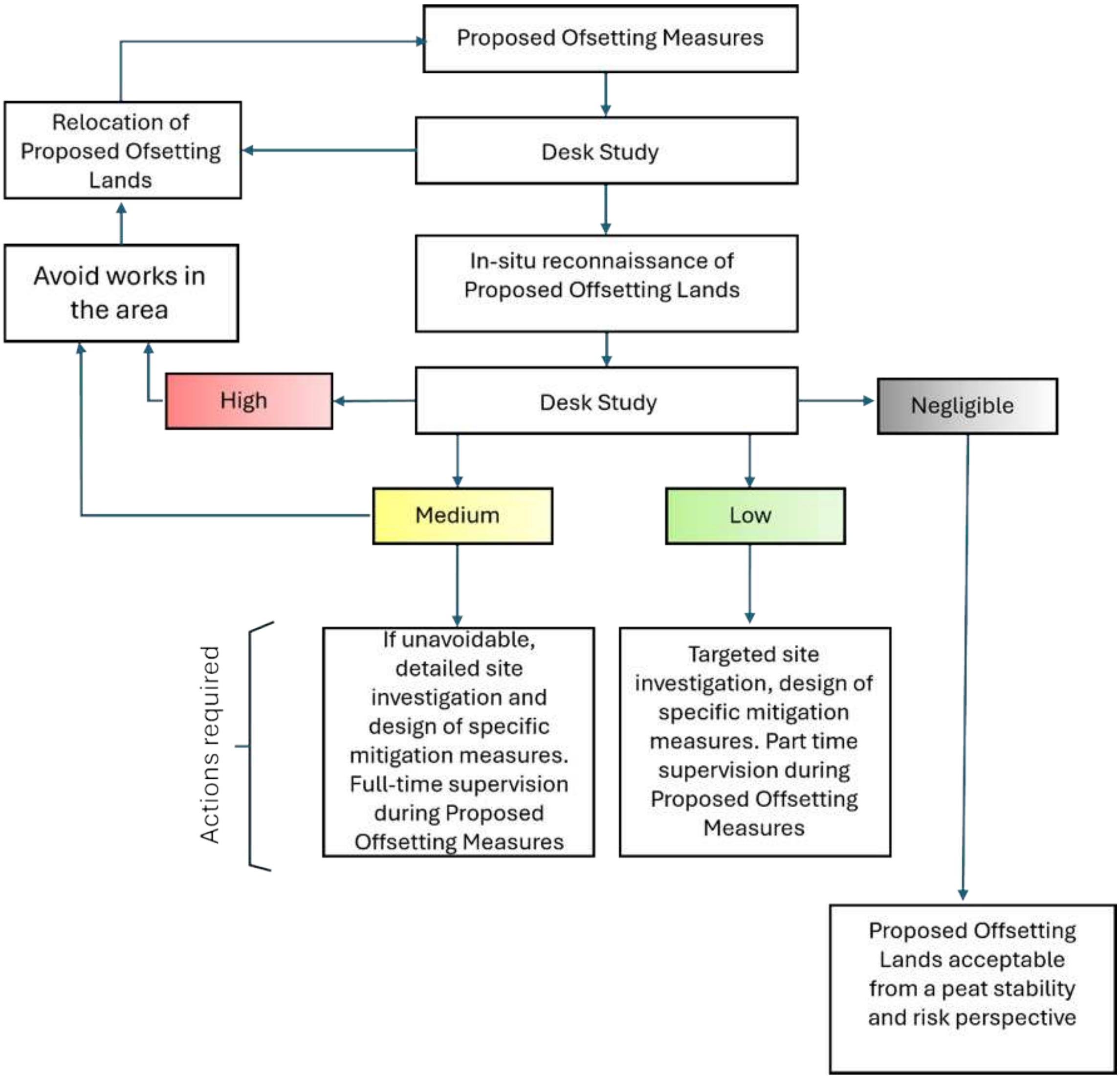

Figure 1-2: Workflow of the PSRA methodology for the acceptability of the Proposed Offsetting Measures (adapted from Scottish Executive, 2017).

2 DESK STUDY

For a preliminary site suitability analysis and background knowledge of local peat stability and ground conditions, the following aspects have been considered:

1. Geology and Quaternary sediments (subsoils);
2. Soils;
3. Moisture;
4. Hydrogeology;
5. Multi-temporal aerial / Satellite imagery;
6. Topography;
7. Landslide inventories and landslide susceptibility;
8. Hydrology;
9. Artificial Drainage;
10. Land cover and land use;
11. Rainfall;
12. Special areas of Conservation and Special Protection Areas; and
13. Relevant academic literature and publications.

2.1 GEOLOGY

2.1.1 BEDROCK GEOLOGY

Geological Survey Ireland (GSI) 1:100,000 scale bedrock mapping shows the Proposed Offsetting Lands and surrounding area to be underlain majorly by, Glenoween Shale Formation (GN) and Feale Sandstone Formation (FS), which is Upper Carboniferous in age (Namurian).

The lithology of the Glenoween Shale Formation is characterised by dark grey silty mudstone, sandy shales and fine-grained sandstone. The lithology of the Feale Sandstone formation comprises sandstone, siltstone and shale. The thickness of these Namurian shales ranges between 1m – 10m. The rock strata in the area are strongly folded with bedding dips between 20°-80° in both N/NE and S/SE directions. Site walkovers indicate that bedrock outcrops in topographic highs of the lands. The main bedrock unit and associated structural features within the Proposed Offsetting Measures boundary and surrounding area are shown in Figure B- 1.

2.1.2 QUATERNARY SEDIMENTS

The map of Quaternary sediments at 1:50,000 scale shown in Figure B- 2 in Appendix B (GSI, 2024) shows that the Proposed Offsetting Lands are underlain by afforested blanket peat, with Tills derived from Namurian sandstones and shales present along the far western margin of Area 2. Glacial till typically comprises a heterogeneous mix of sand, gravel, cobbles, and boulders, usually held in an overconsolidated clay matrix. This till classification indicates that the glacial tills are likely locally derived from the underlying Namurian age bedrock.

2.2 SOIL COMPOSITION

The Irish soil map at a 1:250,000 scale is shown in Figure C- 1 in Appendix C (EPA, Teagasc, & Cranfield University, 2018). The Proposed Offsetting Lands are mapped as containing soils classified as Blanket Peat (peaty). EPA/Teagasc mapping indicates that peaty soils dominate most of the lands with small parcels of Tills, derived from Namurian rocks located in the north and southwestern peripheries (Soil classification 1130a). GSI mapping indicates that in general, soils within the Proposed Offsetting Lands are poorly draining and display acidic mineralisation due to the prevalence of peat. The depth and extent of peat deposits may vary over short distances as a function of local underlying geology, past and ongoing geomorphological progression and management history.

It is noted that the presence or absence of peat cover in the regional scale maps (Figure B- 2 and Figure C- 1) must not be taken as exact. The depth and extent of peat deposits may vary over short distances as a function of local underlying geology, past and ongoing geomorphological activity, and management history. Therefore, these maps have been complemented by peat probes and field observations described in Section 2.12.

2.3 MOISTURE

Water reaching a slope can produce the following processes:

- Lubrication. It reduces friction along rock or soil discontinuities (joints or stratification) (Wu, 2003). In clay soils, lubrication is due to water that produces a repulsion or separation between the clay particles.
- Softening. It mainly affects the physical properties of filler materials in fractures and fault planes in rocks.
- Pore pressure. Water in soil pores exerts pressure on soil particles, changing the effective pressure and the shear strength. The negative impact of pore pressure changes is particularly evident in partially saturated or unsaturated soils, where the increase in moisture content causes the development of a wetting front that converts beneficial negative suction stresses within the capillary structure of the soil to a fully saturated positive pore pressure. When soil is saturated, capillary stresses and adhesion between particles diminish, and, as a result, soil shear strength decreases.
- Confined water pressures. The confined underground water acts as an uplifting pressure on the impermeable layers, decreasing the shear strength and producing hydrostatic pressures on the layers where permeability changes. These lifting stresses can cause material deformation or failure, and pore pressure decreases soil resistance.
- Fatigue failure due to fluctuations in the water table. Some landslides occur in episodes of rain with lower intensity than previous ones. This phenomenon is explained by Santos et al. (1997) as a case of soil fatigue due to cyclical pore pressures. In temperate climates, seasonal temperature variations can lead to slight variations in the water table. These changes are much more significant in tropical climates (Xue & Gavin, 2008).
- Washing away of cement material. The groundwater flow can remove the soluble cement (e.g. calcium carbonate) from the soil and, thus, decreases the cohesion and the friction angle. This process is usually progressive.
- Density increase. The presence of water in soil pores increases the bulk density and weight of the materials in the slope. Therefore, shear stress increases, and the slope safety factor decreases.
- Internal hydraulic forces. The movement of groundwater currents creates hydrodynamic pressure on the ground in the direction of flow. This force acts as a destabilizing element on the groundmass and can appreciably decrease the safety factor of the slope. The hydrodynamic or seepage/flow force can also cause the movement of the particles and the destruction of the soil mass (piping).

- Collapse. Collapsible soils (alluvial soils deposited very rapidly and wind soils or loess) are very sensitive to changes in humidity. When water content increases, their volume decreases, and the microstructure collapses.
- Desiccation cracks. Changes in humidity can cause cracking, and these cracks can determine the extension and location of the surface of failure and have a significant effect on the safety factor or possibility of sliding.
- Piping in clays. Some clayey soils disperse and lose their cohesion when saturated. The result can be the total collapse of the soil structure and the activation of landslides.
- Chemical weathering: Processes of ion exchange, dissolution, hydration, hydrolysis, corrosion, oxidation, reduction, and precipitation (Wu, 2003).
- Erosion. The detachment, dragging, and deposition of soil particles by water flows modifies the relief and the stresses on slopes and can produce the activation of a landslide, especially when erosion undercuts slopes.

The *Normalized Difference Moisture Index Colorized* GIS service or the United States Geological Survey (USGS) has been used to estimate levels of moisture in the soil across the Proposed Offsetting Measures. This service is based on the analysis of multispectral Landsat 8[1] OLI images. Using data processing, the raw digital number (DN) values for each Landsat band are transformed to scaled (0 - 10000) apparent reflectance values, and then, the Normalised Difference Moisture Index is obtained using Equation 2.3-1 (Gao, 1996):

$$\text{NDMI} = (\text{Band } 5^{2} – \text{Band } 6^{3}) / (\text{Band } 5 + \text{Band } 6) \qquad \textbf{Equation 2.3-1}$$

Figure D- 1 in Appendix D illustrates the levels of estimated soil moisture across the Proposed Offsetting Lands as calculated by the above method. Wetlands and other vegetated areas with high levels of moisture appear as dark blue. Regions of lower moisture values are represented as light blue and green. The map indicates that the area as a whole displays a high moisture content.

2.4 HYDROGEOLOGY

2.4.1 GROUNDWATER BODIES

According to GSI's groundwater map viewer, the Proposed Offsetting Lands are entirely underlain by the Scartaglin and Abbeyfeale groundwater bodies (GWB), (ID: IE_IE_SW_G_073) and (IE_SH_G_001). This GWB in relation to the Proposed Offsetting Measures boundary and surrounding area is shown in Figure E- 1.

The Scartaglin and Abbeyfeale GWB covers much of eastern Co. Kerry and comprises a total area of 472 km^2 and 935 km^2.

The Scartaglin and Abbeyfeale GWB are dominated by rock units from the Namurian undifferentiated group and large areas of Namurian sandstones, siltstones and shales. The GWB is described as low permeability with localised zones of enhanced permeability (GSI, 2003).

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[1] Landsat 8 includes 8-band multispectral scenes at 30-meter resolution which are typically used for mapping and change detection of agriculture, soils, moisture, vegetation health, water-land features and boundary studies.

[2] Near Infrared (NIR)

[3] Short Wave Infrared 1 (SWIR1)

Aquifer units may be both confined and unconfined depending on local subsoil conditions. In general, groundwater flow will be concentrated in the upper part of the aquifers, approximately 10-15m below ground level (bgl). Static groundwater levels are often 1-7m bgl. The main discharges are to small streams crossing the aquifers. Local unconfined flow directions are oblique to the surface water channels and overall flow is westwards.

The Scartaglin and Abbeyfeale GWB is characterised as having a 'PP' – poorly productive flow regime (GSI, 2000a) and is not designated as a Groundwater-Dependent Terrestrial Ecosystems (GWDTE).

Groundwater body status for the 2015 – 2018 period is designated as 'Good' overall for both GWBs, passing both quantitative and chemical status requirements under the Water Framework Directive (WFD) 3rd cycle assessment. Groundwater body risk status for the same assessment period is currently designated as 'Not at risk'.

2.4.2 AQUIFER TYPES

The bedrock aquifer type within the Proposed Offsetting Measures boundary and surrounding area is shown in Figure E- 2.

According to GSI's groundwater map viewer, bedrock directly underlying the lands is categorised as a Locally Important (LI) Aquifer Bedrock. This is defined as "Bedrock which is Moderately Productive only in Local Zones". This means groundwater flow occurs predominantly through fractures, fissures and joints, giving a low fissure permeability which tends to decrease with depth. Flow paths are thought to be between 30 – 300m in length and locally important aquifers are generally capable of yielding enough water to supply single domestic wells only (GSI, 2017). The bedrock aquifer has been categorised as a member of the 'Namurian Undifferentiated (NU)' Rock Unit Group (RUG).

The regional groundwater flow direction in the aquifer will be westwards towards the Atlantic Ocean (2000a).

Localised groundwater flow paths within the Proposed Offsetting Lands will follow the orientation of surface water sub-catchments from topographic highs to lower elevation discharge points. Shallow groundwater in the south of the lands will flow in the direction of the River Clydagh (Figure H- 1).

2.4.3 SUBSOIL PERMEABILITY

Subsoil permeability classifications within the Proposed Offsetting Measures boundary and surrounding area are presented in Figure E- 3.

Areas of 'Low' permeability, are mapped across the central and Northeast, South, and Southeast areas of the lands where Peat deposits are slightly thicker. Areas towards the Northwest and centre have been mapped as 'Medium' permeability.

There are no superficial aquifers located within or adjacent to the Proposed Offsetting Measures boundary, although it is possible that localised perched groundwater is present at the base of peat deposits and within granular layers/ lenses within the glacial till matrix.

2.4.4 GROUNDWATER VULNERABILITY

Groundwater vulnerability in Ireland, as defined in the Water Framework Directive – Recharge and Groundwater Vulnerability, is a function of the thickness and permeability of the subsoil that overlies bedrock. These factors strongly influence the attenuation processes and the time it takes for contamination to be released into the subsurface.

Groundwater vulnerability classifications within the Proposed Offsetting Lands and surrounding area are presented in Figure E- 4.

The Proposed Offsetting Lands exhibit a mixture of 'Extreme' and High – Moderate groundwater vulnerability.

Due to the localised variability on-site, based on the site walkover, the ground vulnerability is expected to vary across the lands between 'Extreme – Moderate'.

2.5 MULTITEMPORAL AERIAL/SATELLITE IMAGERY

The aerial / satellite imagery used for this report is the OSI Geohive viewer (1995 onwards), and the Google Earth multitemporal imagery (2012 onwards - Figure 2-1 to Figure 2-5). This imagery has been used to:

- Identify the presence of existing failure scars and the extent of debris runout;
- Identify pre-conditioning factors for failure (where visible at the resolution of the imagery);
- Identify evidence of other pre-development ground conditions of relevance to ground works but not exclusively associated with landslides, including vegetation cover, drainage regime, and dominant drainage pathways;

It is noted that the available imagery's time-lapse is too short to identify old peat instability evidence that may have been eroded or re-vegetated with time or changes in land management.

As discussed further in Section 2.7 and Section 4 below, two large existing peat landslides are identified in close proximity to the Proposed Offsetting Lands. Based on the available Google Earth imagery, the earlier slide (referred to as ME-A) occurred between 2012 and 2018. The second slide (ME-B) occurred in November 2020 (Fehiliy Timoney/GSI, 2024). A summary of the observations from the multitemporal imagery is given in Table 2-1.

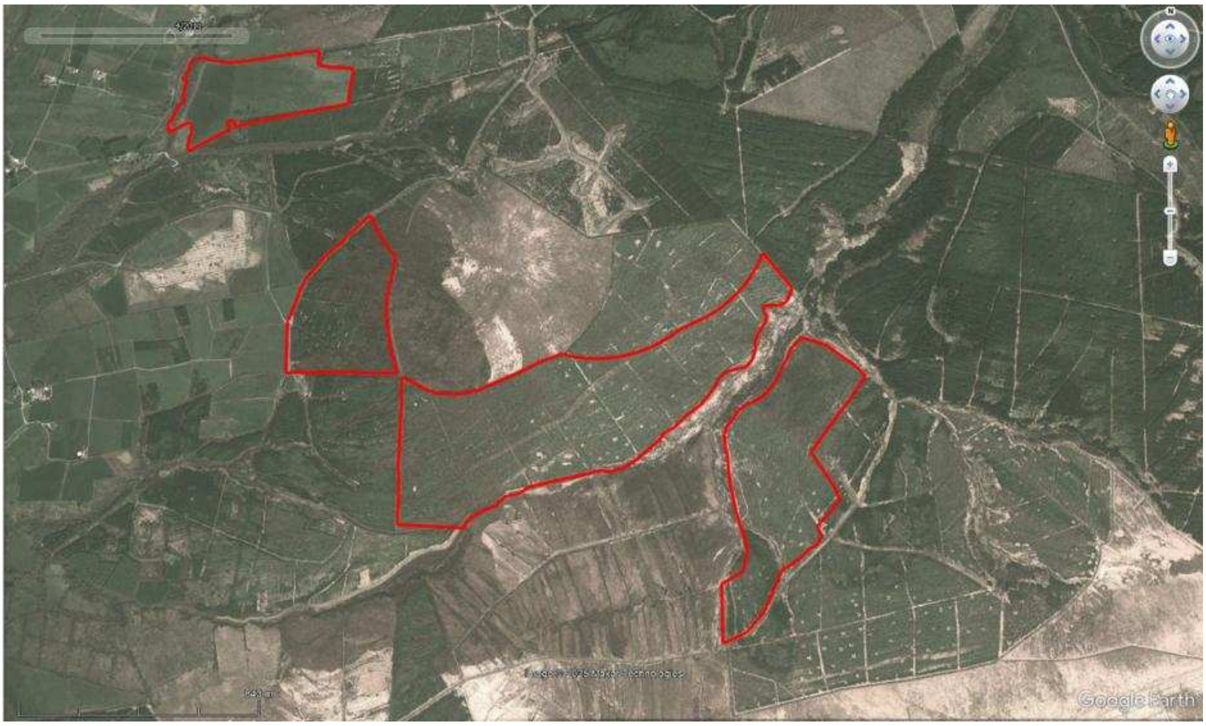

Figure 2-1: Proposed Offsetting Lands Google Earth imagery (2011).

Figure 2-2: Proposed Offsetting Lands Google Earth imagery (2012).

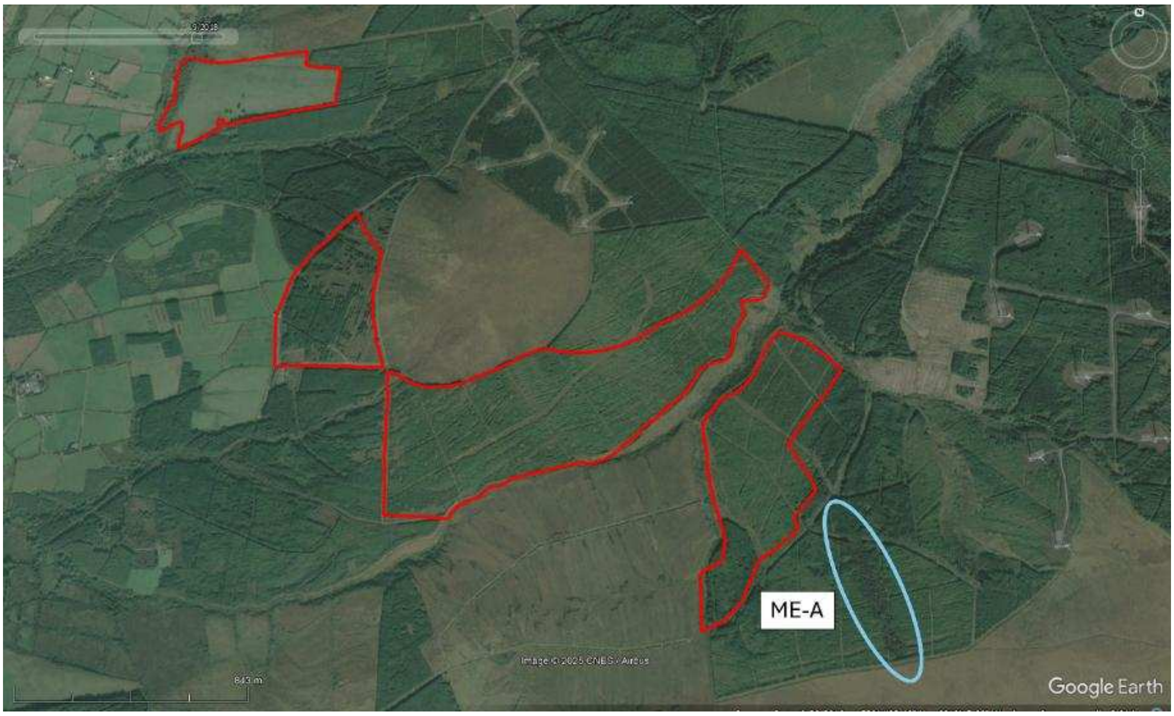

Figure 2-3: Proposed Offsetting Lands Google Earth imagery (2018). ME-A failure visible in the south of the image.

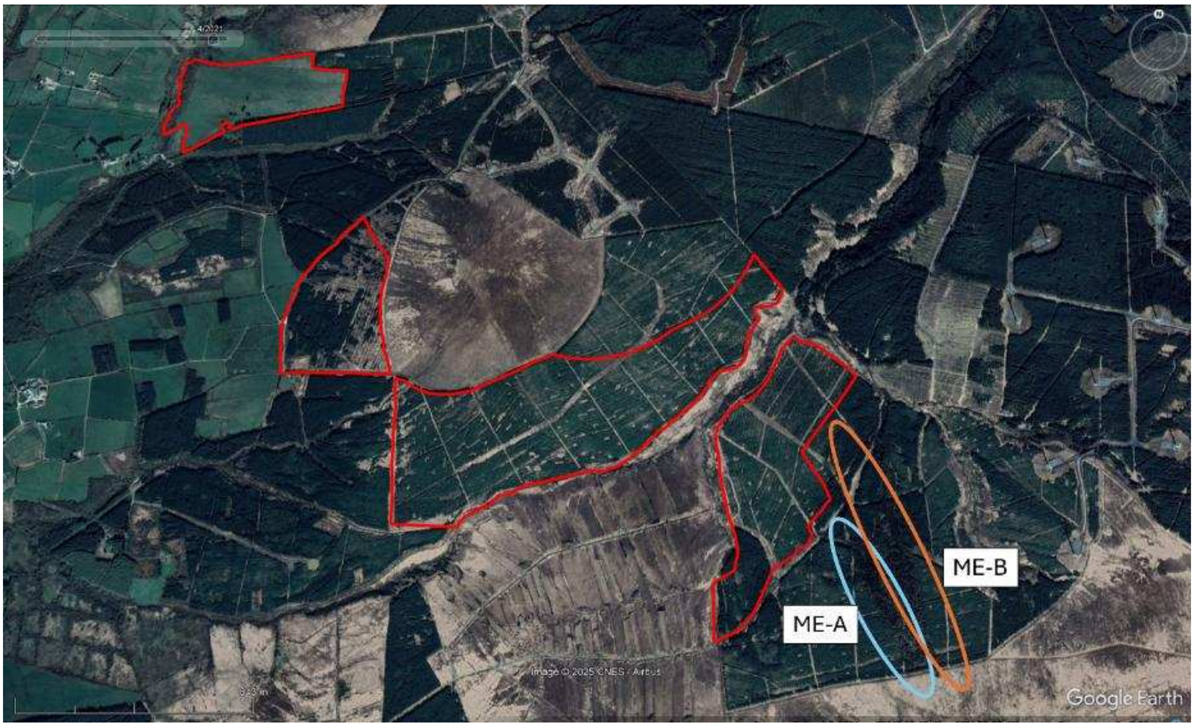

Figure 2-4: Proposed Offsetting Lands Google Earth imagery (2021). ME-A and ME-B failures visible in the south of the image.

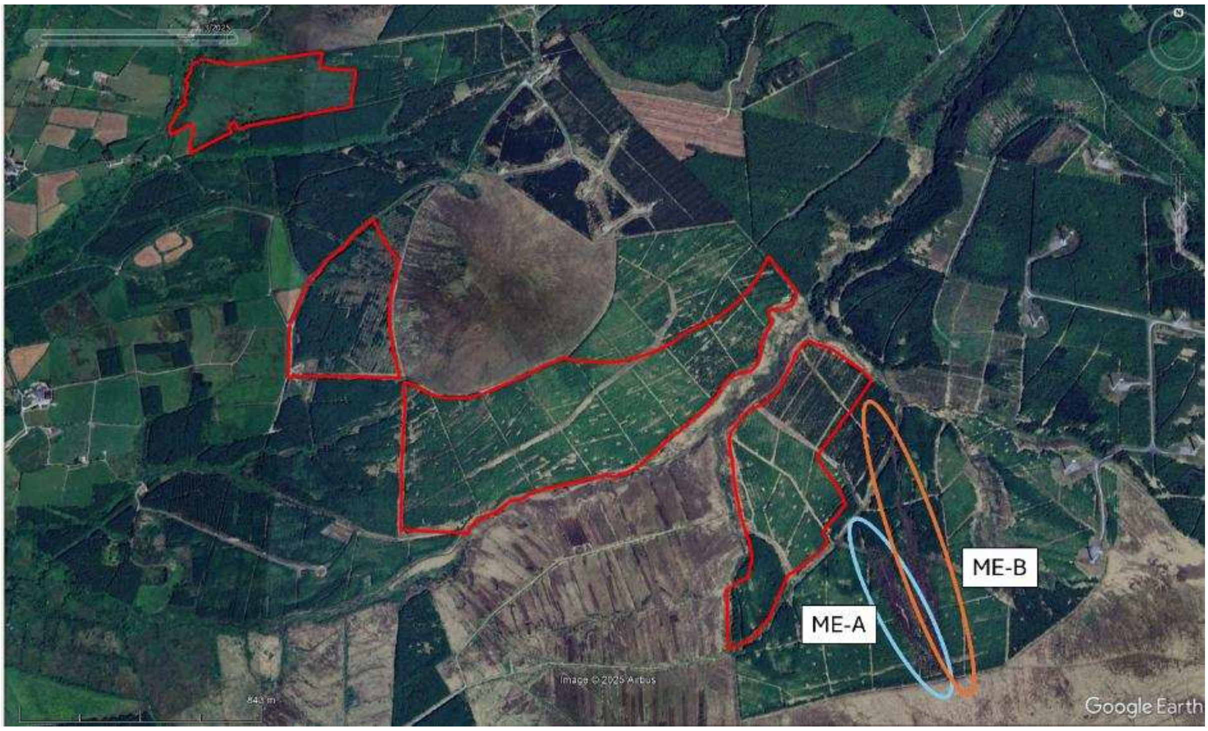

Figure 2-5: Proposed Offsetting Lands Google Earth imagery (2023). ME-A and ME-B failures visible in the south of the image.

Table 2-1: Review of historic land use from multitemporal aerial imagery.

Year	Source	Comment
1995	OSI	Rill drains and initial forestry planation in place in Area 4.
1996	OSI	Drainage network and initial forestry planation in place in Area 1 and Area 2
2001	OSI	Immature forestry visible in Areas 1, 2 and 4.
2006	OSI	Areas 1,2 and 4 covered in forestry plantation. No visible evidence of peat failure within the Proposed Offsetting Measures. Evidence of forestry works or potential die back in Area 2.
2011	Google Earth	Areas 1,2 and 4 covered in forestry plantation. No visible evidence of peat failure within the Proposed Offsetting Measures
2012	Google Earth	Areas 1,2 and 4 covered in forestry plantation. No visible evidence of peat failure within the Proposed Offsetting Measures
2018	Google Earth	Areas 1,2 and 4 covered in forestry plantation. ME-A peat failure visible.
2021	Google Earth	Areas 1,2 and 4 covered in forestry plantation. ME-A and ME-B peat failures visible.
2023	Google Earth	Areas 1,2 and 4 covered in forestry plantation. ME-A and ME-B peat failures visible.

2.6 TOPOGRAPHY

A Digital Elevation Model derived from a Bluesky LiDAR survey was used for the topographical analysis and is presented in Figure F- 1.

The Proposed Offsetting Lands topography is characterised by undulating hills. In the northwestern to southwestern portion, the ground elevation varies from approximately 421m AOD in the north to 321m AOD at Coom Hill in the south. Towards the northeast and southeast, the elevation ranges from 296m AOD, rising to 410m AOD near Mount Eagle Bogs. Across the central area of the lands, elevations range from 270m AOD in the west to 315m AOD in the east. Slope angles across the Proposed Offsetting Lands vary from 0.3° to 41°, with an average of 7° calculated (Figure F- 2).

2.7 SLOPE INSTABILITY MAPPING

Figure G- 1 illustrates the landslide susceptibility (GSI, 2016) across the Proposed Offsetting Measures boundary. This map was obtained by using an empiric probabilistic method at a regional scale and did provide input into site-specific scale engineering studies. The majority of the lands are mapped as a mixture of 'Moderately Low – High, with few areas mapped as 'low', especially along the river valley. Areas of 'High' susceptibility correspond to local topographic highs and locally steeper slopes.

The GSI landslide inventory records one landslide event roughly 200m to the southeast of the Proposed Offsetting Measures boundary on the 15th of November 2020 at 12:00 am. The event was named 'Knockfeha_2020' by the GSI and corresponds with landslide event ME-B outlined in Section 4 of this report. This existing landslide, along with an earlier event visible from aerial imagery (ME-A), located immediately to the west of the 2020 event, are described in more detail in Section 4, and are shown in Figure G- 2.

2.8 HYDROLOGY

According to the Ordnance Survey Ireland (OSi) shapefiles of rivers, lakes, and catchments/basins (Figure H- 1), the Proposed Offsetting Lands are located within the watershed of two catchments (Clydagh- Feale, and Shanowen). The central and southern points of the lands drain into the Clydagh River, which runs W-E through the centre of the lands, eventually draining to Feale and then to the Shannon. Western parts of Area 1 and Area 2 drain to the River Shanowen, which eventually drains to Dingle bay.

2.9 ARTIFICIAL DRAINAGE

Within the forestry plantations across the Proposed Offsetting Lands, there are numerous man-made drains, installed prior to planting to drain the peat. The locations of these drains are illustrated in Figure I- 1. The forestry plantations are generally drained by a network small (rill) drains, which vary from parallel to perpendicular to the contours, though are largely noted to be oblique to contours. The rill drains feed into collector, and eventually interceptor drains down slope of the forestry, with the majority of drains feeding into the Clydagh River.

Excavated firebreaks (approximately 5m in width) are visible on the upslope side of the forestry in the in the centre of the lands, and south of the Proposed Offsetting Measures boundary, and running downslope along the western boundary of the lands. These firebreaks would act as cut-off drains upslope of the forestry, likely connecting to the north-south trending drains within the forestry. It appears that the material excavated during construction of the firebreaks was deposited on the peat upslope of the firebreaks.

The rill drains appear to be spaced about 15m to 20m apart. Interceptor drains are generally located upgradient (cut-off drains) and down-gradient of forestry plantations. Interceptor drains are also located upgradient of existing forestry access roads.

2.10 LAND COVER AND LAND USE

Areas 1,2 and 4 of the Proposed Offsetting Lands currently consist of private coniferous plantation dating to 1995-1997, with forestry tracks traversing the lands. CORINE (2018) land use mapping (Figure J- 1) indicates that land use comprises almost entirely transitional woodland scrub, with Area 3 comprised of pastureland. Site walkovers conducted by GDG confirmed the presence of coniferous forestry and associated tracks.

2.11 RAINFALL

Rainfall records from the Met Éireann rain gauge at Castleisland (Coom), roughly 1.3km SW of the Proposed Offsetting Lands (Figure K- 1), are available as far back as 1944, and have been examined as part of this assessment between 1945 and 2023 (the first and last complete years available), in Figure 2-6. The minimum recorded rainfall was 742mm, recorded in 1987, and the maximum recorded rainfall was 1865mm, recorded in 2008.

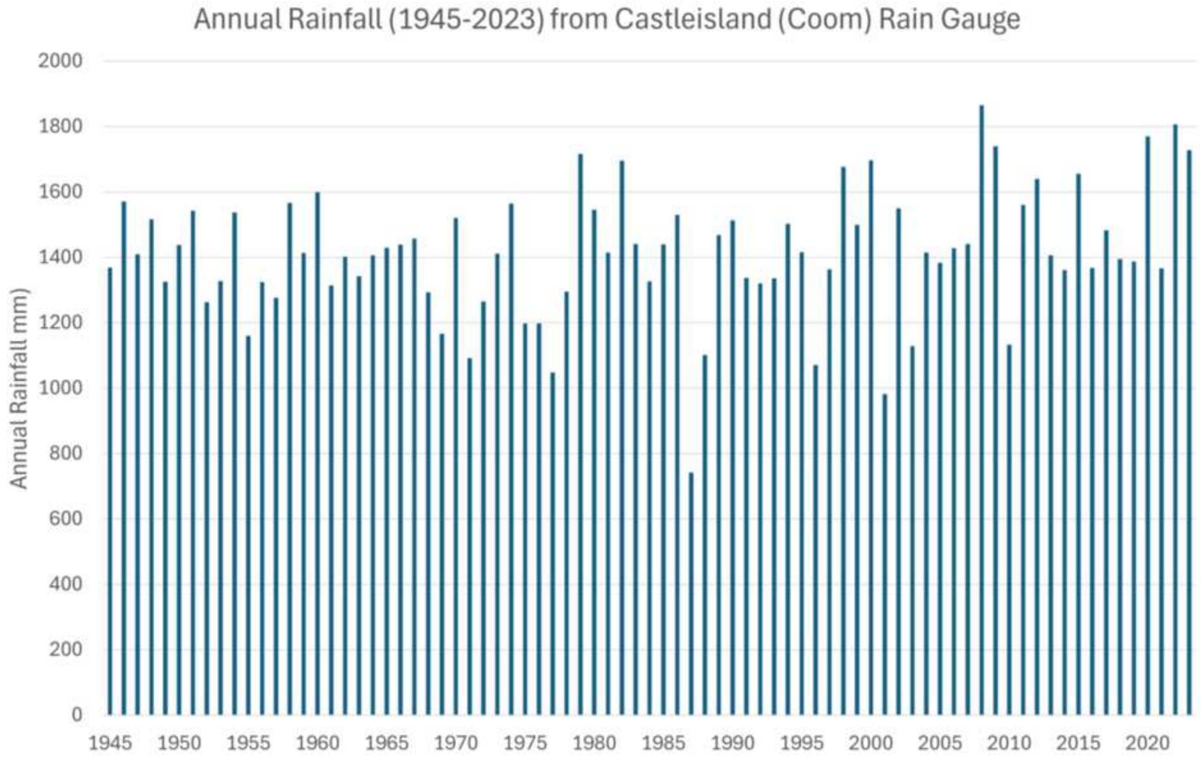

Figure 2-6: Annual rainfall records from Castleisland (Coom) rain gauge (1945-2023).

2.12 SPECIAL AREAS OF CONSERVATION AND SPECIAL PROTECTION AREAS

An overview of the Special Areas of Conservation (SAC) and Special Protection Areas (SPA) in the vicinity of the Proposed Offsetting Lands is illustrated in Figure K- 1.

2.12.1 SPECIAL AREAS OF CONSERVATION

The Proposed Offsetting Lands are not located within an SAC. The areas of Proposed Offsetting Lands which drain to the river Clydagh (Figure H- 1) are located within the upper region of the River Shannon catchment that flows down to the Lower River Shannon SAC approximately 2km downstream of the Proposed Offsetting Lands. The Lower River Shannon SAC encompasses counties Clare, Cork, Kerry, Limerick, and Tipperary. This SAC supports several EU Habitats Directive listed habitats and species, including sandbanks, reefs, alluvial forest, otters, and river vegetation.

2.12.2 SPECIAL PROTECTION AREAS

The Proposed Offsetting Lands are located within Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA (004161), which is designated for Hen Harrier (Circus cyaneus). The open bog south of the conifer plantation in Area 4 is located within Mount Eagle Bogs NHA (002449) which is designated for protection of peatlands.

3 SITE RECONNAISSANCE

GDG conducted a site reconnaissance as part of the assessment, comprising peat probing and site walk-over inspections (October 2024), including a site walkover by a chartered geologist, to record geomorphological features concerning the Proposed Offsetting Lands, peat depths, and peat strength. The walkover inspections and peat probe campaign were carried out over a larger search area, to assess peat stability risk across the local area immediately adjacent to the Proposed Offsetting Lands, in particular those areas in the immediate vicinity of the existing peat landslides. As such, the peat probe campaign includes assessment of areas upslope of, and outside of the Proposed Offsetting Measures boundary. An indication of the site conditions is shown in Figure 3-1 and Figure 3-2. Access was limited to some areas, limiting the number of peat probes taken in areas of extremely dense forestry. Site walkovers conducted by MKO in January 2025 confirmed that peat is not present in Area 3 (Figure 3-3). The original site walkover and peat probing campaign targeted a larger area of Proposed Offsetting Lands. Following the initial phases of this assessment, the area of the current Proposed Offsetting Measures was selected.

The October 2024 GDG Peat probing campaign comprised of:

1) 214 no. peat probes
2) 16 no. Hand Shear Vane Tests

Within the Proposed Offsetting Lands, the October 2024 GDG Peat probing campaign included:

1) 107 no. peat probes
2) 4 no. Hand Shear Vane Tests

In summary, intrusive ground investigations were carried out at a total of 230 locations, including 111 locations within the Proposed Offsetting Measures boundary. The site investigation locations are presented in Figure L- 1 and Figure L- 2 in Appendix L, and considered the following criteria, based on the 2017 Scottish Best Practice Guidance:

- Distance between probe points to avoid interpolation of peat depths across large distances – a minimum 100m grid was maintained where access allowed, across the search area;
- Areas immediately adjacent to the existing peat landslides were targeted at a greater density than the remaining part of the Proposed Offsetting Measures;
- Changes in slope angle, as peat depths are likely to be shallower on steeper slopes;
- Changes in vegetation, which can reflect changes in peat condition;
- Changes in hydrological conditions; and
- Changes in land use.

A raster map was created in GIS software, presenting the interpolated peat depth across a site from the peat probe points using the Inverse Distance Weighted (IDW) method. This interpolated raster of peat depth is represented in Figure L- 3 in Appendix L.

Figure 3-1: Afforested blanket peat from firebreak in Area 1 (refer to Appendix A for Site Location and key to Areas)

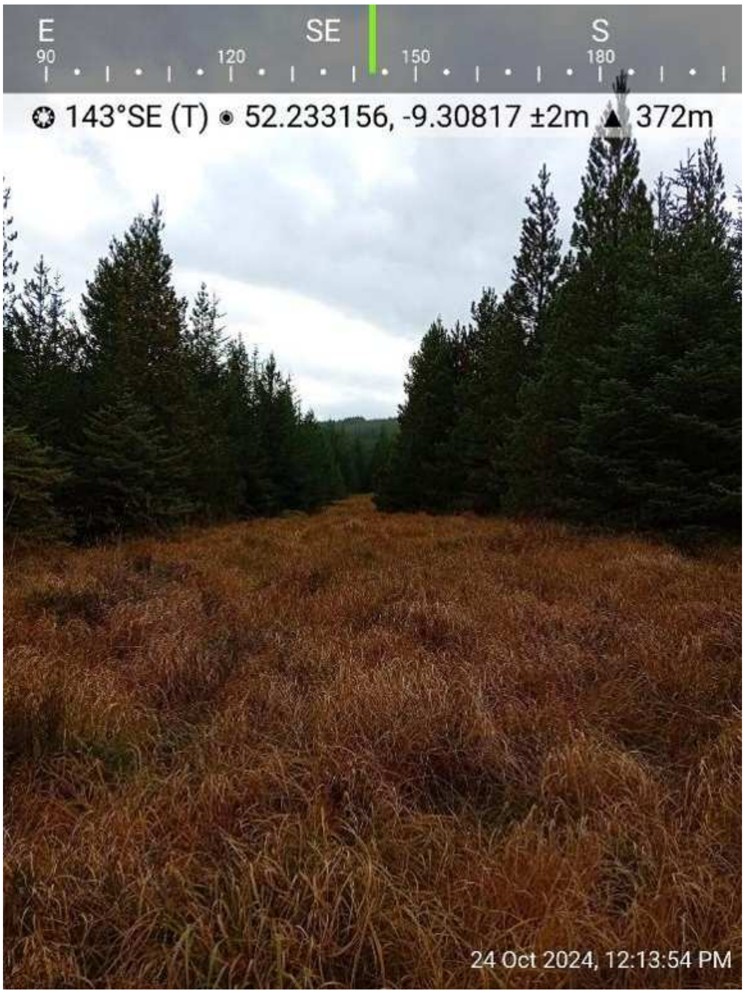

Figure 3-2: Afforested blanket peat from firebreak in Area 4

Figure 3-3: Mineral soils exposed at the edge of the forestry at the eastern edge of Area 3.

3.1 GROUND INVESTIGATION SUMMARY AND PEAT CONDITIONS

3.1.1 GROUND INVESTIGATION SUMMARY

The ground conditions at the Proposed Offsetting Lands comprise a mixed upland environment, with extensive areas of upland blanket peat, afforested with coniferous forestry plantation over much of the lands. Site walkovers specifically targeted the areas adjacent to the existing peat landslides, in addition to covering the entire Proposed Offsetting Lands.

The peat thickness encountered by intrusive investigations varies up to a maximum of 3.8m, with a median of 1.7m recorded (Figure 3-4). Within the Proposed Offsetting Lands, the recorded peat thickness ranges from 0m to a maximum of 3.2m, with a median value of 1.6m recorded. In total, 23% of recorded peat thicknesses within the Proposed Offsetting Lands were under 1m, and 72% were under 2m.

Almost the entirety of the Proposed Offsetting Lands are covered in afforested blanket peat, with areas of open blanket peat observed to the north of the Proposed Offsetting Lands, approximately 350m south of the southern boundary. The frequency of different peat thicknesses is shown in Figure 3-4.

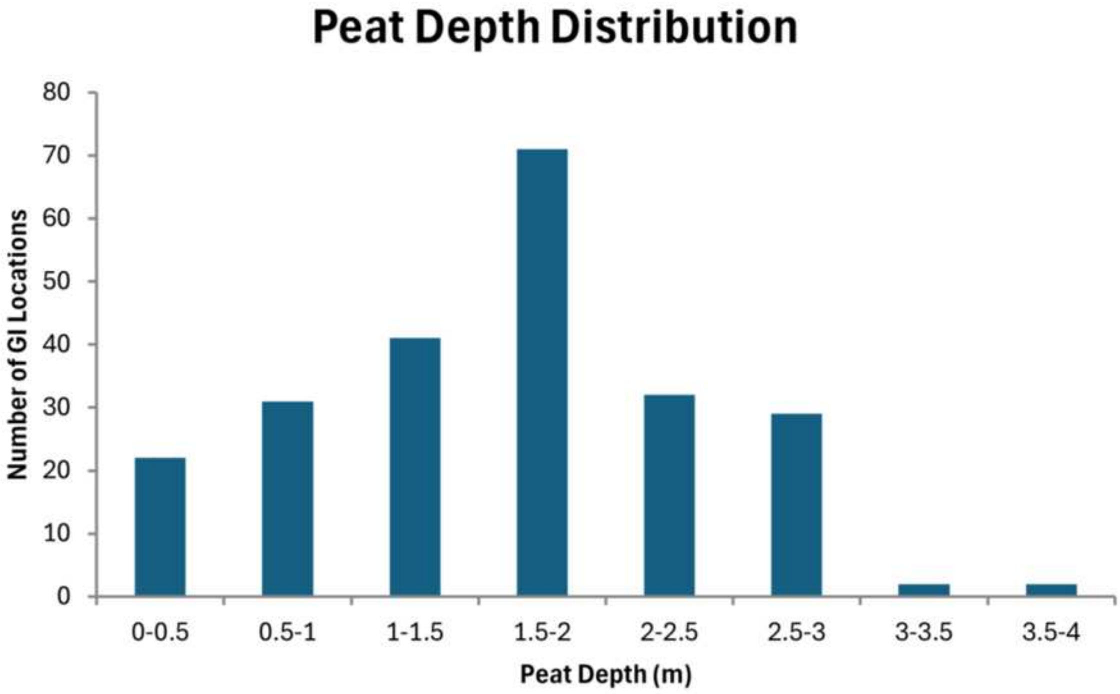

Figure 3-4: Histogram of peat depth frequency.

Hand shear vane tests (HSVs) were completed at 16 locations, of which four were located within the Proposed Offsetting Lands. A summary of the recorded values is provided in Table 3-1. The lowest undrained shear strength value recorded in the peat within the Proposed Offsetting Lands was 11kPa, recorded at 1.5m bgl in HSV5. In areas to the south of the Proposed Offsetting Lands, in proximity to the existing peat landslides (discussed in Section 4), a minimum value of 8kPa was recorded, along with a number of sites where the peat was too saturated for a reading to be taken (HSV14-HSV16, and HSV18.) Based on this available HSV data, a conservative value of 4kPa has been selected as the undrained shear strength value used in the peat stability calculations, as outlined in Section 6.3.

Table 3-1: Summary of hand shear vane test results

Location ID	Measured c_u (kPa)				Area	Notes
	0.5m BGL	**1m BGL**	**1.5m BGL**	**2m BGL**		
HSV3	20	12.5	15	-	Area 1	Lots of roots - roots could have influenced the strength at 0.5m depth
HSV5	16	16	11	-	Area 1	-
HSV6	35	21.5	22	-	Area 1	-
HSV7	14.5	12.5	16	-	Area 1	-
HSV9	21	13	22.5	-	15m S of Area 4	-
HSV10	10	16	14.5	-	300m S of Area 4	Dense grass, lot of roots - roots could have influenced the strength

HSV12	18	14	11.5	-	30m SE of Area 4	Peat was too saturated to make an accurate reading below 1.5m bgl
HSV13	32.5	27.5	-	-	140m SE of Area 4	Peat was too saturated to make an accurate reading below 1m
HSV14*	-	-	-	-	115m S of Area 4	**Peat was too saturated to make an accurate reading**
HSV15*	-	-	-	-	350m SE of Area 4	**Peat was too saturated to make an accurate reading**
HSV16*	-	-	-	-	580m SE of Area 4	**Peat was too saturated to make an accurate reading**
HSV17	14.5	12	17	22	385m SE of Area 4	Lots of roots - roots could have influenced the strength at 0.5m depth, but with depth increasing the peat was saturated
HSV18*	-	-	-	-	560m S of Area 4	**Peat was too saturated to make an accurate reading**
HSV 19	32.5	10	-	-	215m E of Area 2	Peat was too saturated to make an accurate reading below 1m
HSV 20	12	10.5	8	-	650m SE of Area 4	Lots of roots - roots could have influenced the strength at 0.5m depth
HSV 21	12	9.5	13	13.5	500m SE of Area 4	-

*Tests were carried out in saturated conditions, preventing an accurate reading from being taken.

3.1.2 OVERVIEW OF PEAT CONDITIONS

The walkover indicated that the peat is heavily afforested with coniferous forestry plantation, with drains cut at varying angles, oblique to contours in places and perpendicular to contours in some locations. Despite the significant network of small drains located within the forestry, the peat was noted to be extremely wet, and saturated in numerous locations, particularly on the north-facing slope to the south of the Area 4 boundary. Sphagnum moss was observed growing across many of the fire breaks to the south of the Proposed Offsetting Measures boundary, indicating saturated conditions. Within the Proposed Offsetting Lands, evidence for saturated peat conditions was more limited, and the peat appeared to be more well-drained. This is supported by the HSV results outlined in Table 3-1, which indicate consistently higher undrained shear strength values within the Proposed Offsetting Lands, with no occurrences of locations being too saturated for a HSV test to be performed recorded within the boundary.

A large variation in the level of decomposition and humification was observed throughout the peat body. However, this generally appeared to increase with depth. The only locations where peat humification could be assessed were in those areas where peat was exposed in the vicinity of the existing peat landslides about 300m to the Southeast of the Proposed Offsetting Measures boundary. In these locations, peat appeared well humified and amorphous beneath the initial 30cm of more fibrous peat.

4 ASSESSMENT OF EXISTING PEAT LANDSLIDES

Two large peat landslides have been identified as having occurred immediately adjacent to the Proposed Offsetting Lands since 2012. These were first identified by Dykes (2021) and have been referred to in literature as the Mt Eagle Bog Landslides. The Mt Eagle Bog Landslides have also been assessed in detail by Fehiliy Timoney (FT)/Geological Survey Ireland (GSI, 2024). The exact dates of occurrence of these two landslides is unconfirmed, but the earlier event is known to have occurred between 27 March 2012 and 29 March 2019 (the dates of the Google Earth aerial images closest to it). The later event, identified by Dykes (2021) as KFM-20 (Knockanefune Mountain), and by FT/GSI as “the Mount Eagle Landslide” is better constrained by the Google Earth imagery, and is thought to have occurred in November 2020. To differentiate between the two failures for the purpose of this assessment, the pre-2019 event will be referred to as ME-A (Mt Eagle A), and the 2020 failure is referred to as ME-B (Mt Eagle B). The two failures occurred adjacent to each other, with ME-B occurring immediately to the east of ME-A, and slightly further upslope, with the runout zones overlapping. The source zone of ME-A is located a minimum distance of 150m to the east of the Proposed Offsetting Lands, while the source zone of ME-B is located a minimum of 280m to the southeast of the boundary. The runout from the ME-B event passes a minimum distance of 35m from the Proposed Offsetting Lands.

Dykes (2021) provided an assessment of the characteristics and potential failure mechanisms of ME-B based on publicly available Google Earth and drone aerial imagery, with brief reference to ME-A. GDG conducted an in-depth site walkover and peat probing campaign in the vicinity of both failures.

4.1 ME-A LANDSLIDE

4.1.1 LANDSLIDE CHARACTERISTICS

The geometry of ME-A is generally, long and linear, with the source zone measured from Google Earth imagery at about 430m in length, with width varying ranging between 60-100m. The failure can be broken into three distinct sections (Figure 4-1). The head zone (the upper 90m) measures approximately 80m across and narrows to a ‘neck’ of approximately 60m for the next 70m. Below this, the source zone width increases to approximately 100m across the lower section, the main source zone (the remaining 270m). The slope angles across the failure vary from 3-7° in the upper 220m, to 7-11° in the lower 270m, with a convex break in slope approximately 220m below the head. The peat depths recorded around the margins of the ME-A failure indicate average peat depths of approximately 2.3m across the failure. The extents of the run-out zone from the ME-A landslide is uncertain, due to the long gap between aerial images, however assuming 2.3m of peat across the measures source area (approximately 32,600m^2), an approximate total peat failure volume of 75,000m^3 can be calculated.

The lower 270m of the failure (the main source zone), appears to have failed almost instantaneously, with almost complete evacuation of the peat across most of the area, with a large number of randomly distributed blocks floating on slurried catotelm peat throughout. In the October 2024 site walkovers, the mineral substrate was observed to be exposed within the central and downslope parts of the main source zone (Figure 4-2), although it appears from the earlier aerial imagery (Figure 4-10) that a thin layer of peat slurry initially covered much of the floor of the otherwise fully evacuated source zone. It is difficult to tell the condition of the basal peat from the aerial imagery, but these could reflect a basal sliding surface. The margins of the main source zone are fairly well defined, with some lateral fissures/tears extending into the forestry.

The area included within the narrow 'neck' (roughly 60m wide and 70m long, Figure 4-4), contains a large number of larger, more coherent peat rafts, with multiple trees. This area also shows less evidence of large scale sliding and lacks the large scale evacuation of peat slurry seen further downslope. This section of the failure coincides with a localised area of lower slope angle (3-5°), suggesting that this change in morphology can be attributed to greater basal sliding friction in this part of the slope. The area upslope of the 'neck' contains a large number of stranded peat rafts, arranged in a concentric, arcuate pattern at the head of the slide, but with a greater concentration of stranded rafts with significant peat evacuation around them. This area of reduced peat raft density coincides with an increase in slope angle, suggesting that this change in morphology can be attributed to reduced basal sliding friction in this part of the slope. The area at the head of the failure appears not to show evidence for significant evacuation of basal peat from above the arcuate peat rafts.

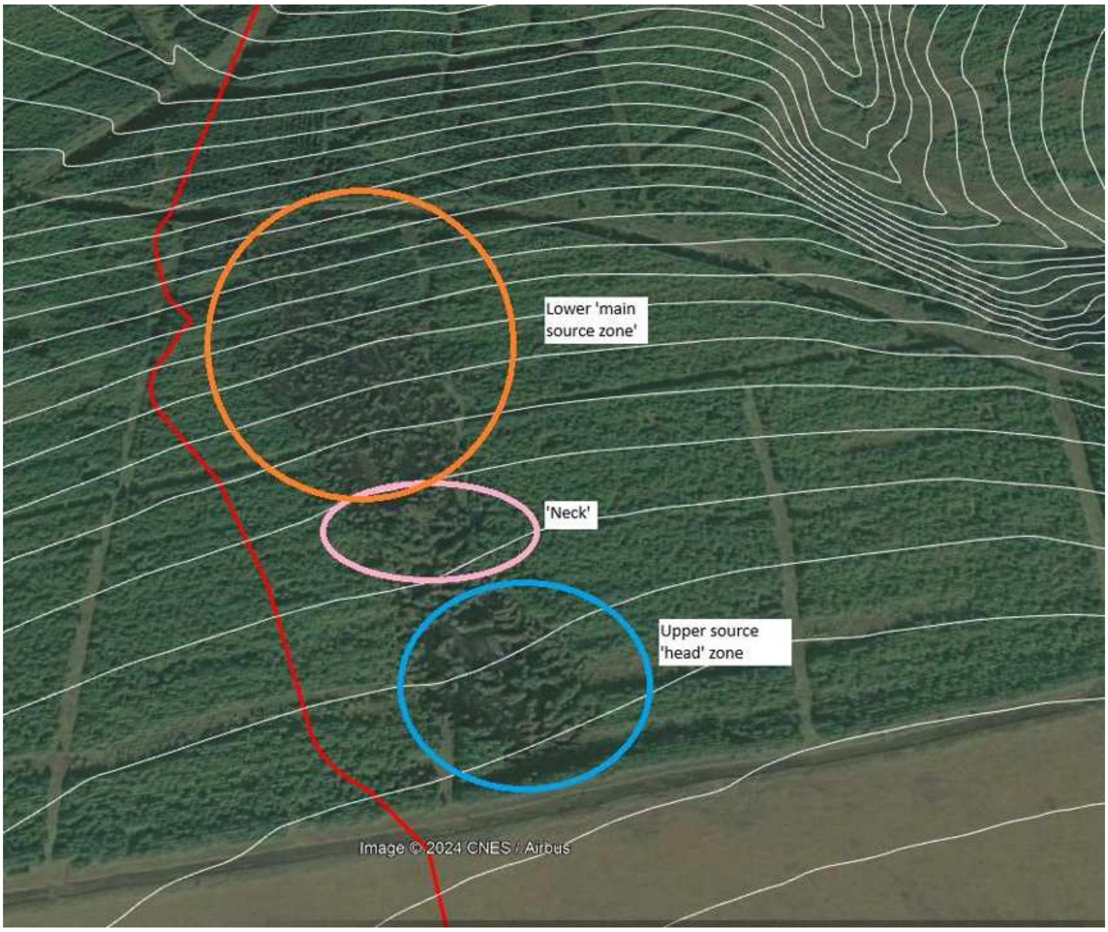

Figure 4-1: ME-A slide morphology (Google Earth, 2018).

Figure 4-2: View downslope of ME-A failure, with peat rafts and exposed substrate visible.

Figure 4-3: Peat raft at the western margin of ME-A.

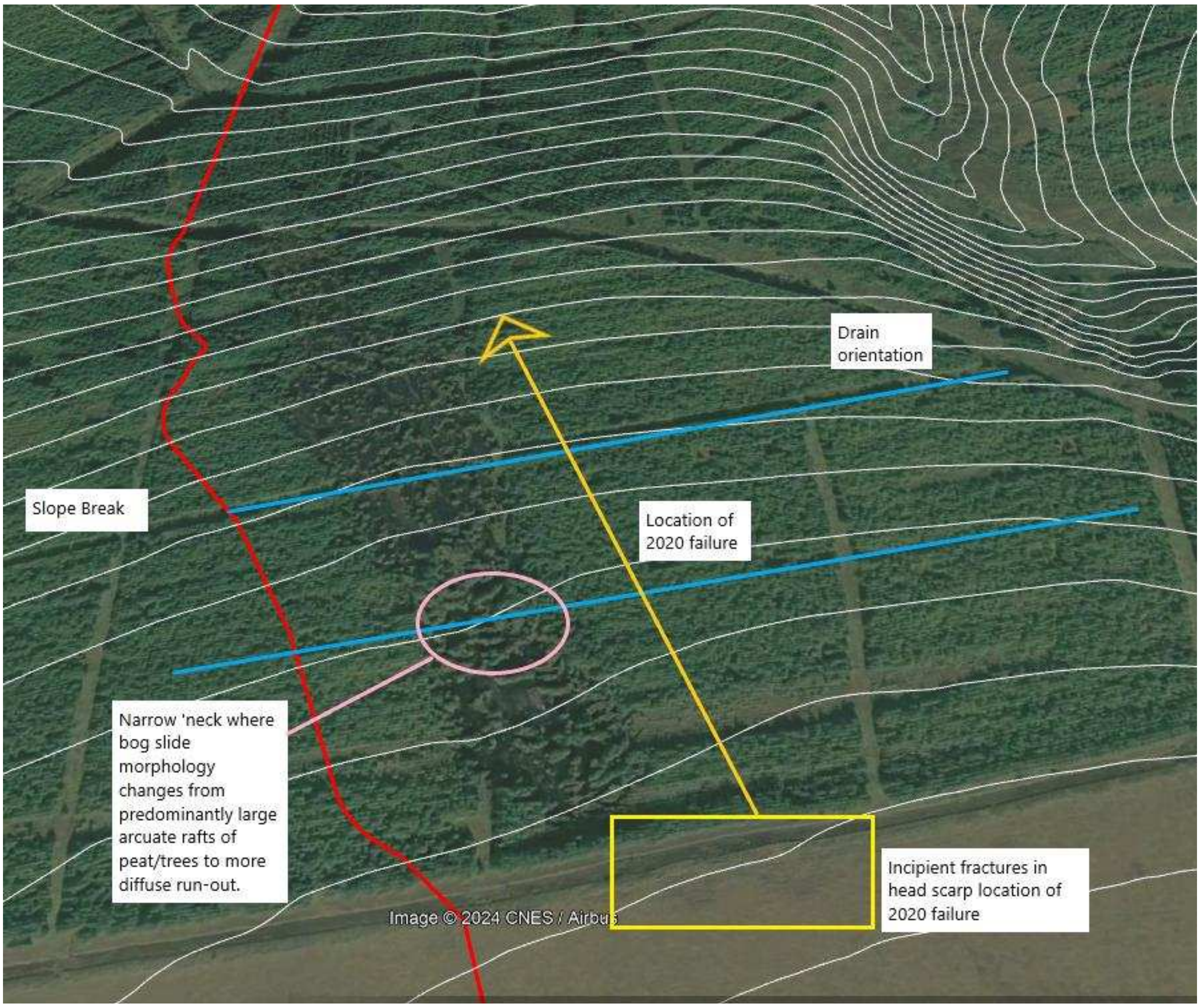

Figure 4-4: ME-A morphology, and incipient tension cracking at the future ME-B location (google Earth, 2018).

Based on the available evidence from aerial imagery and the site walkovers, it is determined that the ME-A failure should be classified as a bog slide (Table 1-1) defined by Dykes and Warburton (2007) as failure of a blanket bog (i.e. bog peat) involving sliding of intact peat on a shearing surface within the basal peat'. The failure appears to have occurred within the humified basal peat. The material is largely concentrated in rafts or blocks along the path, indicative of intact peat layers being displaced. The aerial imagery does not show evidence for extensive runout of liquefied peat in the ME-A event, and there is minimal lateral spreading visible, which suggests the movement is more confined. The failure margins are hard to identify clearly with the presence of the forestry, and with the eastern margin having been subsumed into ME-B. However, these margins appear to be fairly well-defined. The widening of slide footprint above the neck may also potentially indicate that this event proceeded as retrogressive translational failure extending uphill from the initial failure in the main source area, with larger, more coherent peat rafts upslope, suggesting an increase in basal friction at the 'neck'.

4.1.2 CONDITIONING FACTORS

The following contributing factors have been identified, which may have contributed to the initial failure of ME-A:

- Artificial drainage ditches have been cut parallel to contours, roughly perpendicular to the direction of failure across the source zone of the ME-A landslide (Figure 4-4). This may have the effect of focusing surface run-off water into a localised area of afforested blanket bog and leading to ponding of water in the vicinity of the source zone, leading to increased lubrication and increased buoyancy at the base of the peat profile. This is cited as a key factor by both Dykes (2020) and FT/GSI (2024).
- Areas of extremely wet, saturated peat were observed in the vicinity of the source zone. Hand shear vane readings taken during the 2024 GDG site walkovers recorded values as low as 8kPa, with some tests abandoned due the saturation of the peat. This indicates that areas in the vicinity of the failure experienced extremely low peat undrained shear strength.
- The presence of a slight convex break in slope at or close to the assumed failure initiation point has been identified from the available topographic data.
- The afforested and drained nature of the area is hypothesised to have contributed to disruption of the hydrological regime, and to have potentially exacerbated the impacts of the contour parallel drainage.

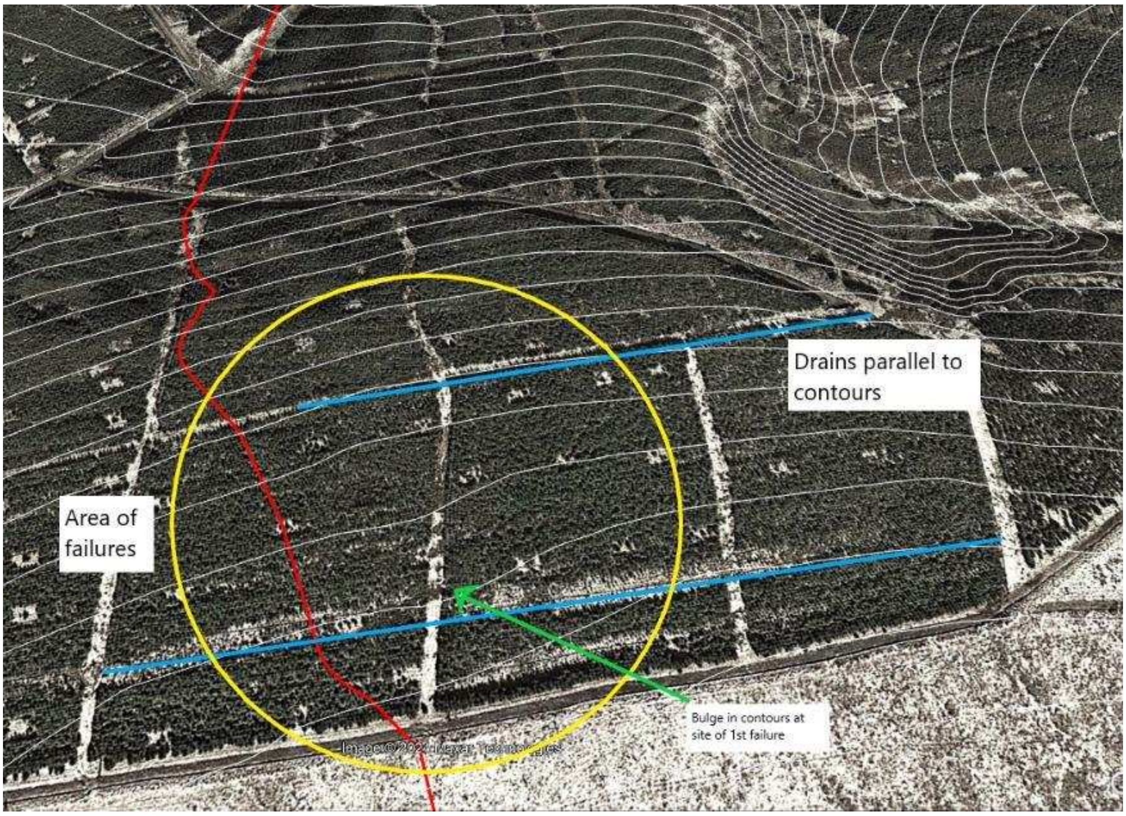

Figure 4-5: Drains cut parallel to contours in area of existing eat landslides (Google Earth, 2012).

4.1.3 TRIGGERING FACTORS

No clear immediate trigger for the ME-A event has been identified. Due to the gap in available aerial imagery between 2013 and 2018, it is difficult to ascertain the precise timing of this failure.

4.2 ME-B LANDSLIDE

4.2.1 LANDSLIDE CHARACTERISTICS

The Geometry of ME-B is broadly similar to ME-A, with this second failure having occurred directly adjacent to, and overlapping with the earlier event. The median peat depth recorded across the ME-B failure is 2.3m. The source zone was measured from Google Earth imagery at about 600m in length, with width varying ranging between 30-100m. The failure can be broken into three distinct sections (Figure 4-7). The head zone (the upper 150m) measures approximately 30-40m across and ends at the upslope margin in an arcuate, concentric set of tension cracks (Figure 4-6). Below this, the source zone width increases to approximately 60-100m across in the main source zone (the remaining 450m). Below this, the runout appears to have become more flow-like upon entering existing drainage channels, and to have split into two main runout zones of 750m and 500m in length, before entering a tributary of the River Clydagh. Existing drainage ditches are clearly visible in the aerial imagery, cutting across slope perpendicular to the failure long axis, and parallel to slope contours (Figure 4-10).

Figure 4-6: Arcuate, concentric tension cracks at the head scarp of ME-B.

In the October 2024 site walkovers, the mineral substrate was observed to be exposed within the central and downslope parts of the main source zone (Figure 4-9, Figure 4-11), although it appears from the earlier aerial imagery (Figure 4-10) that a thin layer of peat slurry initially covered much of the floor of the otherwise fully evacuated source zone. This peat shear surface was observed on site in a small number of locations (Figure 4-8). It is difficult to tell the condition of the basal peat from the aerial imagery, but these could reflect a basal sliding surface. The margins of the main source zone are fairly well defined, with some lateral fissures/tears extending into the forestry.

Analysis of aerial imagery and observations from the site walkover indicate that the failure mechanism was likely very similar to that of ME-A and should be classed as a bog slide. There are some notable differences, however. The most pronounced difference is that while the runout from ME-A appears to have been largely limited to the vicinity of the source area, while the runout from ME-B extends an additional 400-600mm downslope from the source area, and likely entered a tributary of the River Clydagh. This indicates a much greater degree of liquidity in the mobilised peat, with the run-out behaving in a more flow-like manner than in ME-A. Site observations in the run-out area support this conclusion, with peat clearly having been transported as liquid peat slurry.

Observations in the source and head areas indicate that there is not a significant degree of evidence for expulsion of material from the basal regions of the peat mass upslope of the arcuate peat rafts at the head of the failure, and that the failure margin is still well defined.

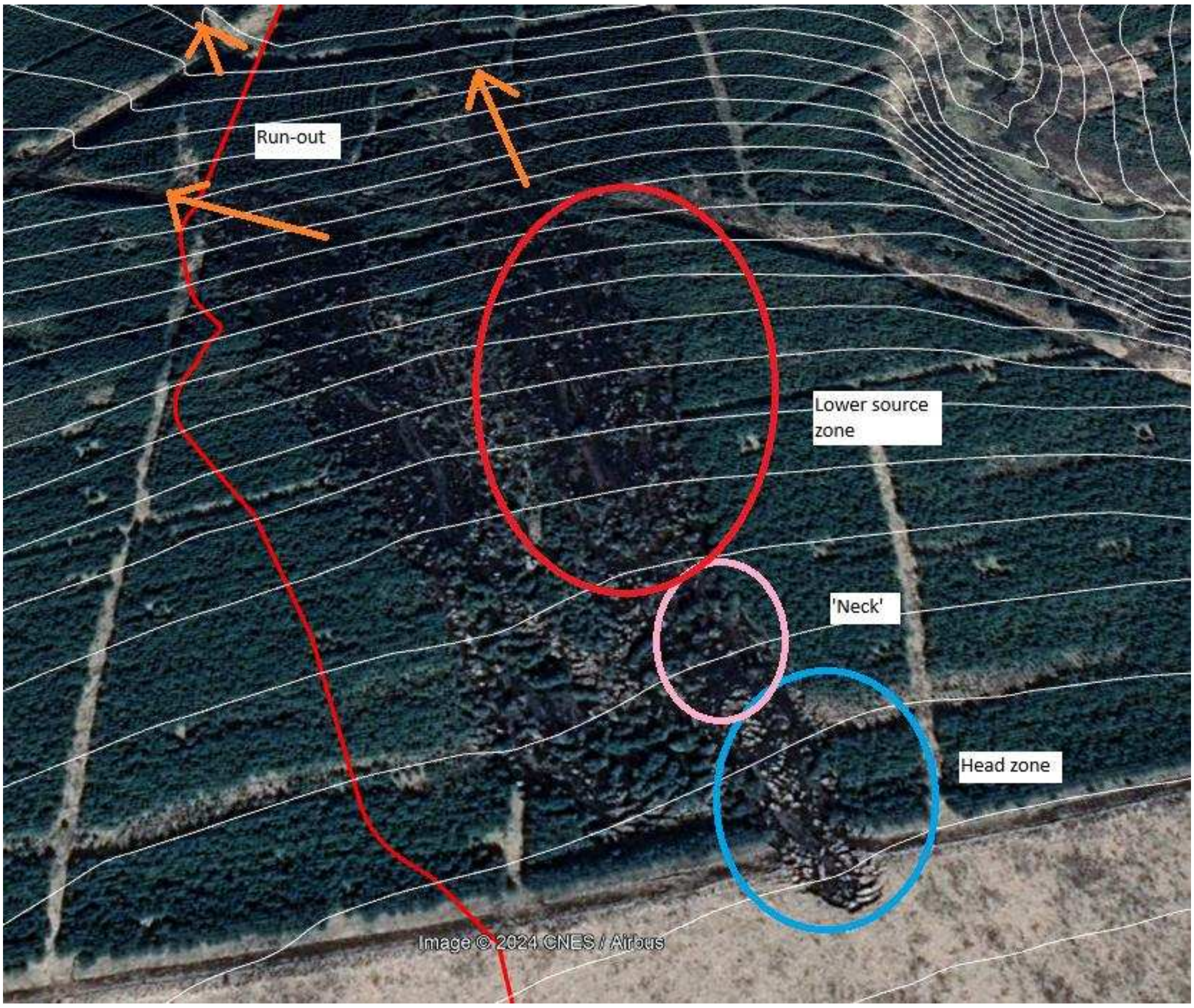

Figure 4-7: ME-B Slide morphology (Google Earth, 2021).

The main body of the failure contains a lower density of stranded peat rafts than observed in the aftermath of ME-A, with many of the rafts initially observed at ME-A having apparently been remobilised during the ME-B event. These morphological features suggest that, while ME-B should be classified as a bog slide, it seems likely that the failure transitioned into a bog flow like morphology downslope, after encountering existing drainage channels. Mineral soils are exposed and visible within the failure scar, suggesting that the failure may have occurred at the interface between the peat and the underlying mineral soil. However, following review of aerial imagery immediately following the failure (2021), and based on site observations, which suggest extensive failure planes within the basal peat, it is assumed that the mineral soils have been exposed by subaerial erosion of the failure scar in the four years following the failure.

Figure 4-8: Potential basal peat shear plane with flow paths, and contour parallel drain visible in foreground.

Figure 4-9: View downslope from the head scarp of ME-B. Mineral soil substrate exposed.

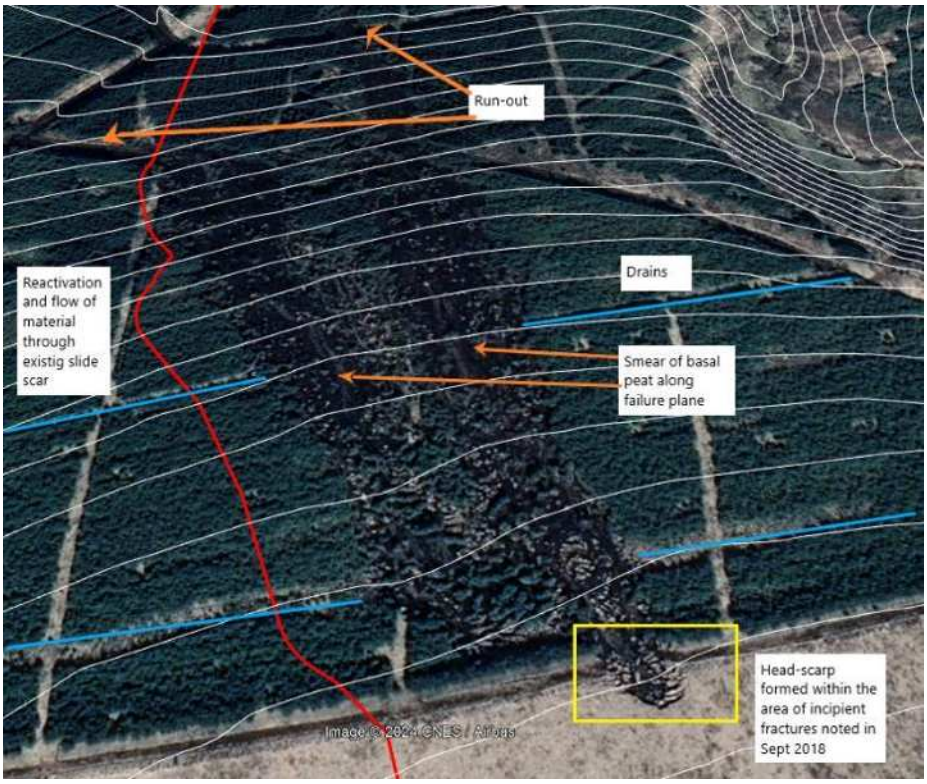

Figure 4-10: 2021 Google Earth imagery showing potential basal peat shear planes.

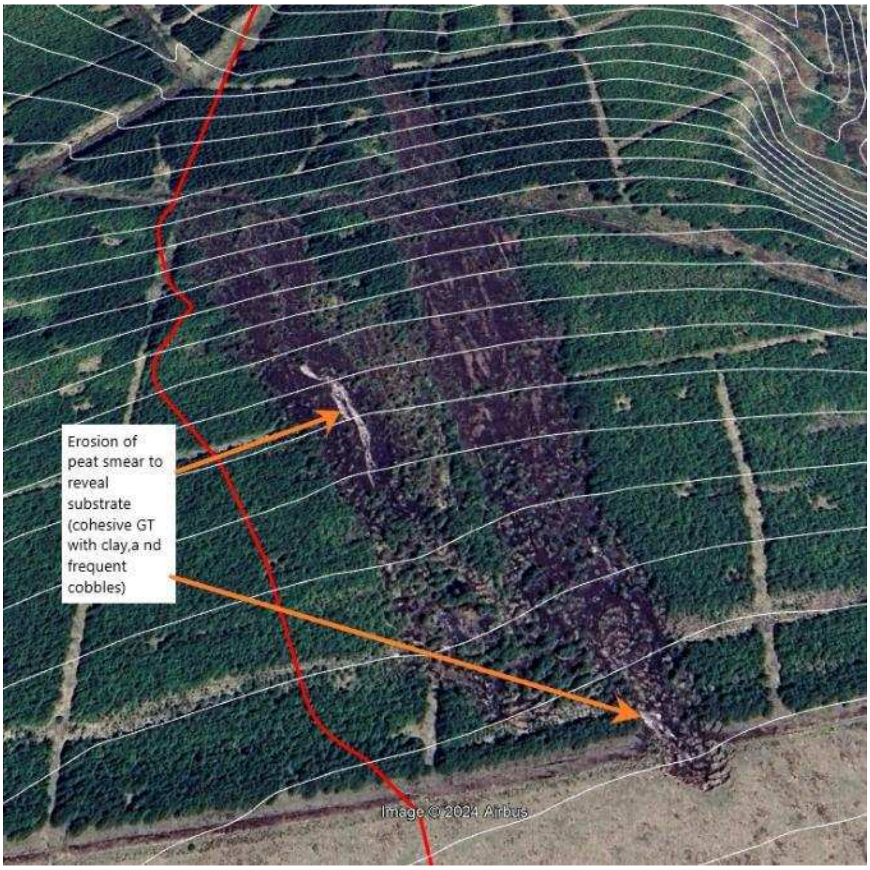

Figure 4-11: 2023 Google Earth imagery showing erosion of basal peat to mineral substrate.

Dykes (2021) and FT/GSI have conducted separate assessment of ME-B (referred to by FT/GSI at Mount Eagle Peat Slide) based on aerial imagery (both) and site observations (FT/GSI, 2024 only). Dykes supported the classification of ME-B as a bog slide, while FT/GSI suggested that this event should be classified as a peat slide and debris slide, based on the visible mineral soils within the failure scar, which they argue indicates a failure plane at the interface between the peat and the mineral soil.

4.2.2 CONDITIONING FACTORS

The following contributing factors have been identified, which may have contributed to the initial failure of ME-B. These are largely the same as for ME-A, with two additional factors added:

- Artificial drainage ditches have been cut parallel to contours (Figure 4-5 and Figure 4-8), roughly perpendicular to the direction of failure across the source zone of the ME-B landslide. This may have the effect of focusing surface run-off water into a localised area of afforested blanket bog and leading to ponding of water in the vicinity of the source zone, leading to increased lubrication and increased buoyancy at the base of the peat profile. This is cited as a key factor by both Dykes (2021) and FT/GSI (2024).
- Areas of extremely wet, saturated peat were observed in the vicinity of the source zone. Hand shear vane readings taken during the 2024 GDG site walkovers recorded values as low as 8kPa, with some tests abandoned due the saturation of the peat. These values could well be lower than 8kPa. This indicates that areas in the vicinity of the failure experienced extremely low peat undrained shear strength.
- The presence of a slight convex break in slope at or close to the assumed failure initiation point has been identified from the available topographic data.
- The afforested and drained nature of the area is hypothesised to have contributed to disruption of the hydrological regime, and to have potentially exacerbated the impacts of the contour parallel drainage.
- The impact of the ME-A failure is likely to have been instrumental in conditioning the slope to failure in the ME-B event. This failure will have removed lateral/downslope support from the source area of the ME-B landslide. It may be argued that the ME-B event was a direct trigger, and the aerial imagery in Figure 4-4 illustrates the appearance of tension cracks within the future head zone of the ME-B landslide having formed in the immediate aftermath of the ME-A event. The formation of these tension cracks will likely have accelerated the process of surface water infiltration into the basal peat within the source zone of the ME-B landslide, further weakening the peat.
- The ME-B source zone is intersected by the large, machine excavated firebreak which runs along the southern boundary of the coniferous forestry plantation. This will have allowed for additional surface water infiltration, and provided a concentration point for surface water ponding within the source zone, and removed downslope support form the head zone of the ME-B landslide.

4.2.3 TRIGGERING FACTORS

No clear immediate trigger for the ME-B event has been identified. There was no clear significant rainfall event immediately prior to the failure in November 2020 (FT/GSI, 2024). However, the combination of a significant dry spell (April and May 2020) followed by relatively high daily rainfall amounts (from June 2020 onwards) may have been the triggering factor in the failure in association with the conditioning factors listed above (FT/GSI, 2024).

4.3 POTENTIAL ADDITIONAL AREAS OF INSTABILITY

Two additional areas of potential relict/active instability have been identified during the 2024 GDG site walkovers. Both areas were identified on the north facing slope to the west of the ME-A and ME-B landslides, between 20m and 260m south of the Proposed Offsetting Lands. These areas have been considered as areas of peat instability in the qualitative assessment in Section 7.3.7.

Figure 4-12: Possible peat failure scarps. Possible evidence for relict instability.

Figure 4-13: Area of tension cracking observed in peat approximately 260m south of Proposed Offsetting Measures boundary.

4.3.1 POTENTIAL RELICT LANDSLIDE

An area of significant peat scarps directly upslope of an area of extremely shallow peat was observed 20-200m to the south of the Proposed Offsetting Lands (Figure 4-12). The significant scarps (>1m), with visible tension cracking, are located in proximity to a significant convex break in slope and adjacent to a natural drainage line. It is hypothesised that this area could represent an area of relict instability pre-dating the plantation of the forestry. The area of potential relict instability is illustrated in Figure G- 2 in Appendix G.

4.3.2 AREA OF TENSION CRACKING

An area of visible tension cracking was observed to the south of the southern boundary of the forestry approximately 260m south of the Proposed Offsetting Measures (Area 4), directly to the south of the mechanically excavated firebreak. This tension cracking is visible at ground level (Figure 4-13) and may represent the early stages of peat failure in this location.

4.4 COMPARISON OF CONDITIONING FACTORS

Following review of the two historical peat landslides observed to the south of Area 4 of the Proposed Offsetting Lands, the following observations can be made comparing the areas immediately adjacent to the historic failures and areas of potential instability, and the areas within the Proposed Offsetting Lands:

- Artificial drainage ditches have been cut parallel to roughly perpendicular to the direction of failure across the source zone of the ME-A and ME-B landslides. As outlined in Section 7.3.3, this drain orientation is commonly observed in the areas in close proximity to the ME-A and ME-B failures, but is not typically observed within the Proposed Offsetting Lands.
- Areas of extremely wet, saturated peat were observed in the vicinity of the source zone of the ME-A and ME-B landslides, along with both potential additional areas of instability. Hand shear vane readings taken during the 2024 GDG site walkovers recorded values as low as 8kPa, with multiple tests abandoned due the saturation of the peat. These values could well be lower than 8kPa. This indicates that areas in the vicinity of the failure experienced extremely low peat undrained shear strength. Hand shear vane results within the Proposed Offsetting Lands were consistently higher (Table 3-1), with a minimum undrained shear strength value of 11kPa recorded, and no tests abandoned due to the peat being too saturated.
- The presence of a slight convex break in slope at or close to the assumed failure initiation point has been identified from the available topographic data. Sharp convex slope breaks are not encountered within the Proposed Offsetting Lands (7.3.2).
- The afforested and drained nature of the area is hypothesised to have contributed to disruption of the hydrological regime, and to have potentially exacerbated the impacts of the contour parallel drainage. The areas within the Proposed Offsetting Lands are also afforested and drained, which may impact stability. This has taken into account in the analysis in Section 7.3.
- The impact of the ME-A failure is likely to have been instrumental in conditioning the slope to failure in the ME-B event. This failure will have removed lateral/downslope support from the source area of the ME-B landslide. It may be argued that the ME-B event was a direct trigger, and the aerial imagery in Figure 4-4 illustrates the appearance of tension cracks within the future head zone of the ME-B landslide having formed in the immediate aftermath of the ME-A event. The formation of these tension cracks will likely have

accelerated the process of surface water infiltration into the basal peat within the source zone of the ME-B landslide, further weakening the peat. This conditioning factor will not have an impact within the Proposed Offsetting Lands, as the historic landslides are located a minimum of 150m from the Proposed Offsetting Lands boundary.

- The ME-B source zone is intersected by the large, machine excavated firebreak which runs along the southern boundary of the coniferous forestry plantation. This will have allowed for additional surface water infiltration, and provided a concentration point for surface water ponding within the source zone and removed downslope support from the head zone of the ME-B landslide. A large, machine excavated firebreak runs along the northern boundary of Area 1 of the Proposed Offsetting Measures boundary. This is considered in Section 7.3.3, but due to the lower peat depths encountered in this location, is not considered to present the same level of risk as in the ME-B source area.
- The median peat depth recorded within the source areas of the two historic landslides (2.3m) was significantly higher than the median peat depth recorded across the Proposed Offsetting Lands (1.6m).

5 PROPOSED OFFSETTING MEASURES METHODOLOGY

The Proposed Offsetting Measures will be achieved by deforestation of approximately 105.5Ha of plantation forestry across the area to create new viable hen harrier habitat, and the works will consist of:

- Deforestation and removal of trees of approximately 10 HA;
- Deforestation to waste of approximately 95.5 HA;
- Windrowing of fell to waste material at 50m intervals where possible;

Replanting of forestry will not occur within the Proposed Offsetting Lands.

The forestry methodology has been designed by SWS Forestry. For the purposes of the forestry works, the Proposed Offsetting Lands have been divided into four areas (Area 1- Area 4), as shown in Figure A- 1. A detailed description of the proposed forestry works can be found in Chapter 4 (Project Description) of the EIAR, but is described in brief in Section 5.1 to Section 5.3. Area 3 contains no forestry, so forestry works are not proposed. This area has been excluded from the PSRA as no peat is present.

No further habitat restoration works such as drain blocking and re-wetting of peatland using peat dams or similar techniques are proposed. It is not proposed that forestry access tracks will be constructed.

5.1 AREA 1

The forestry crop here is considered to be poor, and as such, the proposed methodology is to “cut to waste” by placing the entire crop in windrows about 50m apart, as illustrated in Figure 5-1. A Tracked Excavator Machine with Shears/Harvester Head would cut the trees, and following this, the harvesting operator will swing around and drop the entire tree as far as needed (typically up to 12m from where cut) where it would be within reach of and picked up by a second Tracked Excavator Machine with a dyke/rock bucket or grab that having picked the tree swings around again (c. 12m from where picked) resulting in a windrow being located c. 24 meters from where furthest away trees were cut. The process would then be replicated from the other side so that a windrow (c. 2-3 m wide) comprising approximately 50m of crop is created. The second machine will, using its attachment, compress the material so as to keep the windrows tight and as narrow as possible.

The key hazards to peat stability here is the application of surcharge to the peat by plant tracking, and by placement of the windrows. Windrows will not be placed in areas calculated as being of elevated risk for peat instability.

5.2 AREA 2

The proposed method would be to cut the crop within the heavier (more productive) area comprising c. 10 HA within Area 2 using a shears/harvesting head on a tracked excavator and then using a forwarder to draw all material (whole trees) to a storage area near the entrance. The forwarder would use brash/trees to support the ground upon which it is travelling, bringing approximately 5 ton loads of entire trees to the storage area at a time. Brash would be replenished as required should ground conditions disimprove in order to minimise the impact of machinery causing rutting. Material (estimated total volume c. 2,000 ton) would be left on site adjacent to the entrance for 4-6 months to dry out, after which time a chipping machine would be brought on site, chipping the material and blowing it into lorries for onward deliver to biomass plants.

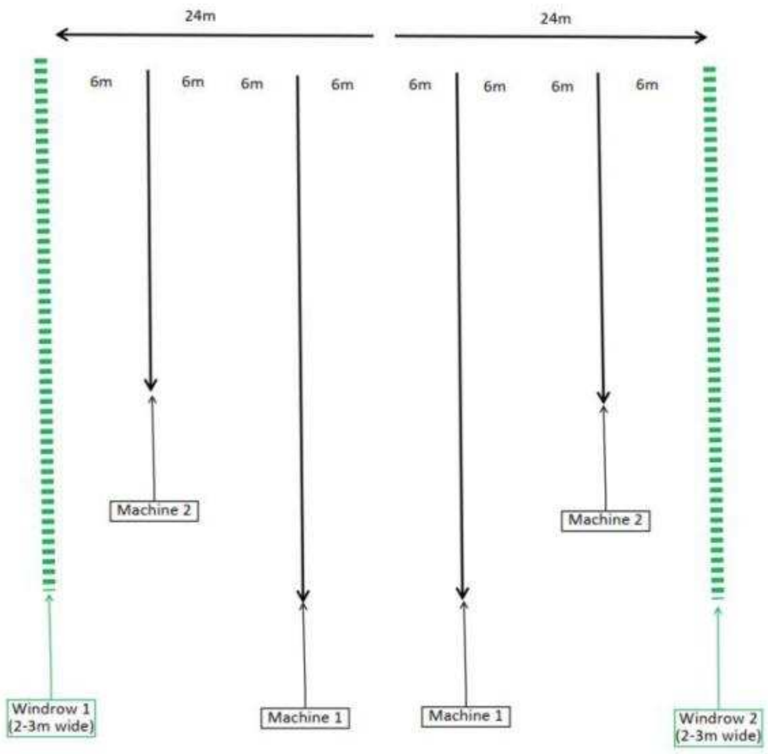

Figure 5-1: Indicative sketch of windrow orientation.

The key hazards to peat stability here is the application of surcharge to the peat by plant tracking. Felled trees will not be placed in areas calculated as being of elevated risk for peat instability (as outlined in Section 8.2).

5.3 AREA 4

As in Area 1, the forestry crop is considered to be poor, and as such, the proposed methodology is to "cut to waste" by placing the entire crop in windrows approximately 50m apart., as illustrated in Figure 5-1. A Tracked Excavator Machine with Shears/Harvester Head would cut the trees, and following this, the harvesting operator will swing around and drop the entire tree as far as needed (approximately 12m from where cut) where it would be within reach of and picked up by a second Tracked Excavator Machine with a dyke/rock bucket or grab that having picked the tree swings around again (approximately 12m from where picked) resulting in a windrow being located approximately 24 meters from where furthest away trees were cut. The process would then be replicated from the other side so that a windrow (about 2-3 m wide) comprising approximately 50m of crop is created. The second machine will, using its attachment, compress the material to keep the windrows tight and as narrow as possible.

The key hazard to peat stability is the application of surcharge to the peat by plant tracking, and by placement of the windrows. Windrows will not be placed in areas calculated as being of elevated risk for peat instability.

6 PEAT STABILITY ASSESSMENT

The peat stability assessment is one of the inputs required for the peat hazard assessment and risk calculation. This section presents:

- A review of the general approaches to assess peat stability;
- The concept of Factor of Safety (FoS);
- The methodology adopted for this report and the parameters required; and
- The resulting FoS delineates safety buffers and peat stockpile restricted areas.

6.1 MAIN APPROACHES TO ASSESS PEAT STABILITY

The main approaches for assessing peat stability for renewable energy developments include the following:

1) Qualitative geomorphological judgement; and
2) Quantitative assessment:
    i) Empirical probabilistic approach.
    ii) Physically based deterministic approach (Factor of Safety – FoS).

Approach 1 is subjective and thus not adopted for this study. Approach 2i is objective and quantitative but is more appropriate for land planning and decision-making studies at a regional scale. Additionally, the method does not provide an engineering indication of physical stability as Approach 2ii does. In this report, the peat stability assessment is carried out by using Approach 2b: deterministic (FoS) approach (Bromhead, 1986).

6.2 THE FACTOR OF SAFETY (FOS) CONCEPT

The factor of safety is a measure of the stability of a slope. For any slope, the degree of stability depends on the balance between the landslide driving forces (weight of the slope) and its inherent shear strength, illustrated in Figure 6-1.

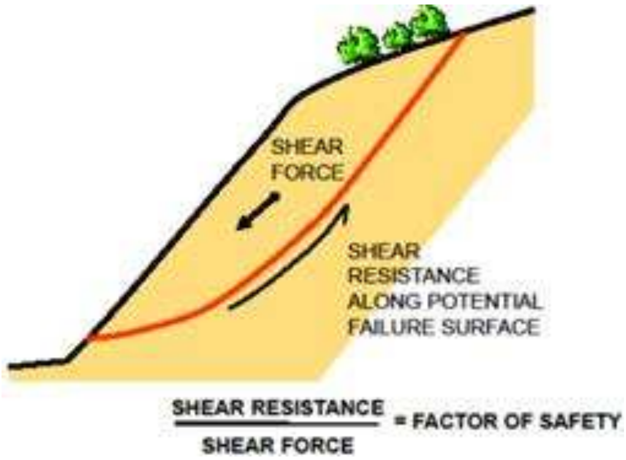

Figure 6-1: Balance of forces in a slope (Scottish Executive, 2017).

Therefore, the factor of safety provides a direct measure of the degree of stability of a slope by the ratio of the shear resistance along a potential surface of failure and the landslide driving forces acting on such surface. Multiple potential surfaces of failure are possible, but the FoS assigned to a slope is that of the surface of failure with the lowest value of FoS.

- FoS < 1 indicates a slope is unstable and prone to failure.
- FoS = 1 indicates a slope is theoretically stable but not safe.
- FoS ≥ 1.3 indicates the acceptable safety threshold. The previous code of practice for earthworks BS 6031:1981 (BSI, 1981) provided advice on the design of earthworks slopes. It stated that for a first-time failure with a good standard of site investigation, the design FoS should be greater than 1.3. This way, the slope is stable and safe.

As a general guide, the FoS limits for peat slopes assumed in this report are summarised in Table 6-1.

Table 6-1: Factor of Safety limits assumed in this report.

Factor of Safety limits	Slope stability
FoS < 1	Unstable
1 ≤ FoS <1.3	Stable but not robust
FoS ≥ 1.3	Stable and safe

Eurocode 7 (EC7) (I.S. EN 1997 1.2005+AC.2009) is now the reference document and basis for design geotechnical engineering works. The design philosophy used in EC7 applies partial factors to soil parameters, actions and resistances. Unlike the traditional FoS approach, EC7 does not provide a direct measure of stability, as global factors of safety are not used.

Therefore, to provide a direct measure of the peat stability across the Proposed Offsetting Lands, the previous FoS method has been used for this assessment rather than EC7 partial factors.

6.3 METHODOLOGY ADOPTED AND PARAMETERS

The stability of a peat slope depends on several factors working in combination, namely the slope angle, the peat's shear strength, the peat, the depth of the peat, the pore water pressure and the loading conditions. An adverse combination of these factors could potentially result in peat failure. An adverse value of one of the factors mentioned above alone is unlikely to result in peat failure. The infinite slope model (Skempton and DeLory, 1957) combines these factors to determine a safety factor for peat sliding in the study area. This model is based on a translational slide, which is a reasonable representation of the dominant mode of movement for peat failures.

To determine the stability of the peat slopes in the study area, undrained (short-term stability) and drained (long-term stability) analyses have been carried out.

6.3.1 UNDRAINED CONDITIONS

The undrained loading condition applies in the short term during the Proposed Offsetting Measures works and until works-induced pore water pressures dissipate.

Undrained shear strength values (c_u) for peat are used for the total stress analysis. Based on the findings of the Derrybrien failure (Lindsay and Bragg, 2004), undrained loading during construction was found to be the critical failure mechanism.

Among the shear strength values obtained by GDG by using the hand shear vane tests in the Proposed Offsetting Lands, several tests could not be completed due to saturated peat conditions, registering values of 0kPa (Table 3-1). The lowest registered value for a completed test was 8 kPa.

A back analysis exercise was conducted on the existing peat failures to the south of the Proposed Offsetting Lands, with this exercise indicating that a c_u of 4kPa was sufficient to bring the sections of slope that failed to the point of equilibrium. Based on this exercise, and on GDG's experience in the assessment of similar blanket peats and values reviewed in the literature, a conservative value of 4 kPa has been adopted for the undrained shear strength (c_u) across the entire Proposed Offsetting Lands. The Shear Vane testing was carried out in the summer and is not considered to be representative of undrained winter conditions. This has been considered when selecting the design c_u value. The formula used to determine the factor of safety for the undrained condition in the peat (Bromhead, 1986) is as follows:

$$F = \frac{c_u}{\gamma z sin\alpha cos\alpha} \qquad \text{Equation 6.3-1}$$

Where,

F = Factor of Safety;

c_u = Undrained strength (4 kPa in the Proposed Offsetting Lands);

γ = Bulk unit weight of the material (assumed 10 kN/m^3);

z = Depth to failure plane assumed as the depth of peat (this is the interpolated raster of peat depth); and

α = Slope angle (in each pixel of 5 m. This is obtained from the 5m DEM provided by MKO).

6.3.2 DRAINED CONDITIONS

The drained loading condition applies in the long term. The condition examines the effect of the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes.

A drained analysis requires effective cohesion (c') and effective friction angle (ø') values for the calculations. These values can be difficult to obtain because of the disturbance experienced when sampling peat and the difficulties in interpreting test results due to the excessive strain induced within the peat. A review of published information on peat was undertaken to determine suitable drained strength values. Table 6-2 shows a summary of the drained parameters used in published literature. Based on GDG's experience in the assessment of similar blanket peats and the values reviewed in the literature, it was considered appropriately conservative to use design values below the averages, namely c' = 4 kPa and ø' = 25°.

Table 6-2: Effective cohesion and friction angle values from the literature

Reference	Cohesion, c' (kPa)	Friction Angle, ø'
Hanrahan et al. (1967)	5 to 7	36 to 43
Rowe and Mylleville (1996)	2.5	28
Landva (1980)	2 to 4	27.1 to 32.5
Landva (1980)	5 to 6	-
Carling (1986)	6.5	0
Farrell and Hebib (1998)	0	38
Farrell and Hebib (1998)	0.61	31
Rowe, Maclean and Soderman (1984)	3	27
McGreever and Farrell (1988)	6	38

Reference	Cohesion, c' (kPa)	Friction Angle, ø'
McGreever and Farrell (1988)	6	31
Hungr and Evans (1985)	3.3	-
Madison et al. (1996)	10	23
Dykes and Kirk (2006)	3.2	30.4
Dykes and Kirk (2006)	4	28.8
Warburton et al (2003)	5	23.9
Warburton et al (2003)	8.74	21
Entec (2008)	3.8	36.8
Komatsu et al (2011)	8	34
Zhang and O'Kelly (2014)	0	28.9 to 30.3

The formula used to determine the factor of safety for the drained condition in the peat (Bromhead, 1986) is as follows:

$$F = \frac{c' + (\gamma z - \gamma_w h_w)\cos^2\alpha \tan\phi}{\gamma z \sin\alpha \cos\alpha} \qquad \text{Equation 6.3-2}$$

Where,

F = Factor of Safety;

c' = Effective cohesion (4 kPa);

γ = Bulk unit weight of the material (10 kN/m^3);

z = Depth to failure plane assumed as the depth of peat (this is the interpolated peat depth);

γ_w = Unit weight of water (9.81 kN/m^3);

h_w = Height of the water table above the failure plane (= z, i.e. surface level);

α = Slope angle (in each pixel. This is obtained from the 5m DEM provided by MKO);

ϕ' = Effective friction angle (25°).

Several general assumptions were made as part of the analysis:

1) Peat depths are based on the maximum peat depths recorded in each probe from the walkover surveys.
2) The slope angles derived from the DEM (Bluesky, 2024), as outlined in Section 2.6, accurately represent slope angles within the Proposed Offsetting Lands.
3) The surface of failure is assumed to be parallel to the ground surface.
4) The peat stability is calculated in pixels of 5m across the fringe containing information on peat depth and the proposed infrastructure.

Two surcharging conditions are considered for the stability analysis:

- No surcharging load; and
- Surcharging load of 10 kPa.

6.4 FoS Results

The factors of safety obtained for the two different conditions (undrained and drained) and for the two surcharge scenarios (no surcharge and 10kPa of surcharge are presented in both table format and map format.

Table M- 1 and Table M- 2 in Appendix M show the FoS calculation process at each GI location within the Proposed Offsetting Measures boundary for undrained and drained conditions, respectively. The FoS calculation for the rest of the Proposed Offsetting Lands, i.e. the areas between the GI points, has been carried out semi-automatically in GIS by implementing Equation 6.3-1 and Equation 6.3-2 in the GIS raster calculator.

6.4.1 FoS for Undrained Conditions

The spatial distribution of the FoS values calculated for undrained conditions (no surcharge) is shown in Figure M- 1 in Appendix M. Almost all of the pixels are shown to be stable and safe (FoS > 1.3, green), but there are some small areas along the south eastern and south western boundaries of Area 1 and Area 4 that are shown with a factor of safety of <1.

These risk areas are caused by locally steeper slope close to the edge of the forestry, where the topography dips towards the river valley, and towards machine excavated firebreaks. Where required, additional mitigation, including Safety Buffer zones and Felled Material Restriction areas, have been scheduled in Section 8 which the contractor must adhere to during the Proposed Offsetting Measures works.

6.4.2 FoS for Undrained Condition and Surcharge of 10 kPa

Figure M- 2 in Appendix M depicts the spatial distribution of the FoS values calculated for undrained conditions and with a 10 kPa surcharge. The 10kPa simulated the placement of 1m of peat material on the ground surface. In terms of the factor of safety results, the undrained condition with the 10kPa surcharge is considered to be the critical stability scenario. The vast majority of the pixels are shown to be stable and safe (FoS > 1.3, green), but there are some small areas in the north of Area 2, and along the south and eastern boundaries of Area 1 and Area 4 which show a FoS value of 1-1.3, or <1.

The area of low factor of safety in Area 2 is generated by the simulation of the placement of 1m of peat surcharge on a locally steep slope where little to no peat currently exists. As no peat will be placed during the forestry works, this is not considered to represent a true peat landslide risk. The risk areas in Area 1 and Area 4 are caused by locally steeper slope close to the edge of the forestry, where the topography dips towards the river valley, and towards machine excavated firebreaks. Where required, additional mitigation, including Safety Buffer zones and Felled Material Restriction areas, have been scheduled in Section 8 which the contractor must adhere to during the Proposed Offsetting Measures works.

6.4.3 FoS for Drained conditions

The spatial distribution of the FoS values calculated for undrained conditions (no surcharge) is shown in Figure M- 2 in Appendix M. Almost all of the pixels are shown to be stable and safe (FoS > 1.3, green), but there are some small areas along the eastern and southwestern extremities of Area 1 and Area 4 where pixels are calculated as having factor of safety values of <1.

These risk areas are caused by locally steeper slope close to the edge of the forestry, where the topography dips towards the river valley, and towards machine excavated firebreaks. Where required, additional mitigation, including Safety Buffer zones and Felled Material Restriction areas, have been scheduled in Section 8 which the contractor must adhere to during the Proposed Offsetting Measures works.

6.4.4 FOS FOR DRAINED CONDITION AND SURCHARGE OF 10 KPA

The spatial distribution of the FoS values calculated for undrained conditions (no surcharge) is shown in Figure M- 4 in Appendix M. Almost all of the pixels are shown to be stable and safe (FoS > 1.3, green), but there are some small areas along the eastern and southwestern boundaries of Area 1 and Area 4 where pixels are calculated as having factor of safety values of <1.

These risk areas are caused by locally steeper slope close to the edge of the forestry, where the topography dips towards the river valley, and towards machine excavated firebreaks. Where required, additional mitigation, including Safety Buffer zones and Felled Material Restriction areas, have been scheduled in Section 8 which the contractor must adhere to during the Proposed Offsetting Measures works.

6.5 ASSESSMENT AND INTERPRETATION OF FOS RESULTS

The interpretation of the factor of safety analysis and accurate assessment of the peat stability conditions is a semi-automated approach that combines the developed polygon areas of the FoS results, areas of risk identified during the site walkovers, and potential risk areas identified from the examination of peat depths and site topography. It is noted that the results from all FoS analyses (drained/undrained, with and without surcharge) are used, highlighting any areas indicative as having a FoS of less than 1.3 in the worst-case surcharged condition with 10kPa. These areas were then cross-examined with the observations from the site visits and topographic models.

7 PEAT STABILITY RISK ASSESSMENT (PSRA)

A peat stability risk assessment (PSRA) has been carried out across the Proposed Offsetting Lands, considering the landslide hazard probability and potential consequences at each location. The peat stability factor of safety is the most significant factor in generating a risk rating.

7.1 RISK DEFINITION

Risk is the potential or probability of adverse consequences, including economic losses, environmental or social harm, or detriment. Risk is expressed as the product of a hazard (e.g. peat landslide) and its adverse consequences (Lee & Jones, 2004; Corominas et al., 2014) (Equation 7.1-1). Some use approximate synonyms and refer to risk as the product of the likelihood and the impact or the product of susceptibility and the exposure.

$$\text{Risk} = (\text{Hazard}) \times (\text{Adverse Consequences}) \qquad \text{Equation 7.1-1}$$

7.2 GENERAL METHODS FOR RISK ASSESSMENT

There are various levels of risk assessment, ranging between:

- Detailed quantitative risk assessments (QRA) where the objective is to generate more precise measures of the risks (e.g. expressing risk as a specific probability of loss). These require a large amount of quantitative input and time, and
- High-level qualitative assessments where the objective is to develop an approximate estimate of the risks, particularly in relative terms (e.g. low, medium, and high levels of risk).

Qualitative risk assessments are typically used for PSRA reports, given the availability of information and the time frame. To apply Equation 7.1-1, the quantitative information (e.g. FoS) and the qualitative information (e.g. geomorphic observations relevant to peat stability) that determine the hazard and the consequences need to be transformed into subjective ratings. The following sections address the calculation of the two risk components: hazard and consequence.

7.3 HAZARD ASSESSMENT

Landslide hazard is the likelihood or probability of landslide occurrence in each location and a given period. The likelihood or hazard of peat landslides has been determined according to the guidelines for geotechnical risk management given by Clayton (2001), taking into account the approach of MacCulloch (2005), and Mills (2023), and using the available data from the desk study, site reconnaissance, and site investigations.

The hazard is calculated from a variety of weighted factors, including the FoS and six secondary factors related to geomorphic observations, including previous slide history, forestry, land use, artificial drainage, substrate and slope convexity. These secondary factors are difficult to quantify in a stability calculation but may contribute to peat instability. The hazard scores have been assigned to rasters generated in ArcGIS and calculated for each pixel within the Proposed Offsetting Lands.

In accordance with the Scottish Guidance (2017), each hazard factor has been reclassified into one of four classes using the ArcGIS raster calculator, with rating values ranging from 0 to 3, with a fifth class (4) added for existing slide history. A rating of 0 indicates that the hazard factor is not relevant; ratings 1, 2, and 3 indicate low, moderate, and high correlation to peat slide hazard, respectively.

The rating of 4 in the existing slide history category indicates areas within the extent of existing landslides.

These factors have been assigned weighting values to reflect their relative importance in peat stability. The rating values have been assigned according to the expert criteria of the project team and are presented in Appendix M. These factors and their corresponding weightings are presented in Table 7-1.

Table 7-1: Factors affecting peat stability and hazard.

<table>
<tr><th colspan="3">Hazard factors</th><th>Role in peat stability</th><th>Weight</th></tr>
<tr><td colspan="3">Factor of Safety</td><td>This is the most critical factor, including the slope angle, the peat depth, the peat density, the peat cohesion in the drained and undrained conditions, and the effective friction angle. This is the complete factor. See Section 6 for further details.</td><td>10</td></tr>
<tr><td rowspan="6">Secondary factors</td><td>Topography</td><td>Slope Form</td><td>This represents the curvature across down-slope. Peat failures are commonly associated with convex slope breaks.</td><td rowspan="5">1</td></tr>
<tr><td>Hydrology</td><td>Artificial drainage</td><td>Drainage ditches that are aligned cross slope can affect the overall stability of a slope face.</td></tr>
<tr><td>Vegetation</td><td>Forestry</td><td>The vigour of forestry is another indicator of peat stability, with stunted trees more frequent in unstable sectors.</td></tr>
<tr><td>Land Use</td><td>Evidence for Peat Cutting</td><td>The presence of peat cuts at a site can negatively impact peat stability.</td></tr>
<tr><td>Substrate Geology</td><td>Substrate Type</td><td>Peat failures are frequently cited in association with soft clays and cohesive glacial tills.</td></tr>
<tr><td>Slide history</td><td>Distance to previous slides (m)</td><td>This suggests that landslides at the site are likely if a peat slide has occurred at the site or within a close radius. The weight assigned is doubled the weights for the other secondary factors</td><td>2</td></tr>
</table>

The hazard value for a given pixel is the sum of the scores of all the hazard factors (multiplied by their weighting) divided by the maximum hazard value possible to obtain a normalised hazard value ranging from 0 to 1 (see Table 7-2). Hazard is grouped into four categories: Negligible, low, medium, and high. The hazard (likelihood) class scores are shown in Figure N- 8.

Table 7-2: Normalised Hazard Scoring

Hazard Score	Class
0.0 - 0.3	Negligible
0.3 - 0.5	Low
0.5 - 0.7	Medium
0.7 - 1.0	High

A detailed description of the scoring methodology for each contributing factor is given in Section 7.3.1 to Section 7.3.7

7.3.1 FACTOR OF SAFETY

This is the most critical hazard factor, taking into account the slope angle, the peat depth, the peat density, and shear strength in the undrained condition respectively. Please see Section 6 for further details. For the purposes of this assessment, the undrained scenario with 10kPa peat surcharge has been selected, as this is considered the critical stability scenario. The hazard score for the factor of safety has been calculated by reclassifying the factor of safety values as illustrated in Table 7-3. The reclassified factor of safety scores are shown in Figure N- 1.

Table 7-3: Factor of safety classes (undrained with 10kPa surcharge), influence on stability and score.

Factor of Safety	Significance	Likelihood Score
1.30 or greater	Stable/safe	0
1.10-1.29	Stable but not safe	1
1.01-1.10	Slope close to equilibrium	2
≤1.0	Unstable	3

The factor of safety scores across the Proposed Offsetting Lands are discussed in further detail in Section 6.4.

7.3.2 SLOPE FORM

Table 7-4 shows slope form classes, influence on stability and related scores. Slope form has been interpreted from the available topographic data. Convex and concave slopes (i.e. positions in a slope profile where slope gradient changes by a few degrees) have been associated with the initiation point of peat landslides by a number of authors e.g. Dykes and Warburton, 2007a; Boylan et al., 2011). Convexities are often associated with thinning of peat, such that thicker peat upslope applies stresses to thinner 'retaining' peat downslope. Conversely, buckling and tearing of peat may trigger failure at concavities. The slope form scores are shown in Figure N- 2.

Table 7-4: Slope form classes, influence on stability and score.

Slope Form	Significance	Likelihood Score
Flat Slope	Peat slides are rarely reported on flat ground	0
Concave Slope	Peat slides are occasionally reported on concave slopes	1
Planar Slope	Peat slides are often reported on planar slopes	2

Slope Form	Significance	Likelihood Score
Convex Slope	Peat slides are most frequently reported on convex slopes	3

Slopes within the Proposed Offsetting Lands boundary are typically classed as planar, with localised convex slope breaks identified 250-500m upslope of the southern boundary of Area 4. An area of concave slope is identified between 50 and 250m to the north, upslope of Area 1.

7.3.3 ARTIFICIAL DRAINAGE

Table 7-5 shows the artificial drainage classes, influence on stability and related scores. Drain orientation has been interpreted from the available OSI and Google Earth aerial imagery, and from site observations. Transverse / oblique drainage lines, both natural and artificial, may reduce peat stability by creating lines of weakness in the peat slope and encouraging the formation of peat pipes. A number of peat failures have been identified which have failed over moorland grips (Warburton et al., 2004).

Roughly 40% of peat slides and 30% of bog bursts occur in drained areas (Mills, 2023), though usually in association with drains that are oblique to slope rather than along contour (noting that contour aligned drains are less common. Mills (2023) asserts that despite this, contour aligned drains hypothetically have the greatest negative impact on instability. It is also noted that contour aligned drains have been identified in association with the ME-A and ME-B failures described in Section 4.

Table 7-5: Artificial drainage classes, influence on stability and score.

Drainage Orientation	Significance	Likelihood Score
No/minimal artificial drainage	No effect on stability	0
Drains are generally aligned downslope (<30° to slope)	Failures are rarely associated with artificial drains parallel to slope or adjacent to natural drainage lines	1
Drains are generally aligned oblique (15°-60°) to contour	Peat slides are often reported in association with drains aligned oblique to slope	2
Drains are generally aligned along contours (<15°)	Peat slides have been observed in association with contour aligned drains (including the ME-A and ME-B landslides). Hypothetically, contour aligned drains have greatest effect on instability	3

The majority of the rill drains within the Proposed Offsetting Lands are aligned oblique to slope, with interceptor drains typically aligned downslope. Some areas towards the eastern boundary of the area, and some areas upslope of the southern boundary have rill drains aligned along contours. The artificial drainage class scores are shown in Figure N- 3.

7.3.4 FORESTRY

Table 7-6 shows the forestry classes, influence on stability and related scores. Lindsay and Bragg (2005) suggested that row alignments, desiccation cracking and loading (by trees) could all influence peat stability.

Table 7-6: Forestry classes, influence on stability and score.

Forestry Class	Significance	Likelihood Score
Not afforested	No influence on stability	0
N/A	N/A	3
Afforested area	Peat underlying forestry has inter ridge cracks which are conducive to slope instability	2
N/A	N/A	3

As the majority of the Proposed Offsetting Lands are afforested, the whole area has been assigned a score of ‘2’. The forestry class scores are shown in Figure N- 4.

7.3.5 LAND USE

Table 7-7 shows the land use classes, influence on stability and related scores. Mills (2023) carried out a review of landslide triggering factors and found that strong evidence for a causal link between peat cutting and peat landslides is somewhat lacking, though peat failures have been reported in association with peat cutting. Therefore, the classes outlined in Table 7-7 are based on fundamental stability principles rather than evidence, e.g. the effects of cuttings on adjacent, upslope peat (which might act to reduce its stability) or the effects of machine cutting in fragmenting the peat mass (not dissimilar to the effects of cutting of drains).

Table 7-7: Land Use classes, influence on stability and score.

Land Use	Significance	Likelihood Score
Other Land Use (e.g. forestry – covered in Section 7.3.4)	No influence on stability	0
N/A	N/A	1
Turbary/Hand Cutting	Hand cutting may remove slope support from adjacent upslope materials	2
Machine Cutting	Machine cutting of peat has significant impacts on slope compartmentalisation and has been reported in association with peat slides	3

As the majority of the Proposed Offsetting Lands are afforested, and no peat cutting was observed within the boundary, the whole area has been assigned a score of ‘0’. The land use class scores are shown in Figure N- 5.

7.3.6 SUBSTRATE GEOLOGY

Table 7-8 shows the substrate geology classes, influence on stability and related scores. Substrate geology has been interpreted from site observation and peat probe date (sound of probes at the point of refusal) where possible but is largely unknown for the Proposed Offsetting Lands. In instances where substrate in uncertain, an intermediate score (2) has been applied).

Peat failures are frequently cited in association with glacial till deposits in which an iron pan is observed in the upper few centimetres (Dykes and Warburton, 2007a). They have also been observed over glacial till without an obvious iron pan, or over impermeable bedrock. They are rarely cited over permeable bedrock, probably due to the reduced likelihood of peat formation

Table 7-8: Substrate geology classes, influence on stability and score.

Substrate Geology	Significance	Likelihood Score
N/A	N/A	0
Granular or bedrock	Failures are less frequently associated with bedrock or granular (silt / sand / gravel) substrates	1
Gritty/granular till with clay OR substrate unknown	Failures are occasionally associated till substrates with a minor clay component. Lack of understanding of substrate condition is a significant uncertainty (an intermediate score is therefore applied)	2
Cohesive (clay) or iron pan	Failures are often associated with soft clay substrates and/or iron pans	3

Granular substrate, with bedrock/weathered bedrock outcropping at/or near the surface was identified in the northwest portions of the Proposed Offsetting Lands. These areas were assigned a score of ‘1’. Within the existing peat landslides upslope of the Proposed Offsetting Lands, cohesive glacial tills with frequent cobbles and gravel were exposed. These areas were therefore scored a ‘2’. Data acquired from the sound of peat probe termination depths was inconclusive, and substrate was largely not visible elsewhere. The remaining portions of the lands were therefore assigned a score of ‘2’. The substrate class scores are shown in Figure N- 6.

7.3.7 EXISTING LANDSLIDE HISTORY

Table 7-9 shows the existing landslide history classes, influence on stability and related scores. While there is no observable direct relationship between distance to existing landslides and future failures, it is hypothesised that the likelihood of peat landslides will increase with proximity to existing failures or evidence for instability (e.g. tension cracks).

Table 7-9: Existing landslide history classes, influence on stability and score.

Existing Landslide History	Significance	Likelihood Score
No pre-existing peat landslide within 1km	No influence on stability	0
Pre-existing peat landslide within 1km	Failures still may be more likely within a larger radius of pre-existing peat landslides	1
Pre-existing peat landslide within 500m	Failures may be more likely within a close radius of pre-existing peat landslides	2
Pre-existing peat landslide within 250m	Failures often recur on hillslopes with pre-existing peat landslides	3
Pre-existing peat landslide extent, or visible evidence of peat instability (e.g. tension cracks)	Large peat failures are likely to remain unstable, and may reactivate, or trigger adjacent failures. Visible features of peat instability may indicate that failure is in progress, or may be initiated in the near future.	4

The existing landslide footprints (including the areas of potential relict instability and tension cracking) have been assigned a score of ‘4’, and all other areas scored based on distance buffers as outlined above. Parts of Area 4 closest to the existing landslides received a score of ‘3’, while the remainder of Area 4 received a score of ‘2’. The eastern parts of Area 1 received a score of ‘1’, while the wester parts of Area 1, and the entirety of Area 2 received a score of ‘0’. The existing landslide distance class scores are shown in Figure N- 7.

7.4 ADVERSE CONSEQUENCES ASSESSMENT

The impacts of peat landslides on the surrounding environment may typically generate a variety of adverse consequences. This report qualitatively assessed these consequences following the Scottish-Executive ECUBP Guidance (2017).

Table 7-10 summarises the consequences considered for the PSRA of the Proposed Offsetting Measures.

Table 7-10: Consequences considered for the PSRA.

Consequence factors		Description	Weight
Potential Failure Volume	The volume of potential peat flow (function peat depth in the area)	This is the second most heavily weighted factor. It is estimated based on the depth of peat in the area. The deeper the peat depth, the larger the landslide.	3
Watercourse Proximity	Proximity to watercourses (m)	This is the distance from the pixel to the nearest defined river valley. Rivers close to potential landslide sectors are more vulnerable to a landslide event.	1
Topography	Downhill slope angle	This factor accounts for the runout distance as a matter of slope angle.	
Environmental Sensitivity	Downstream aquatic environment	Reflects the severity of a peat slide event's impact on the receiving aquatic environment.	
Infrastructure	Public roads in the potential peat flow path	Rates the impact of a peat slide striking a public road.	
	Overhead lines in the potential peat flow path	Rates the impact of a peat slide striking a service line.	
	Buildings in the potential peat flow path	Rates the impact of a peat slide striking a habitable structure.	
Response	Capability to respond (access and resources)	Rates the capability of the site staff to respond to a peat instability event.	

The eight consequence factors considered have been reclassified in the same fashion the hazard factors were reclassified (Appendix M). A rating of 0 indicates that the consequence factor is not relevant and a rating of 3 indicates high consequences. The consequence scores have been assigned to rasters generated in ArcGIS and calculated for each pixel within the Proposed Offsetting Measures boundary.

'Volume of potential landslide' has been assigned a weight of 3 to reflect its relative importance in the potential consequences. The rest of the factors have been assigned a weight of 1. Both the rating and the weighting values have been assigned according to the expert criteria of the project team.

The consequences value for a given pixel is the sum of the eight consequences scores (each multiplied by their weighting). This total value is then divided by the maximum consequence value possible to obtain a normalised consequence value ranging from 0 to 1 (see Table 7-11). Consequences are grouped into four categories: Negligible, low, medium, and high. The total adverse consequence class scores are shown in Figure N- 17.

A detailed description of the scoring methodology for each consequence factor is given in Section 7.3.1 to Section 7.3.7.

Table 7-11: Normalised Adverse Consequences Scoring

Hazard Score	Class
0.0 - 0.3	Negligible
0.3 - 0.5	Low
0.5 - 0.7	Medium
0.7 - 1.0	High

7.4.1 POTENTIAL PEAT FLOW VOLUME (PEAT DEPTH)

Table 7-12 shows potential peat flow volume (peat depth) classes, influence on adverse consequences and related scores. Peat depths are assessed from the available peat ground investigations (Section 3). Greater thicknesses of peat are capable of producing greater failure volumes. The peat depths have been assessed using the interpolated peat depth raster outlined in Section 3. The potential peat volume class scores are shown in Figure N- 9.

Table 7-12: Peat depth classes, influence on consequences and score.

Peat Depth Class	Significance	Adverse Consequence Score
0-0.5m	Peat depths of under 0.5m are considered peaty soils and will not generate significant pea landslides volumes.	0
0.5-1m	Increasing peat depth creates the possibility for more significant landslide volume.	1
1-2m	Increasing peat depth creates the possibility for more significant landslide volume.	2
>2m	Increasing peat depth creates the possibility for more significant landslide volume.	3

Large parts of Area 4 are given scores of '3' and '2', due to the generally deeper peat encountered in these areas. Area 1 is given scores ranging from '0' to '3', as the peat depths vary significantly across the area. The areas given a score of '3' are generally quite localised, and the majority of the Area is given a score of '2'. The majority of Area 2 is given a score of '0', due to the shallow peat depths encountered, though this increases slightly to a score of '1' on the eastern half of Area 2, with some portions of the eastern margins of the area receiving a score of "2".

7.4.2 PROXIMITY TO WATERCOURSES

Table 7-13 shows watercourse proximity classes, influence on adverse consequences and related scores. Proximity to watercourses has been defined using OSI/EPA watercourse shapefiles, with distance buffers produced in ArcGIS.

Distance between a given pixel and watercourses influences the ability of peat material to enter a watercourse following failure. The watercourse proximity class scores are shown in Figure N- 10.

Table 7-13: Watercourse proximity classes, influence on consequences and score.

Distance to Defined Watercourse	Significance	Adverse Consequence Score
>1km	Peat unlikely to enter watercourse.	0

Distance to Defined Watercourse	Significance	Adverse Consequence Score
500m-1km	Peat less likely to enter watercourse. Only highly liquefied material mar reach watercourse.	1
200-500m	Peat material must travel a significant distance before entering watercourses. Volume of peat entering watercourse may be reduced.	2
0-200m	Peat landslide material can easily enter watercourses.	3

Much of Area 1 and Area 4 are scored “3”, as large portions of these areas are located within 200m of the River Clydagh, with small tributaries running through the centre of Area 1. The remaining portions of Area 1 and Area 4 are scored “2”. The majority of Area 2 is scored “2”, “1” or “0”, as this area is located further from the mapped watercourses.

7.4.3 SLOPE ANGLE

Table 7-14 shows slope angle classes, influence on adverse consequences and related scores. The downhill slope angle will act as a control on the potential run-out distance of peat material in the event of a failure. The greater the slope angle, the further the run-out is likely to travel. The slope angle has been calculated from the topographic BlueSky LiDAR data (DTM) provided by MKO (2024). The slope angle class scores are shown in Figure N- 11.

The vast majority of Areas 1 and 4 are scored “1” or “2”, as the slope angles within these areas typically range between 2-10°. Almost the entirety of Area 2 is scored “3”, as slope angles within this area are typically >10° (average of 12°).

Table 7-14: Slope angle classes, influence on consequences and score.

Slope Angle (°)	Significance	Adverse Consequence Score
<2	Peat run-out distance is likely to increase as a function of slope angle	0
2-5	Peat run-out distance is likely to increase as a function of slope angle	1
5-10	Peat run-out distance is likely to increase as	2

Slope Angle (°)	Significance	Adverse Consequence Score
	a function of slope angle	
>10	Peat run-out distance is likely to increase as a function of slope angle	3

7.4.4 DOWNSLOPE/DOWNSTREAM ENVIRONMENT SENSITIVITY

Table 7-15 shows downstream aquatic environment classes, influence on adverse consequences and related scores. The presence of sensitive aquatic environments or drinking supplies downstream of potential peat failures will increase the potential for adverse environmental and human consequences.

Table 7-15: Downstream aquatic environment classes, influence on consequences and score.

Downstream Aquatic Environment	Significance	Adverse Consequence Score
No watercourses present	No impact	0
Non-sensitive	Non-sensitive environments will not be as severely impacted by peat failure.	1
Sensitive	Peat failure within or upstream of sensitive aquatic environments will likely have a significant environmental impact	2
Drinking water supply	Peat failure within or upstream of drinking water supplies will have a significant impact on water supply	3

As discussed in Section 2.12, much of the Proposed Offsetting Lands are located in the upper region of the River Shannon catchment that flows down to the Lower River Shannon SAC, and the entirety of the Proposed Offsetting Lands are located within the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA. Any peat landslide occurring within the boundary has the potential to enter one of the watercourses which drain the area (particularly the River Clydagh), potentially impacting the SAC. Any peat landslide would also have the potential to impact the SPA. The whole Proposed Offsetting Lands has therefore been classified as sensitive and given a score of '2'. The environmental sensitivity class scores are shown in Figure N- 12.

7.4.5 PUBLIC ROADS IN POTENTIAL PEAT FLOW PATH

Table 7-16 shows public road classes, influence on adverse consequences and related scores. The presence of public roads within potential flow pathways has been assessed using Google Earth aerial imagery, and the flow pathways map shown in Figure F- 3. The increased size/importance of the infrastructure leads to increased consequences in the event of a peat failure. The public road consequences class score is shown in Figure N- 13.

Table 7-16: Public roads in potential peat flow paths, influence on consequences and score.

Public roads in potential peat flow paths	Significance	Adverse Consequence Score
No roads in potential flow path	No impact	0
Minor roads	Risk to members of the public, cost of repair and replacement of minor road infrastructure	1
Local roads	Increased risk to members of the public, increased cost of repair and replacement of local road infrastructure	2
Regional/National Roads	Significant risk to members of the public, increased cost of repair and replacement of regional/national road infrastructure	3

Areas 1 and 4 are scored “0”, as there are no public roads downslope of these areas, and there fore none within potential flow paths. Area 2 is scored “1”, as there is a minor road immediately downslope of this area.

7.4.6 OVERHEAD LINES IN POTENTIAL PEAT FLOW PATH

Table 7-17 shows overhead line classes, influence on adverse consequences and related scores. The presence of public roads within potential flow pathways has been assessed using Google Earth aerial imagery, and the flow pathways map shown in Figure F- 3. The increased importance of the infrastructure leads to increased consequences in the event of a peat failure. The overhead lines consequence class is shown in Figure N- 14.

Table 7-17: Overhead lines in potential peat flow paths, influence on consequences and score.

Overhead Lines in Potential Peat Flow Paths	Significance	Adverse Consequence Score
No OHLs in potential flow path	No impact	0
Phone lines	Disruption to the public, cost of repair and replacement phone-line infrastructure	1
Electricity (LV)	Increased disruption to the public, increased cost of repair and replacement of LV infrastructure	2
Electricity (MV, HV)	Significant disruption the public, increased cost of repair and replacement of MV/HV infrastructure	3

The entirety of the Proposed Offsetting Lands is scored a “0” as there are no overhead lines within potential flow paths.

7.4.7 BUILDINGS IN POTENTIAL PEAT FLOW PATH

Table 7-18 shows building classes, influence on adverse consequences and related scores. The presence of public roads within potential flow pathways has been assessed using Google Earth aerial imagery, and the flow pathways map shown in Figure F- 3. The increased importance of the infrastructure leads to increased consequences in the event of a peat failure. The building consequences class score is shown in Figure N- 15.

Table 7-18: Buildings in potential peat flow paths, influence on consequences and score.

Buildings in Potential Peat Flow Paths	Significance	Adverse Consequence Score
No buildings in potential flow path	No impact	0
Farm outhouses	Risk to members of the public, cost of repair and replacement of outbuildings	1
Wind Farm Infrastructure/Substations	Increased risk to members of the public, increased cost of repair and replacement of wind farm infrastructure	2
Residential Properties	Significant risk to life for members of the public, increased cost of repair and	3

Buildings in Potential Peat Flow Paths	Significance	Adverse Consequence Score
	replacement of residential buildings	

The entirety of Area 1 and Area 4, and the majority of Area 2 are scored "0", as there are no buildings in potential flow paths downslope of these areas. A portion of the southwest corner of Area 2 is scored "3" as there is a potential residential building downslope of this area.

7.4.8 CAPABILITY TO RESPOND TO FUTURE PEAT LANDSLIDES

Table 7-19 shows response capability classes, influence on adverse consequences and related scores. In assessing the potential adverse consequences of a future peat landslide, the capability of the relevant authorities to respond to mitigate and limit potential adverse impacts will factor into the potential magnitude of any adverse effects. The greater the capability of the relevant authorities to respond, the higher chance that adverse effects can be mitigated.

Table 7-19: Capability to respond to future peat landslides, influence on consequences and score.

Capability to Respond	Significance	Adverse Consequence Score
N/A	N/a	0
Good	Well connected sites with easy access to regional and national road infrastructure, close (within 30 minute drive) to large population centres. Easily accessed, with rapid response possible.	1
Fair	Moderately well connected sites, with access to local roads, within 1 hour of to large population centres. Medium potential response times.	2
Poor	Remote sites, accessed only be minor roads or forestry tracks. Long potential response times.	3

Due to the remote location of the Proposed Offsetting Lands, a score of '3' has been assigned across the entire site. The capability to respond class score is shown in Figure N- 16.

7.5 RISK CALCULATION

Risk at each 5m x 5m pixel is calculated with Equation 7.5-1, i.e., multiplying the hazard scores and the consequences scores:

Risk Score = (Hazard Score) x (Adverse Consequences Score) Equation 7.5-1

The risk rating ranges between 0 and 1 and the following levels of risk rating have been distinguished (Table 7-2 and Table 7-11, based on the Scottish Government Best Practice Guidelines (2017):

- High (0.6 to 1): Avoid project development at these locations. Mitigation is generally not feasible.

- Medium (0.4 to 0.6): The project should not proceed unless risk can be avoided or mitigated at these locations without significant environmental impact to reduce risk ranking to low or negligible.
- Low (0.2 to 0.4): Project may proceed pending further investigation to refine assessment and mitigate hazard through relocation or re-design at these locations.
- Negligible (0 to 0.2): The project should proceed with monitoring and mitigating peat landslide hazards at these locations as appropriate.

It should be noted that these guidelines were developed for large energy developments (e.g. wind farm developments) on peatlands. It is considered that if risk is carefully mitigated, that the Proposed Offsetting Measures can proceed in areas scored as medium, due to the low impact of forestry measures.

Appendix N gathers the risk calculation process across the Proposed Offsetting Lands, with the risk scores illustrated in Figure N- 18. Almost the entirety of the Proposed Offsetting Measures is located in areas of negligible or low risk, with a few small, localised areas of medium risk identified. These areas are contained within the Safety Buffer zones and Felled Material Restriction areas outlined in Section 8.2.

It is stressed that the resulting risk rating score does not indicate a probability of a landslide occurring; it simply expresses a rating of the potential risk.

8 MITIGATION MEASURES

8.1 MITIGATION BY AVOIDANCE

The Proposed Offsetting Lands has been selected using an iterative process, carried out alongside this assessment, to remove areas of high risk for peat instability from the area where possible. Safety buffer zones which are to be avoided during deforestation have been identified and are outlined in Section 8.2.1. Felled Material Restriction areas (FMRs) have also been identified and are outlined in Section 8.2.2. Stockpiling or placement of forestry materials will not be carried out in these areas.

8.2 SAFETY BUFFER ZONES AND FELLED MATERIAL RESTRICTION AREAS

From the site reconnaissance and the calculations of the FoS for the peat slopes, a series of safety buffer zones (SBZ) and Felled Material Restriction (FMR) areas are proposed and presented in Appendix O, Figure O- 1.

8.2.1 SAFETY BUFFER ZONES

Safety Buffer zones are areas identified during the initial phases of the PSRA and are highlighted as possessing a potential instability risk. The development of the safety buffer zones is a semi-automated approach that combines the developed polygon areas of the FoS results, areas of risk identified during the site walkovers, and potential risk areas identified from the examination of peat depths and site topography. It is noted that the results from all FoS analyses (drained/undrained, with and without surcharge) are used, highlighting areas indicative as having a FoS < 1in the undrained scenario. Five Safety Buffer zones have been identified within the Proposed Offsetting Measures Boundary. It is considered that the low factor of safety calculated in these areas is caused by localised factors, and do not represent a global stability risk. Each safety buffer zone is located at the edge of the forestry, close to machine excavated firebreaks or small streams, with the locally higher slopes generating the low factor of safety score. It is considered that these areas do not present a significant peat landslide risk, provided the below mitigations are adhered to.

These areas are to be marked out on site with warning tape, and the following mitigation measures adhered to:

- No large plant is to enter the Safety Buffer zones.
- No logs, windrows, stone or other materials will be temporarily or permanently placed in the areas within the FMR areas.

Safety buffer areas are outlined in Figure O- 1 in Appendix O and will be included in the Safety File for the Proposed Offsetting Measures.

8.2.2 FELLED MATERIAL RESTRICTION AREAS

Although the peat stability results and safety buffers have been considered in the siting of the Proposed Offsetting Measures, there are some locations where forestry work is required within a safety buffer zone. The stability assessment results at these locations suggest FoS values <1 in the surcharged scenario only and have FoS results >1.0 in the analysis without the surcharge. This suggests that the areas are of a low instability risk in their natural state but are unsuitable for the storage of felled logs or other materials.

Felled Material Restriction (FMR) areas are identified at 18 locations within the Proposed Offsetting Lands.

The risk at these locations can be examined by looking at the geometry of the local slope and the proposed deforestation methodology, and the hazards can be mitigated with restricted peat placement and the limiting of plant operations within the area.

FMR areas are outlined in Appendix O, Figure O- 1. Certain mitigations must be adhered to within the FMR areas in future stages of the Proposed Offsetting Measures:

- No logs, windrows, stone or other materials will be temporarily or permanently placed in the areas within the FMR areas,
- Any trees permanently felled in the area will be immediately removed and placed/ stored in an appropriate storage location,
- Plant used within these areas will be low ground bearing and only the necessary plant will be used here. No excessive quantity or size of plant will be stored in these areas,
- During, and for seven days following significant rainfall events, all works in the FMR areas will be halted, to prevent disturbance of potentially saturated peat.

Safety buffer zones are outlined in Appendix O, Figure O- 1.

8.3 ENGINEERING MITIGATION MEASURES

Many of the site specific (e.g. peat depth, slope angle) and site independent variables (e.g. weather) that contribute to the incidence of natural peat landslides are beyond engineering control without significant damage to the peat itself. However, a number of engineering measures exist to minimise the risks associated with potential triggers (such as short term peaks in hydrogeological activity).

8.3.1 PROPOSED OFFSETTING MEASURES WORKS MANAGEMENT

Inappropriate storage of excavated/felled material, as well as uncontrolled loading of peat material is considered one of the main causes of peat instability and landslide event triggers. The management and control of these activities is key to de-risking peat stability at the Proposed Offsetting Lands. It is required that the construction method statements for the project also take into account, but not be limited, to the guidance documents listed in Section 1 and the recommendations and requirements outlined throughout this document.

The general requirements for the management of peat and the mitigation of peat instability at the Proposed Offsetting Measures are as follows:

- Appointment of experienced and competent contractors;
- The forestry works on site should be supervised by experienced and qualified personnel;
- Allocate sufficient time for the project to proceed safely with all peat stability mitigation measures included in the programme;
- Set up, maintain and report findings from monitoring systems, including sightline monitoring;
- Maintain vigilance and awareness through Tool-Box-Talks (TBTs) on peat stability;
- Prevent undercutting of slopes and unsupported excavations;
- Prevent placement of loads/overburden on marginal ground;
- Manage and maintain a robust drainage system. This will be the responsibility of the appointed contractor;

- Storage of felled material including windrows be carried out in the permitted areas only;
- All works will be halted during significant rainfall events, and for a minimum of one day afterwards; and
- A method statement and risk assessment (RAMS) which considers the potential causes and mitigations of peat instabilities and landslide is required and must be regularly communicated to all site staff. An observational approach by all site staff to the ground conditions and the risks should be promoted and any changes in the ground or site conditions should be reported and the risk dynamically assessed.

8.3.2 DRAINAGE MEASURES

Installation of targeted drainage measures would aim to isolate areas of susceptible peat from upslope water supply, re-routing surface (flushes/gullies) and subsurface (pipes) drainage around critical areas. Surface water drainage plans should be implemented to account for modified flows created by Proposed Offsetting Measures works, which in turn may affect peat stability, pollution and wildlife interests. Drainage measures need to be carefully planned to minimise any negative impacts.

8.4 MONITORING

The installation of movement monitoring posts is recommended for areas where works are taking place on or adjacent to identified peat depths greater than 2m.

Movement monitoring posts will be installed upslope and downslope of the works areas and will be as outlined:

- Posts will be 1m to 1.5m in length, installed at 5m intervals with no less than seven posts in each line of sight (~30m).
- A string line will in attached to the first and last post with all intermediate posts in contact with one side of the string line,
- A numbering system will be designs for the monitoring posts and a record will be kept of this numbering system.

Movement monitoring posts will be observed at least once a day with more frequent inspections which adjacent works are ongoing. Should movements be recorded the frequency of these inspections will be increased. Record will be kept of all monitor post inspections with reference to date, time and any relative movement between posts, if any. Any movement identified in the posts will be recorded with reference to the post numbering system. The contactor will also develop a routine inspection of all areas surrounding work in peat, not just exclusively on the monitoring posts. These inspections will include an assessment of ground stability and drainage conditions. These inspections should identify any cracking or deformation on the peat surface, excessive settlement on structures, drain blockages or springs etc.

8.5 ENGINEERING MITIGATION MEASURES TO CONTROL LANDSLIDE IMPACTS

Although the stability of the peat is considered to be safe for the activities proposed, and should the peat be managed in line with the details of this document, the risk of a peat failure or landslide is negligible to very low. However, it is important to consider the actions which will be carried out if signs of instability are identified during the outlined monitoring or should a failure occur at the Proposed Offsetting Lands.

The full methodologies for these activities will be outlined in the Contractor's RAMS and include the methodologies for immediate and long-term response.

8.5.1 MOVEMENT OR INSTABILITY OBSERVED IN MONITORING AREAS

Where excessive movement has been observed in the installed monitoring outlined in Section 8.4 the following measures will be taken:

- All works will be suspended in the area,
- A competent Geotechnical Engineer will carry out an assessment of the peat instability including drainage. The competent Geotechnical Engineer will compile a report outlining the surveys undertaken, the potential cause of the instability, assessment of any increased risk caused by the instability, and the further measures required to manage this risk,
- An increased monitoring regime will be specified including increase in number of monitoring post lines, decrease on monitoring post spacing and an increase in the frequency of monitoring post observations,
- Should no further movement be detected, activities will be recommenced while maintaining the increased monitoring regime,
- Should further excessive movement be detected, the geotechnical engineer will need to be informed and the design of further reinstatement works will be required such as excavation of the disturbed material, installation of a granular berms or similar.

8.5.2 EMERGENCY RESPONSE TO A LANDSLIDE EVENT

Due to the high factors of safety and negligible risk of peat landslides identified on site, it is not anticipated that peat failure will occur on site, However, in the event of peat failure (e.g. tension cracking, surface rippling, sliding), the following measures will be implemented by the contractor:

- All members of the project team will be alerted immediately or as it is safe to do so;
- All habitat restoration works will be ceased with immediate effect, and all available resources will be used for the management and mitigation of the risks posed by the event;
- Localised peat slides that do not present a risk to watercourses will be assessed by competent engineers, and will be stabilised by rock infill and granular material where necessary;
- The key initial activity will be to prevent displaced materials from reaching any watercourses or sensitive environments. Given the terrain of the Proposed Offsetting Lands, the key risk is the development of a propagation landslide or slip within topographic valleys and watercourses. Where possible, catch ditches will be constructed to aid prevent further run out of the disturbed peat material. These catch ditches may slow or halt runout, although it is preferable that they are cut in non-peat material. Simple earthwork ditches can form a useful low-cost defence. Paired ditches and barrages have been observed (Tobin, 2003) to slow peat landslide runout at failure sites.

The contractor will be responsible for providing suitable contingencies outlined within the construction stage CEMP. The contractor will additionally need to carry out a construction stage PSRA.

9 GEOTECHNICAL RISK REGISTER

The register included in Table 9-1 lists significant potential peat geotechnical hazards and associated risks concerning the Proposed Offsetting Measures, and recommended mitigations.

Table 9-1: Geotechnical risk register

Ref.	Risk	Contributing factor	Mitigation
1	Peat Instability	Overestimation of soil strength parameters	The soil parameters are based on the hand shear vane test carried out by GDG across the Proposed Offsetting Lands. Shear vane testing was carried out at 0.5m intervals through the peat to assess variation within the peat body. The interpreted undrained shear strength values take into account a conservative reduction factor for the influence of the fibres within the peat. The derived values were compared with a literature review of the most common general drained and undrained parameters for each type of soil and on the descriptions. The GI completed to date is considered to be thorough and robust for the purposes of the EIAR. It would be expected that an observational approach will be required when carrying out forestry works on peat due to the limitations associated with testing and verifying its strength and the contractor is required to frequently inspect the peat material and provide proof of inspection.
2	Peat Instability	Underestimation of peat depth	Extensive peat ground investigation including peat probing and hand shear vane testing has been carried out across the Proposed Offsetting Lands. GI locations have been carried out at locations where access was possible. Access was limited to some areas of the Proposed Offsetting Lands with restrictions. It would be expected that an observational approach will be required when carrying out forestry works on peat due to the limitations associated with testing and verifying its strength and the contractor is required to frequently inspect the peat material and provide proof of inspection.
3	Failure of peat slope due to loading or	Failure to identify existing instability/ peat deformation at	Assessment of satellite imagery and topographical data for evidence of past landslide events was carried out as part of the desk study, in addition to four site walkovers. Desk study review focused on the two

Ref.	Risk	Contributing factor	Mitigation
	agitation of existing instability	the Proposed Offsetting Lands	recorded existing peat landslides within close proximity to the Proposed Offsetting Lands. Additional areas of potential instability have been identified and discussed further in Section 2.7 and 7.3.7. During the site walkovers, the site GDG engineers examined the landscape and the areas surrounding the existing peat landslides, and in other areas identified as areas of potential current instability, including areas upslope of the Proposed Offsetting Lands. No direct evidence of peat instability was identified within the Proposed Offsetting Lands. Although there is no evidence of landslides within the Proposed Offsetting Lands boundary, this does not necessarily mean that landslides have never occurred at the Proposed Offsetting Lands. It is noted that the geomorphological features associated with peat landslides (peat slides and bog bursts) are softened with time through erosion, drying, and re-vegetation. Access was limited to some areas of the Proposed Offsetting Lands with restrictions relating to raised peat bogs traversed by large drainage ditches. Further inspection will be required during the forestry stage to inspect for peat instabilities. This will be carried out by the Contractors team. The design team will develop their own inspection and testing criteria to satisfy and de-risk the possibility of larger peat depth occurring at these locations.
4	Peat Instability	Failure due to excessive loading of peat	The peat stability analysis factor of safety exercise examines the peat in the drained and undrained condition both without and with the addition of a surcharge equating to 1m of peat loading. Areas indicative of a low or moderate FoS result with the 1m peat surcharge have been designated as safety buffer zones, as outlined in Section 8.2. The 1m peat loading scenario is used here to assess the impact of peat loading with permanently felled immature forestry and placing materials into “wind rows”. The forestry contractor will have to adhere to defined safety buffer and Felled Material Restriction areas.
5	Failure of peat slopes	Over/underestimation of existing slope angles.	The peat stability analysis factor of safety exercise examines the peat slope angle using data drawn from a 2024 Bluesky LiDAR survey. This survey was

Ref.	Risk	Contributing factor	Mitigation
			provided in the form of a 5x5m DEM raster. It is possible that slope angles generated using this raster may slightly over/under estimate the slope angle at any given pixel. It is considered that this level of detail is acceptable for carrying out the factor of safety analysis, and that this gives a more representative view of slope wide slope angles. Conservative peat strength values have been assumed.
6	Instability of peat/ slippage	Variations in the groundwater conditions at the Proposed Offsetting Lands	The groundwater conditions were examined during the walkovers. Areas of saturated surface peat were identified during the walkovers as outlined in Section 2.12 and these have been considered in the risk assessment and findings of the report. The groundwater conditions and peat moisture content way vary seasonally and/or more frequently with the immediate weather conditions. Hydrology of the area will be maintained as far as possible by implementing and maintaining an appropriate drainage system.

10 CONCLUSIONS AND RECOMMENDATIONS

Following the guidance of the Scottish Executive, a review of the published thematic geographic information (e.g. geology, soils, protected areas) and relevant background literature was undertaken for the Proposed Offsetting Lands. Site reconnaissance and site investigations were carried out to validate and enhance the desk study information. Based on the available data, the fieldwork, and GDG's professional judgement, it is concluded that significant peat slides are unlikely on the Proposed Offsetting Lands with diligent peat management and careful consideration of the peat conditions at the Proposed Offsetting Lands during the Proposed Offsetting Measures works .

A deterministic Factor of Safety was calculated across the Proposed Offsetting Lands, and from this, a robust peat stability risk assessment (PSRA) was performed. The findings of the peat assessment showed that the Proposed Offsetting Lands have an acceptable margin of safety and is suitable for the Proposed Offsetting Measures, provided appropriate mitigation measures, as outlined in Section 8, are implemented. These must be adhered to in future stages of the Proposed Offsetting Measures.

The peat stability risk for the Proposed Offsetting Lands are almost entirely scored as negligible to low, aside from a few small, localised areas classed as medium. It is considered that these areas do not present a significant peat slide risk if the mitigation measures outlined in Section 8 are implemented, and that the residual risk is manageable.

To minimise the risk of forestry activity causing potential peat instability the Construction Method Statements (CMSs) for the project will implement in full, but not be limited to, the recommendations above.

During deforestation works, it is strongly recommended to carry out frequent monitoring works, especially after heavy rainfall events or prolonged rainfall.

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Appendix A LOCATION

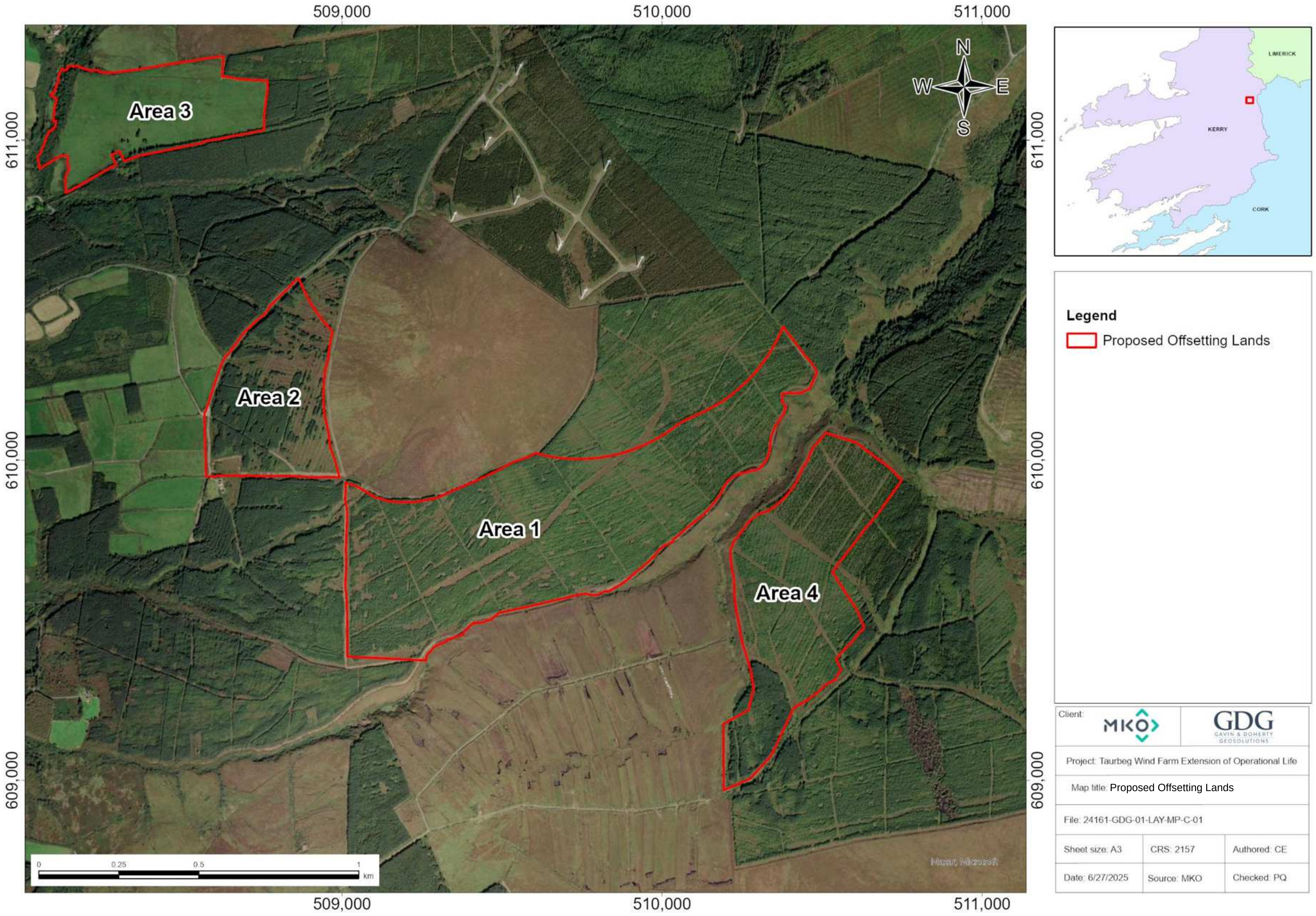


Figure A- 1: Proposed Offsetting Measures Location.

Appendix B GEOLOGY

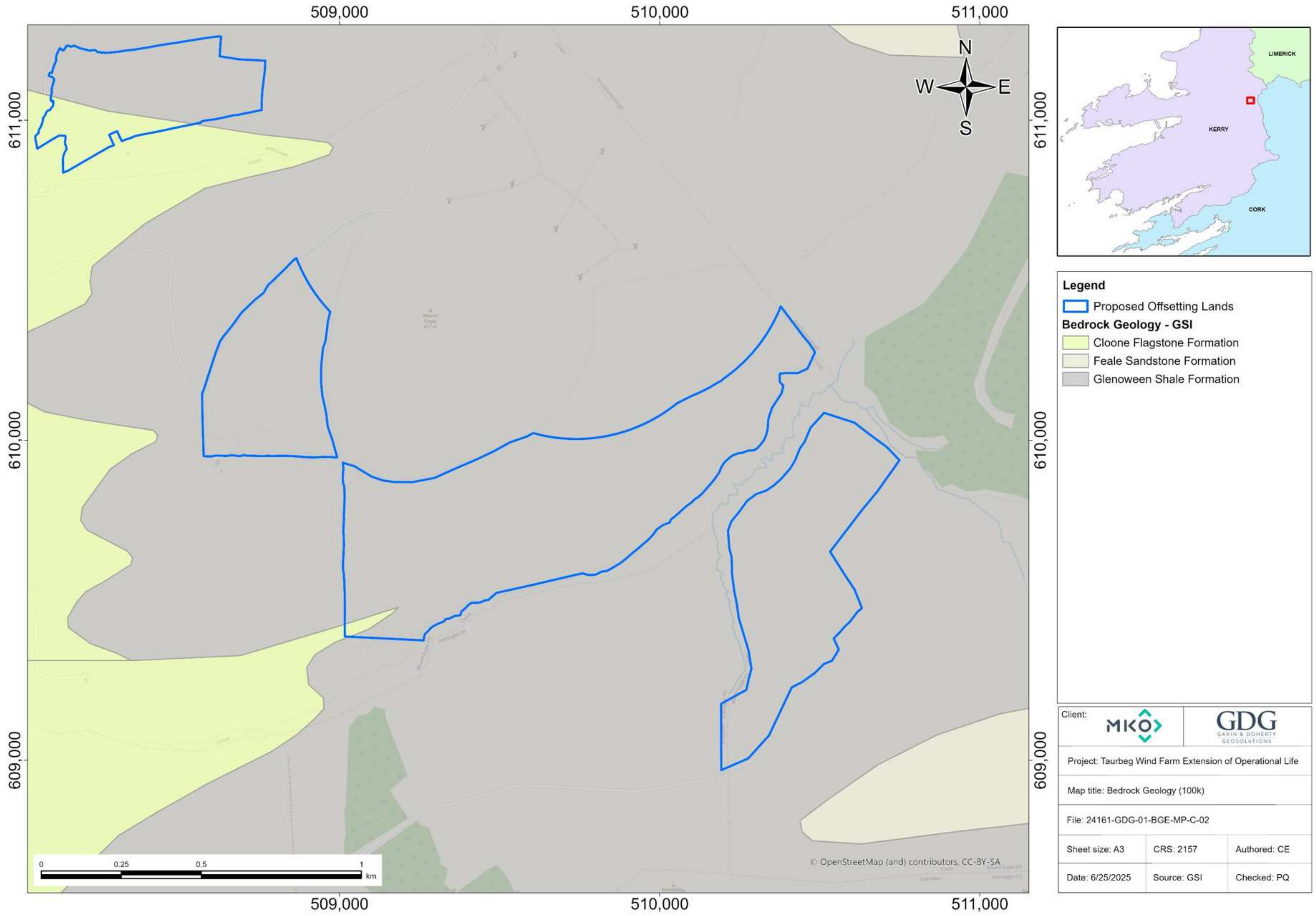


Figure B- 1: Bedrock Geology (GSI).

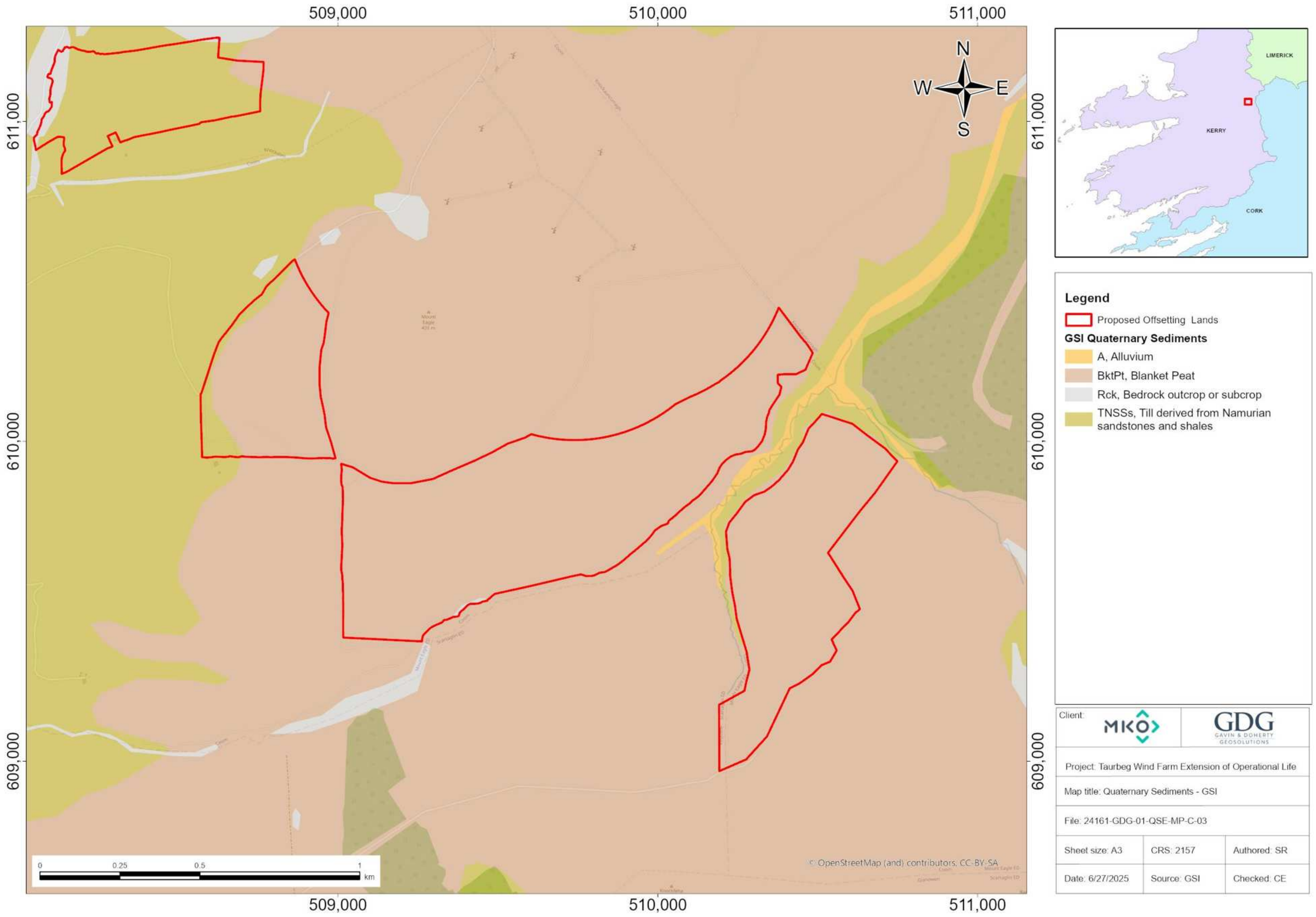


Figure B- 2: Quaternary Sediments (GSI).

Appendix C SOILS

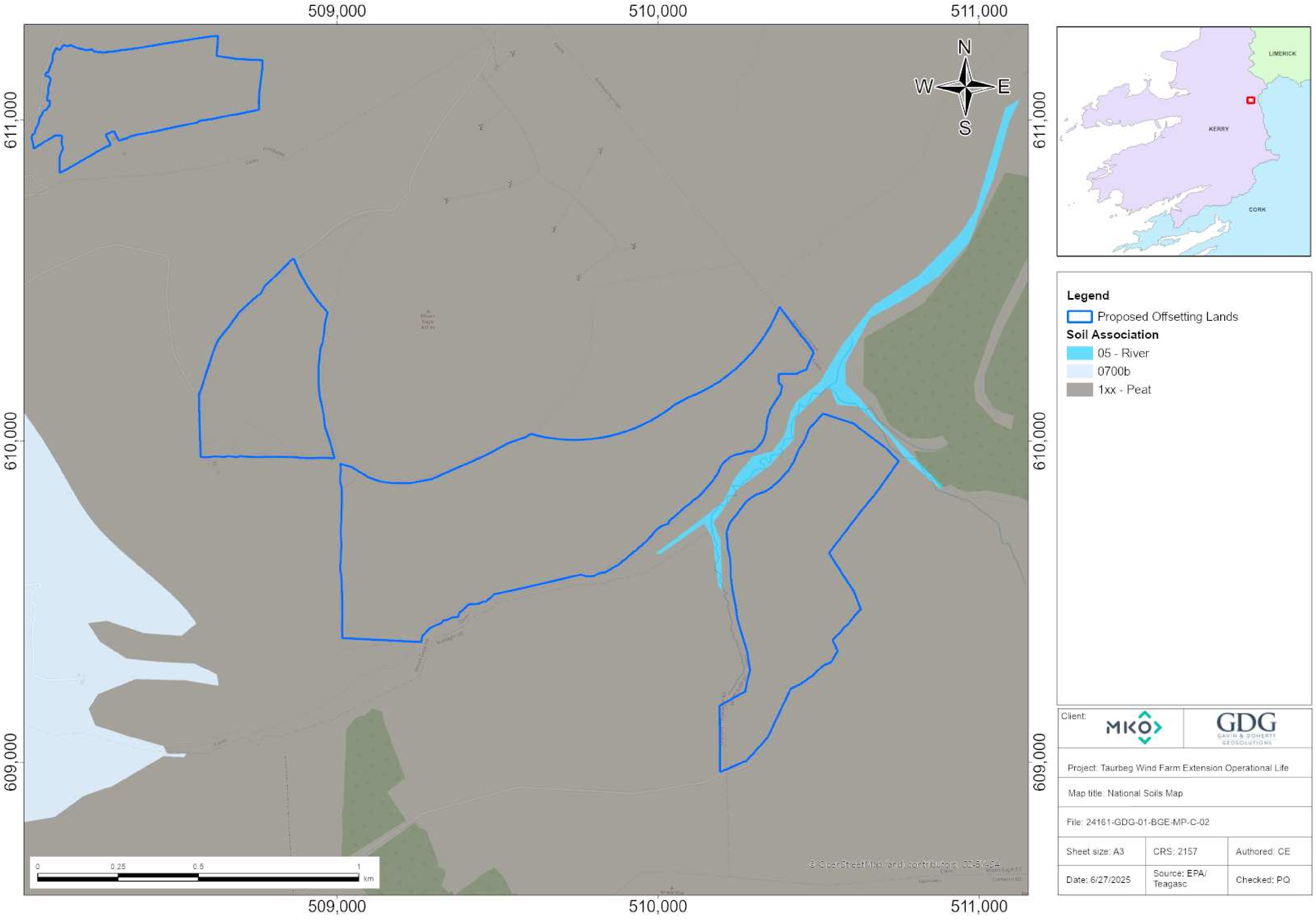


Figure C- 1: Soil Associations (EPA/Teagasc).

Appendix D MOISTURE

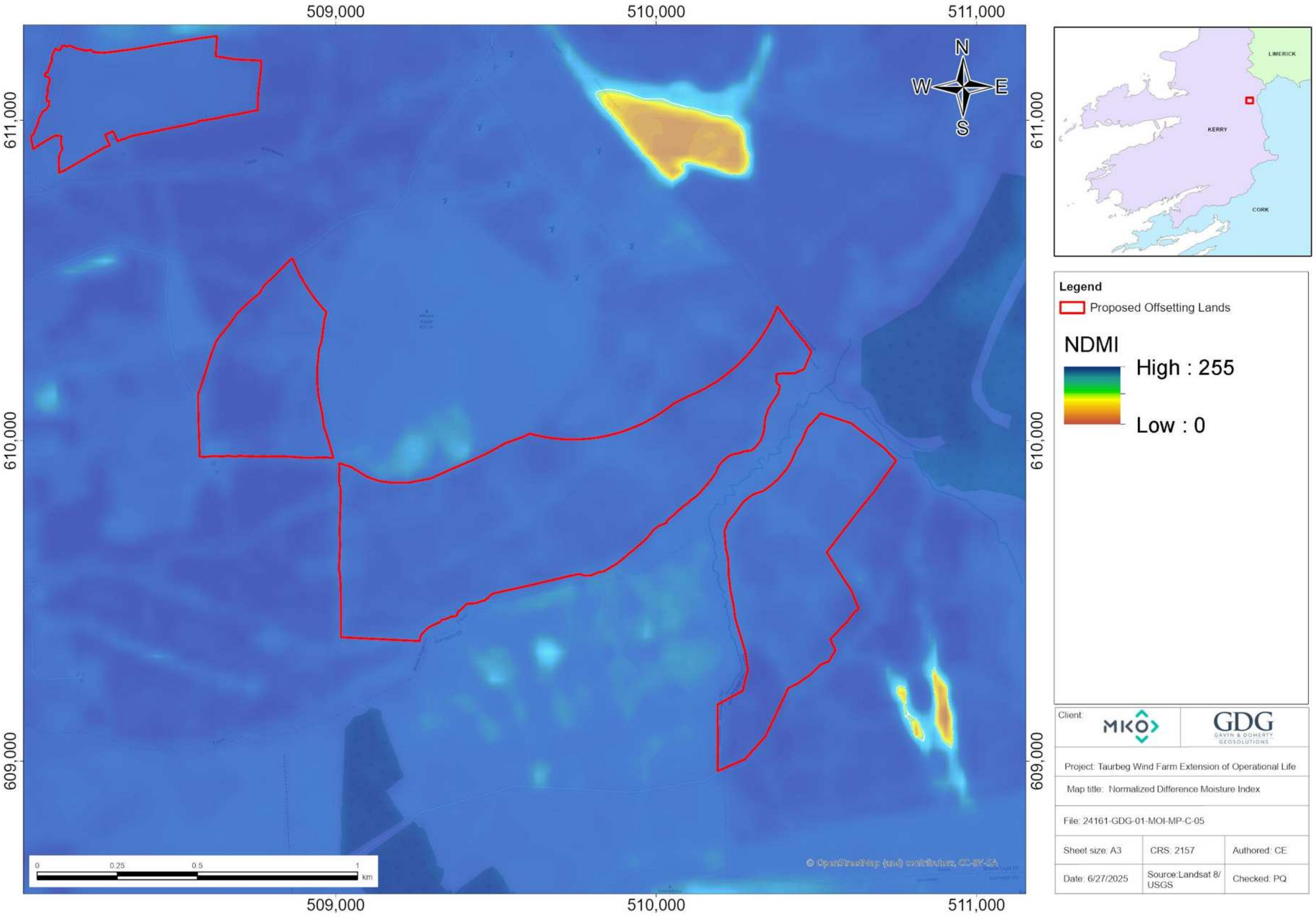


Figure D- 1: Normalised Difference Moisture Index (Landsat 8/USGS).

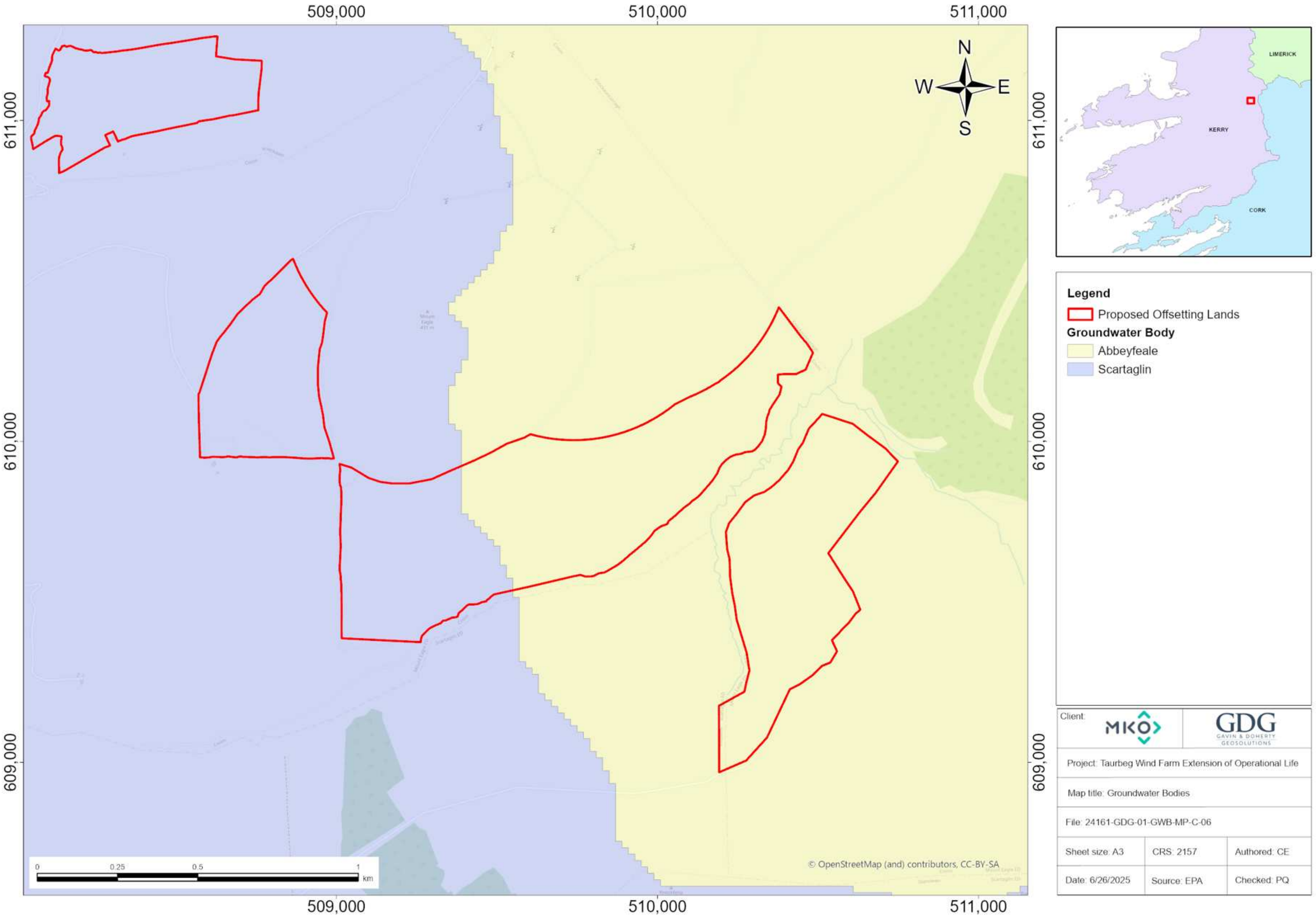


Figure E- 1: Groundwater Bodies (EPA).

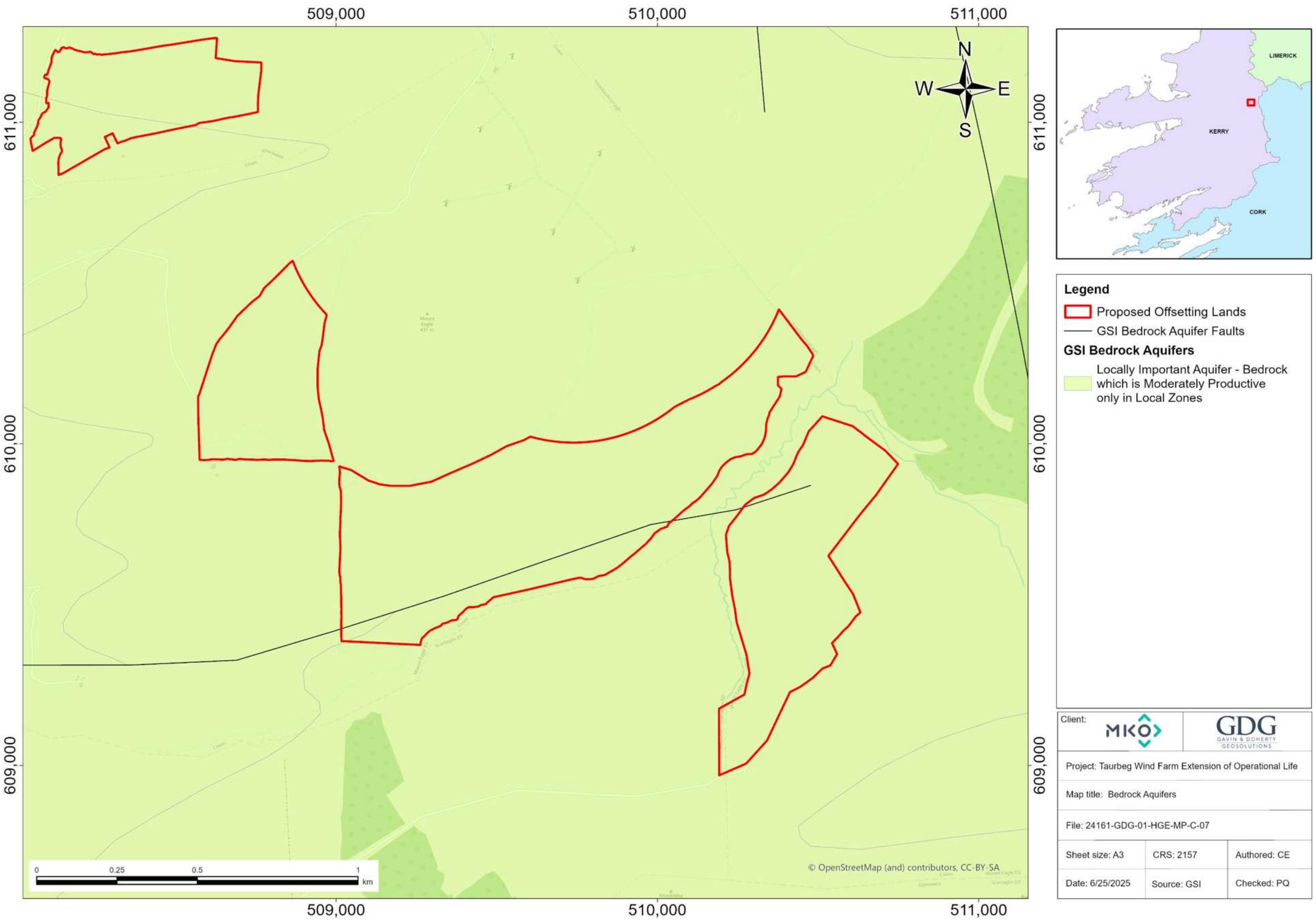


Figure E- 2: Bedrock Aquifers (GSI).

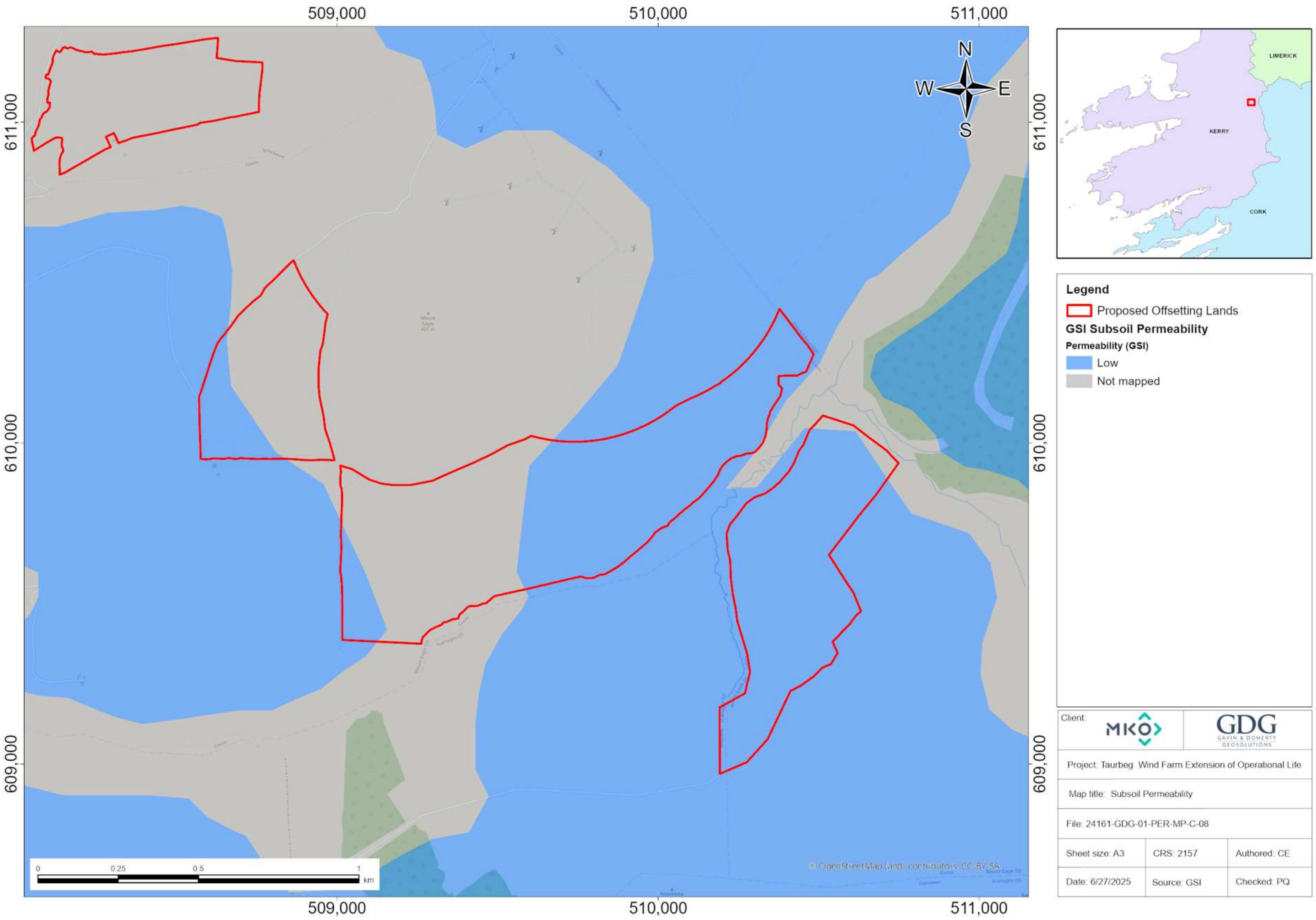


Figure E- 3: Subsoil Permeability (GSI).

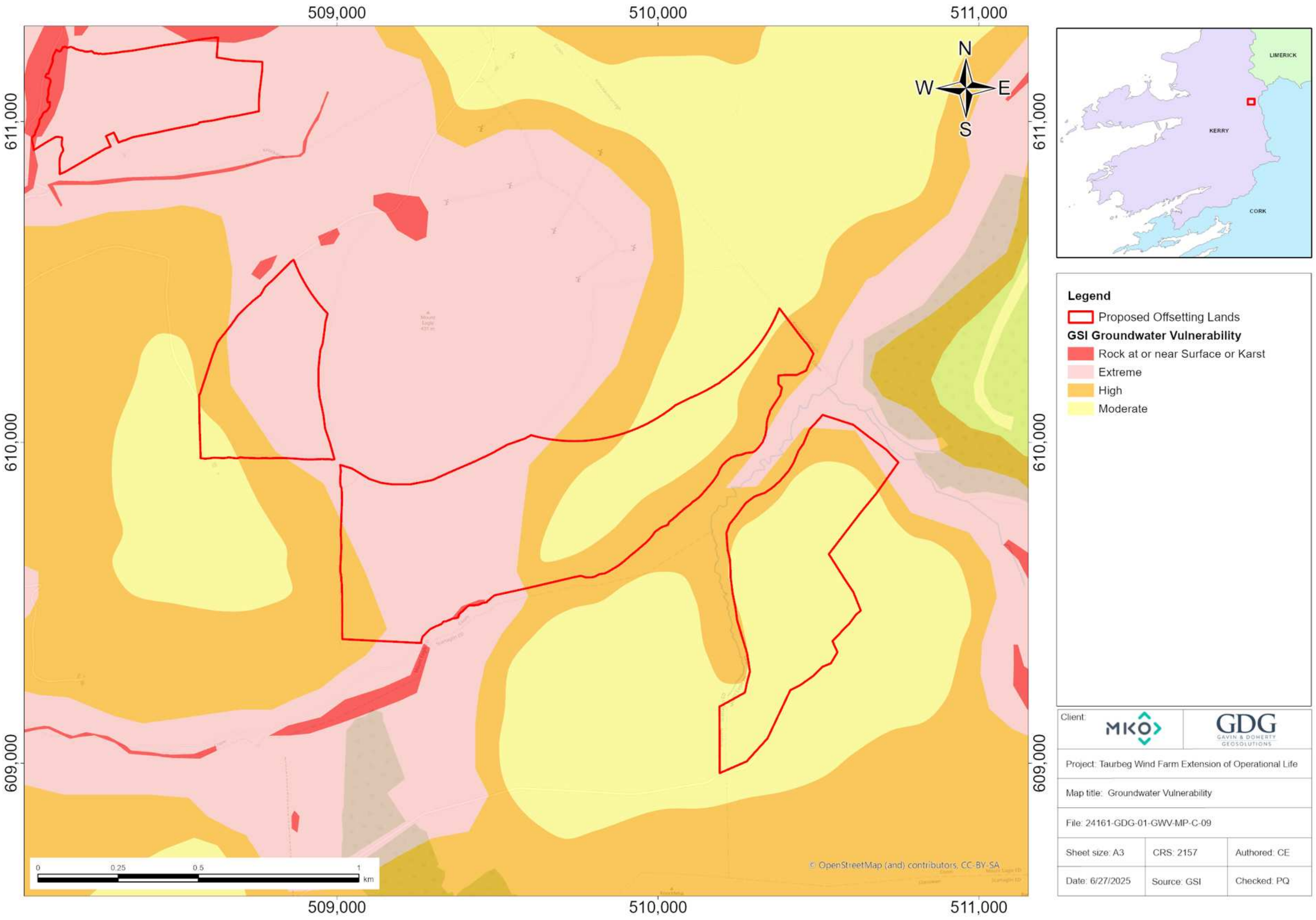


Figure E- 4: Groundwater Vulnerability (GSI).

Appendix F TOPOGRAPHY

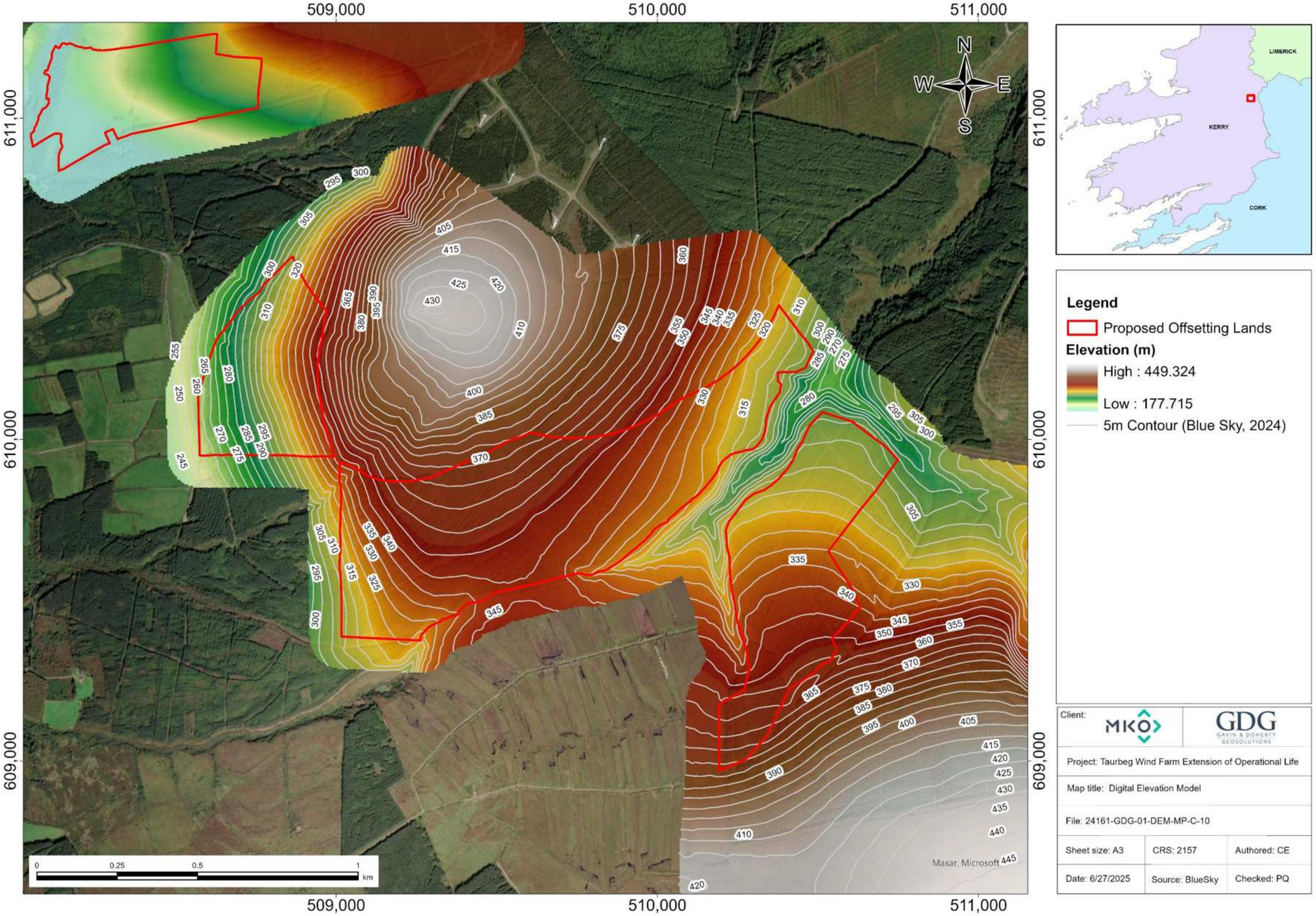


Figure F- 1: Digital Elevation Model (BlueSky, 2024).

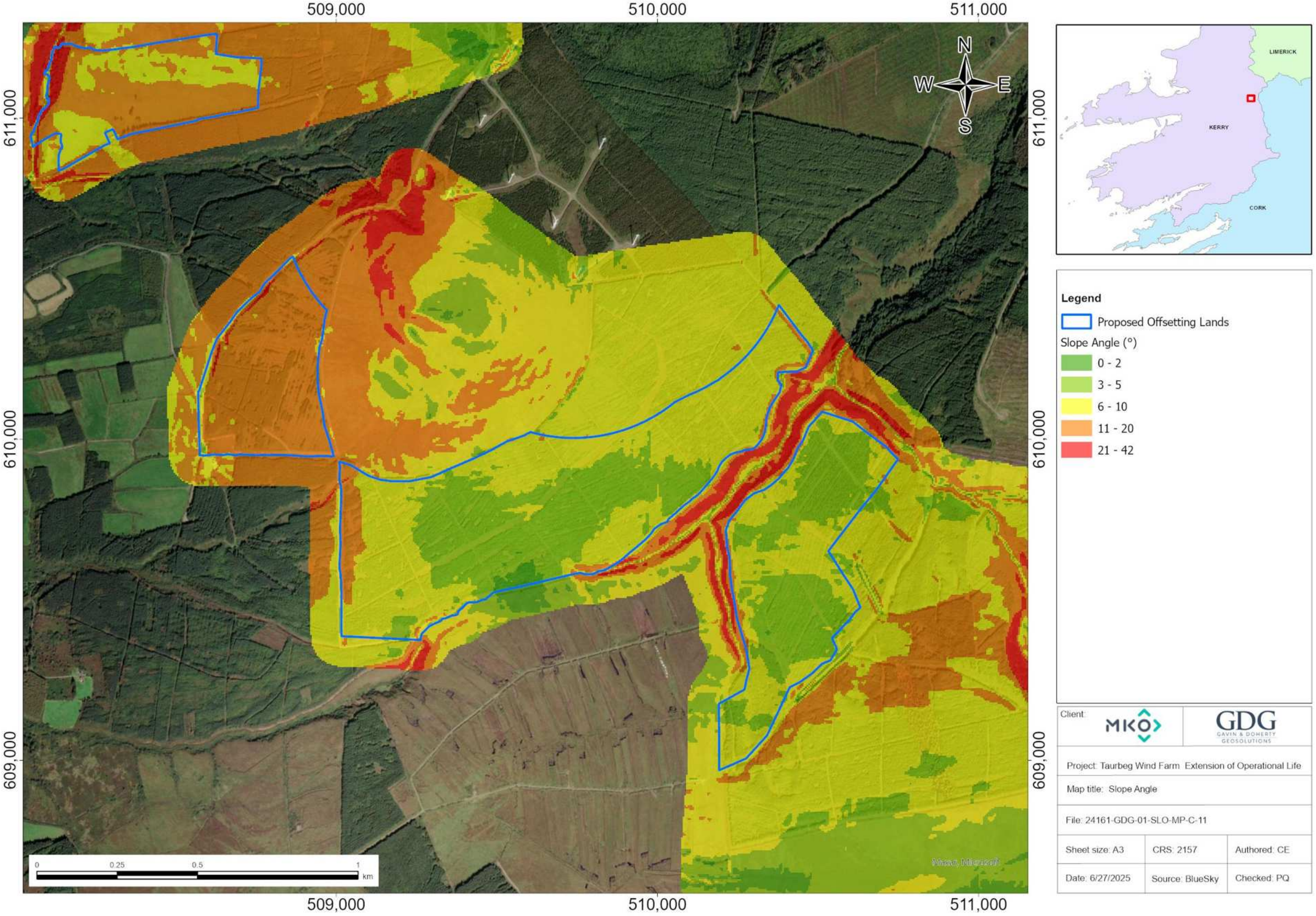


Figure F- 2: Slope Angles (Derived from BlueSky, 2024).

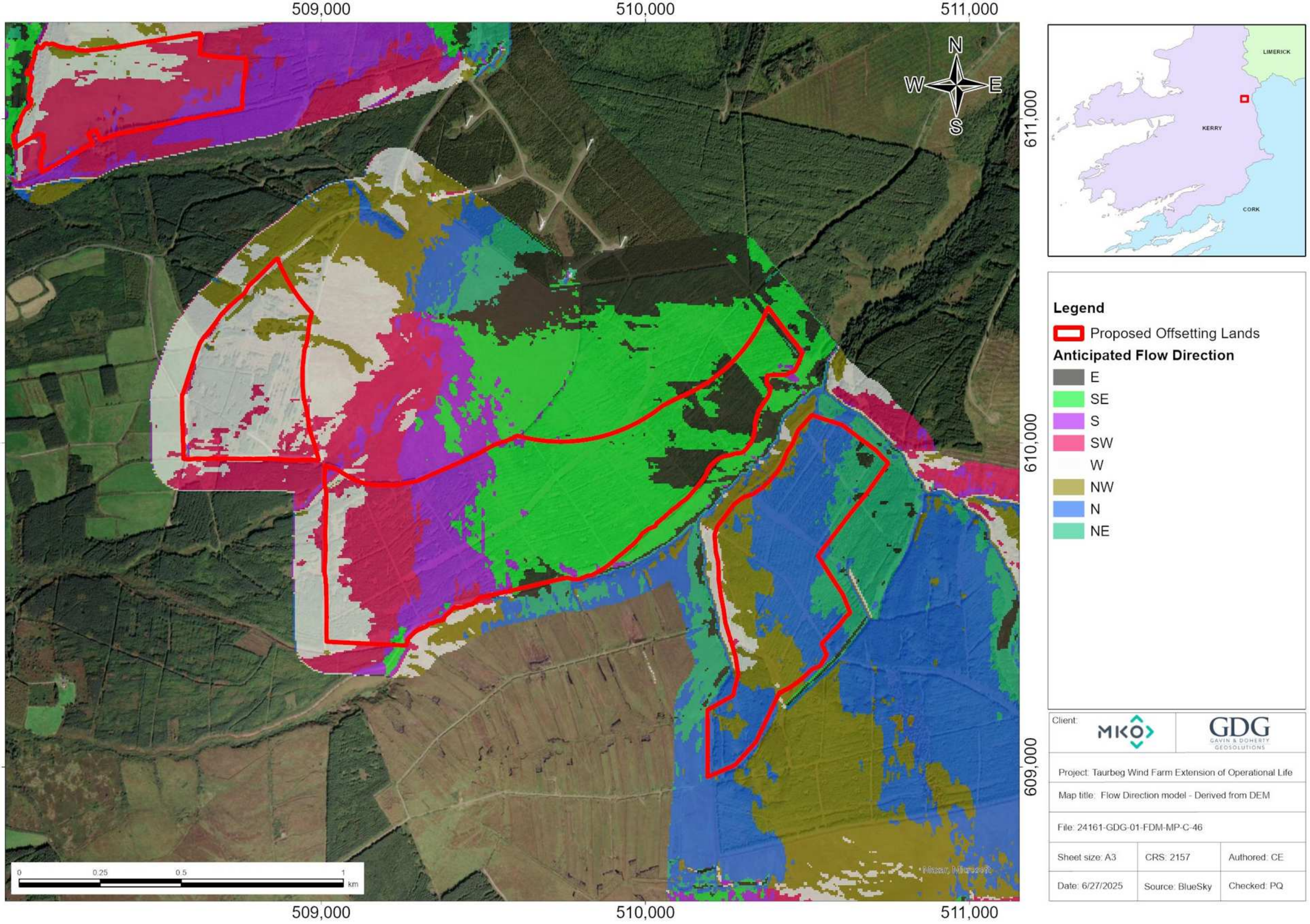


Figure F- 3: Flow Direction model – derived from DEM (BlueSky, 2024).

Appendix G SLOPE INSTABILITY MAPPING

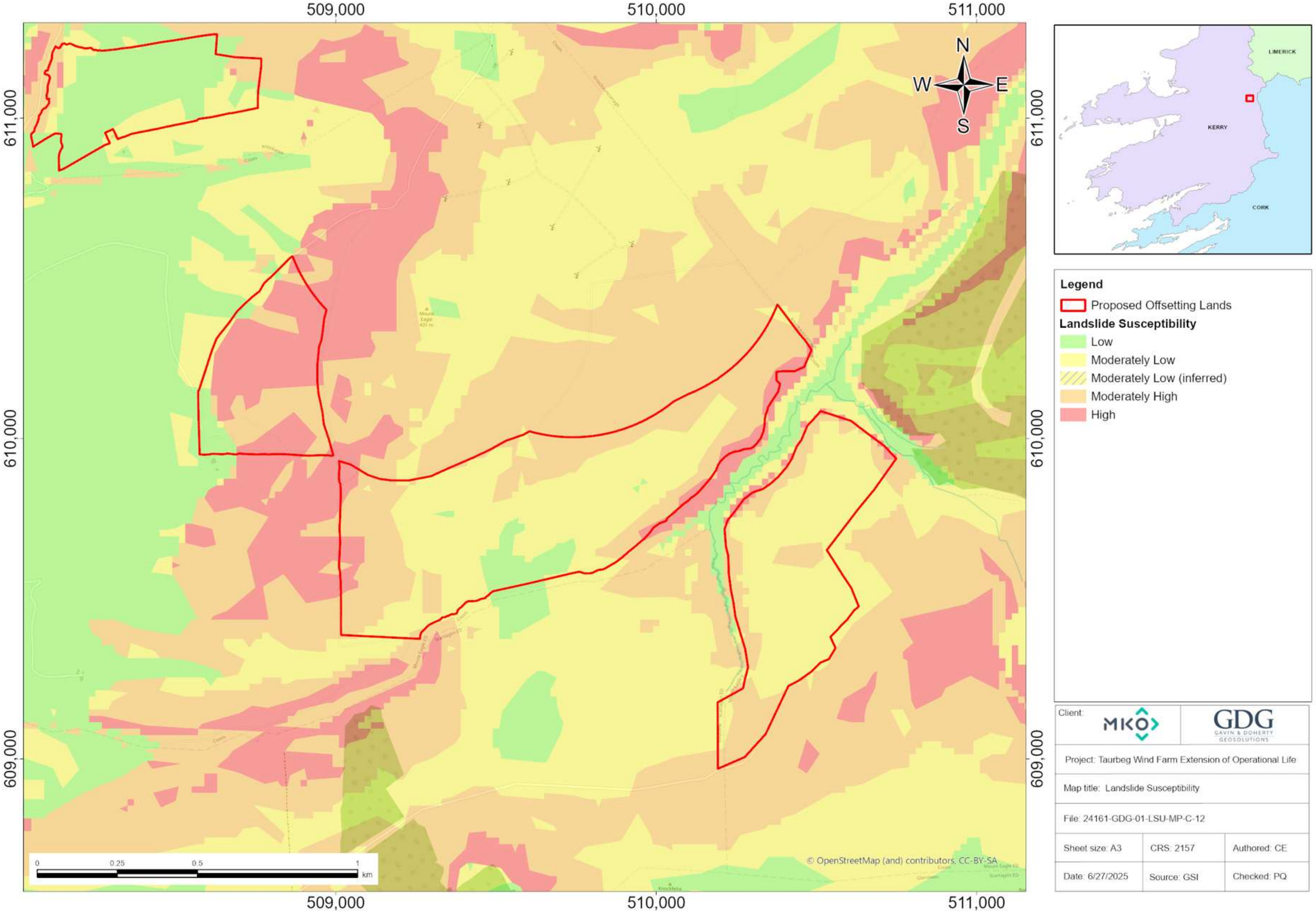


Figure G- 1: Landslide Susceptibility (GSI).

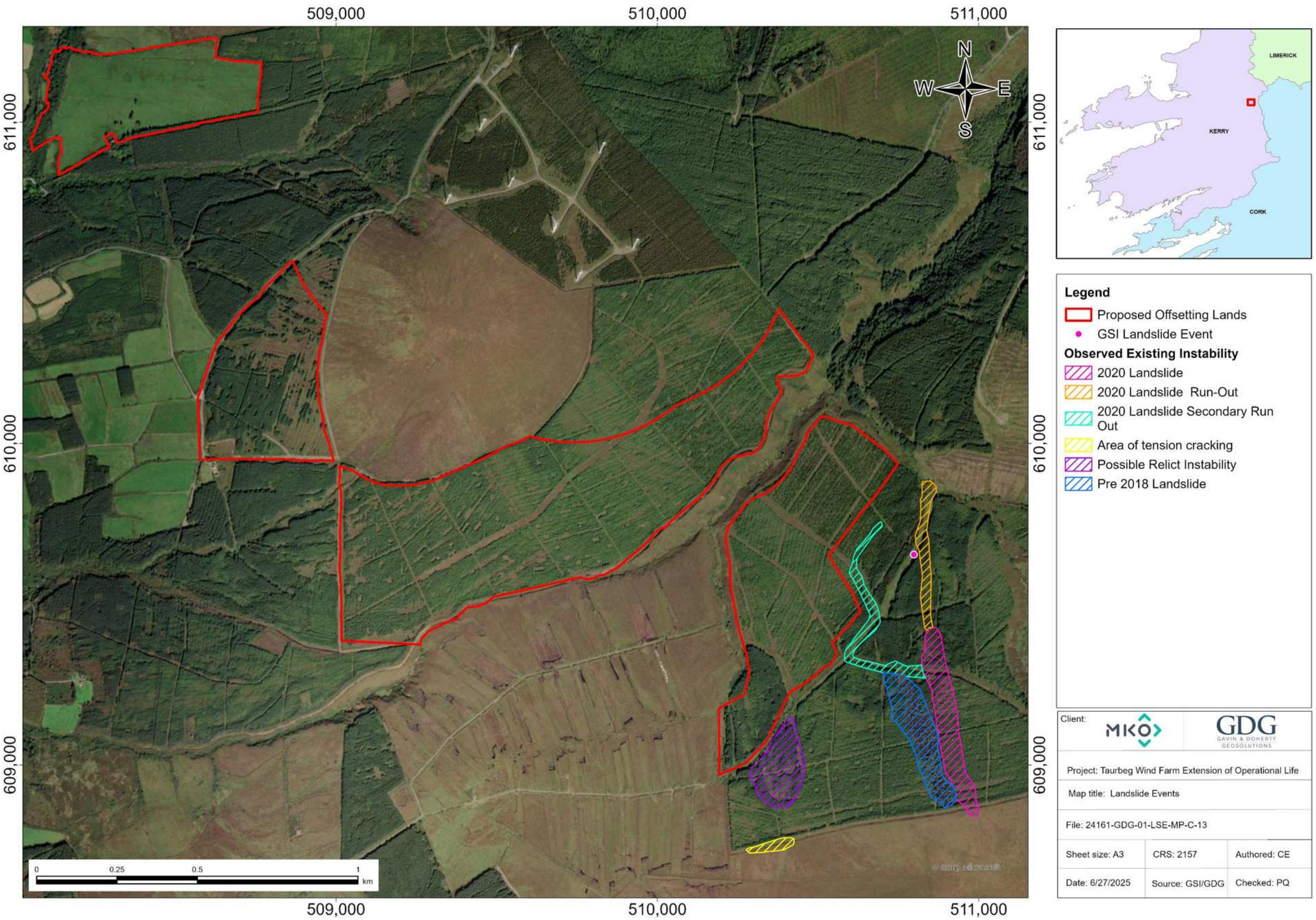


Figure G- 2: Landslide Events (GSI/GDG).

Appendix H HYDROLOGY

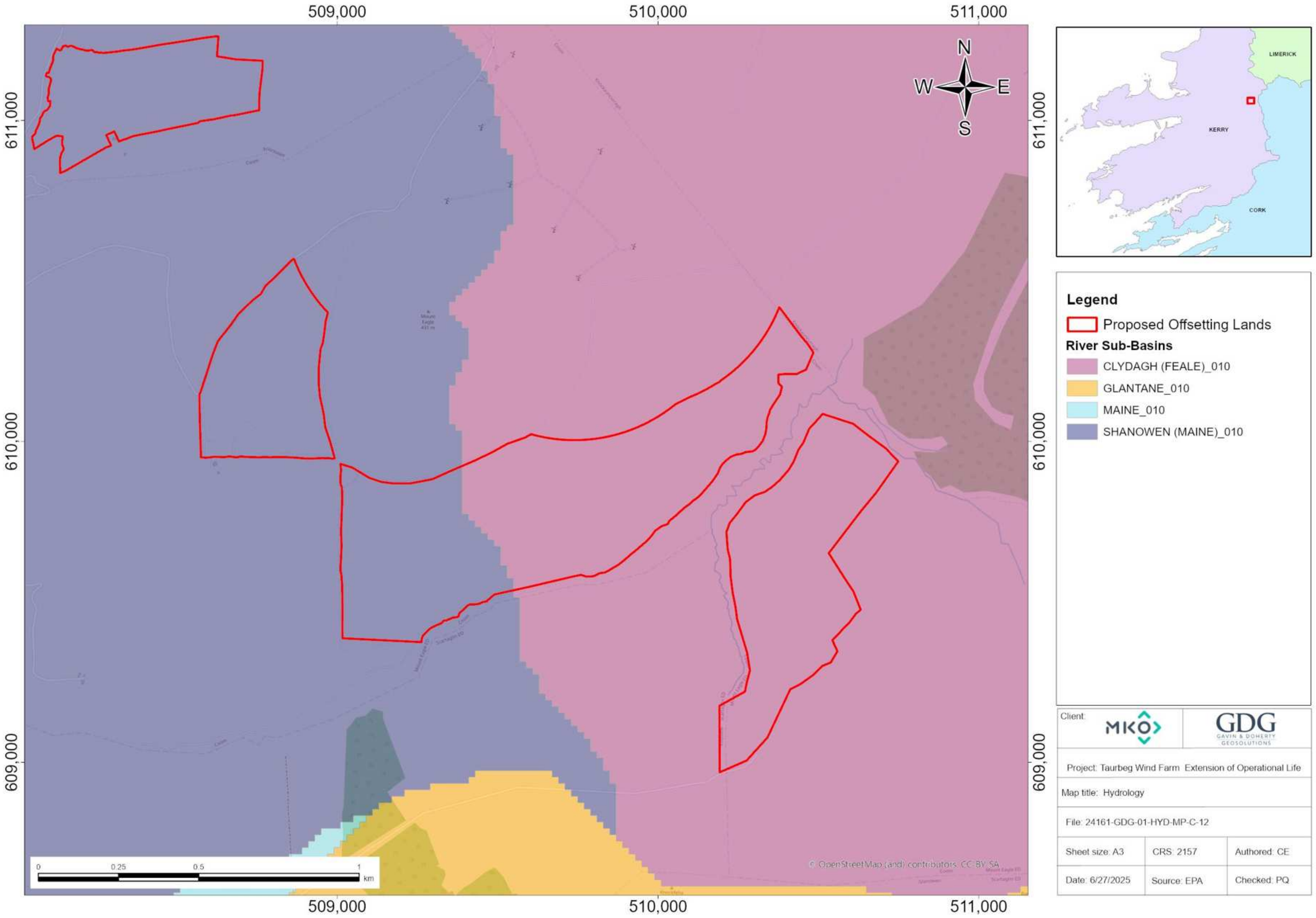


Figure H- 1: Hydrology (EPA).

Appendix I ARTIFICIAL DRAINAGE

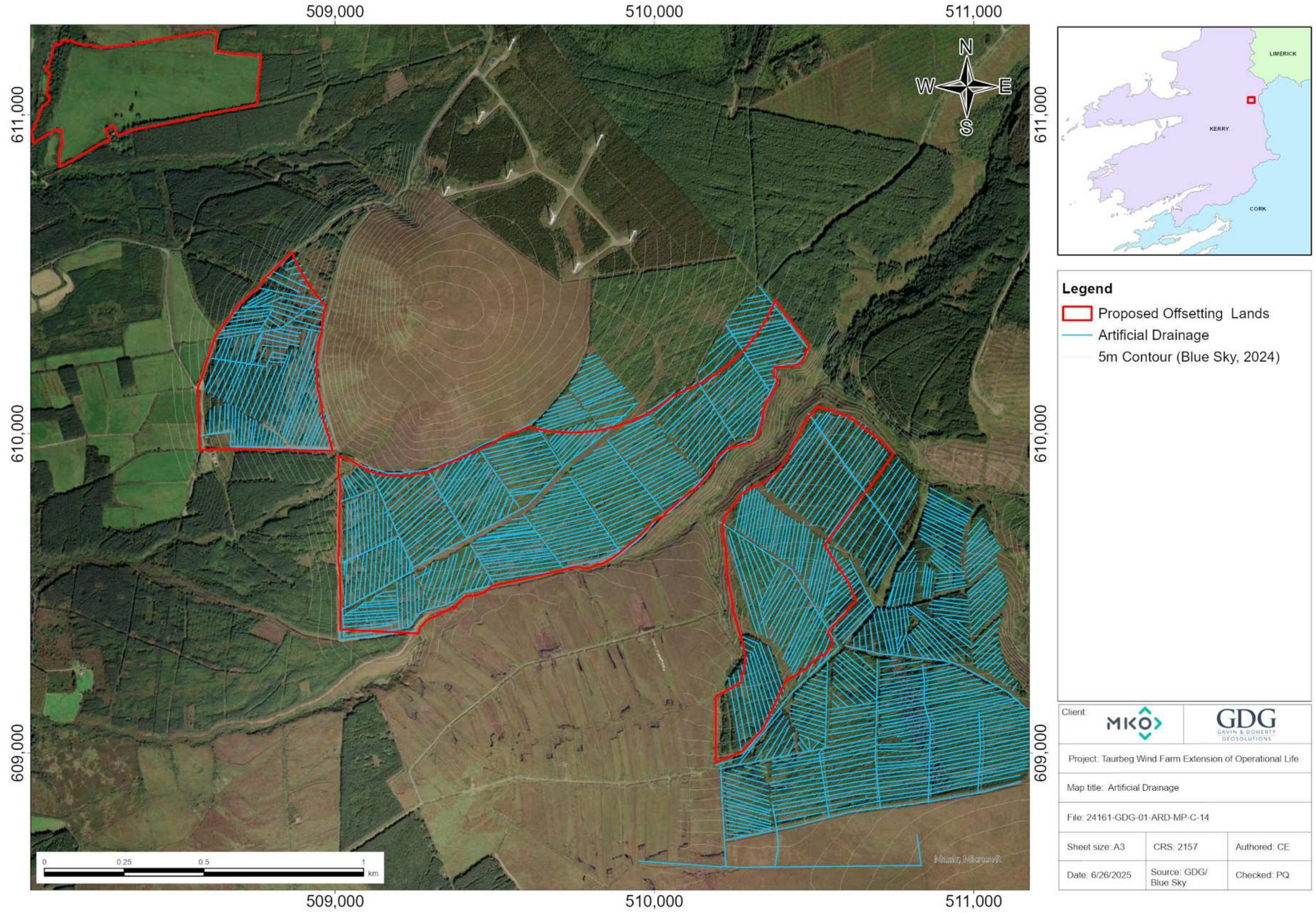


Figure I- 1: Artificial Drainage Network (from site observations and aerial imagery).

Appendix J LANDCOVER

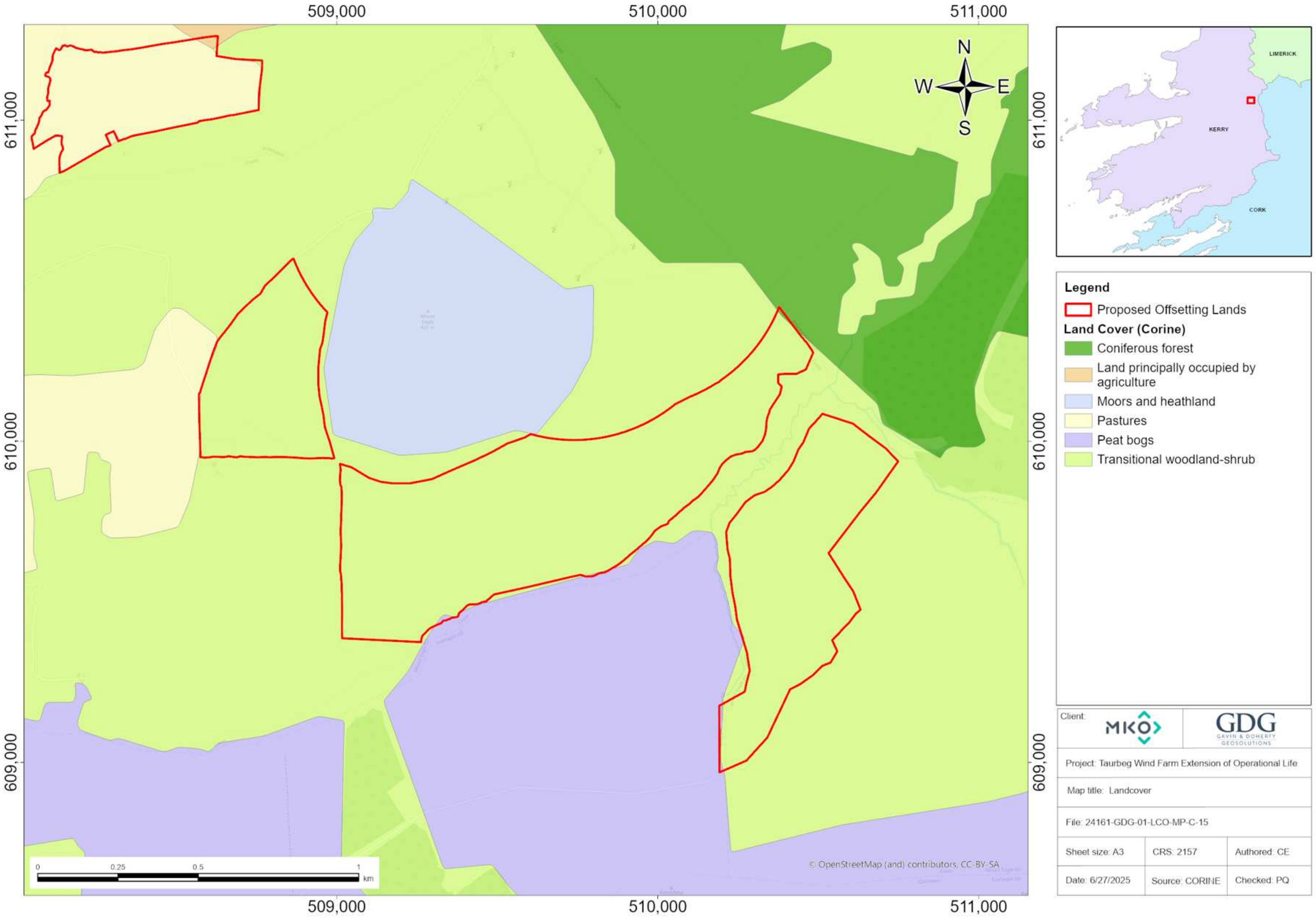


Figure J- 1: Corine Land Cover Mapping (2018).

Appendix K Special Areas of Conservation, Special Protection Areas and Rainfall Gauges

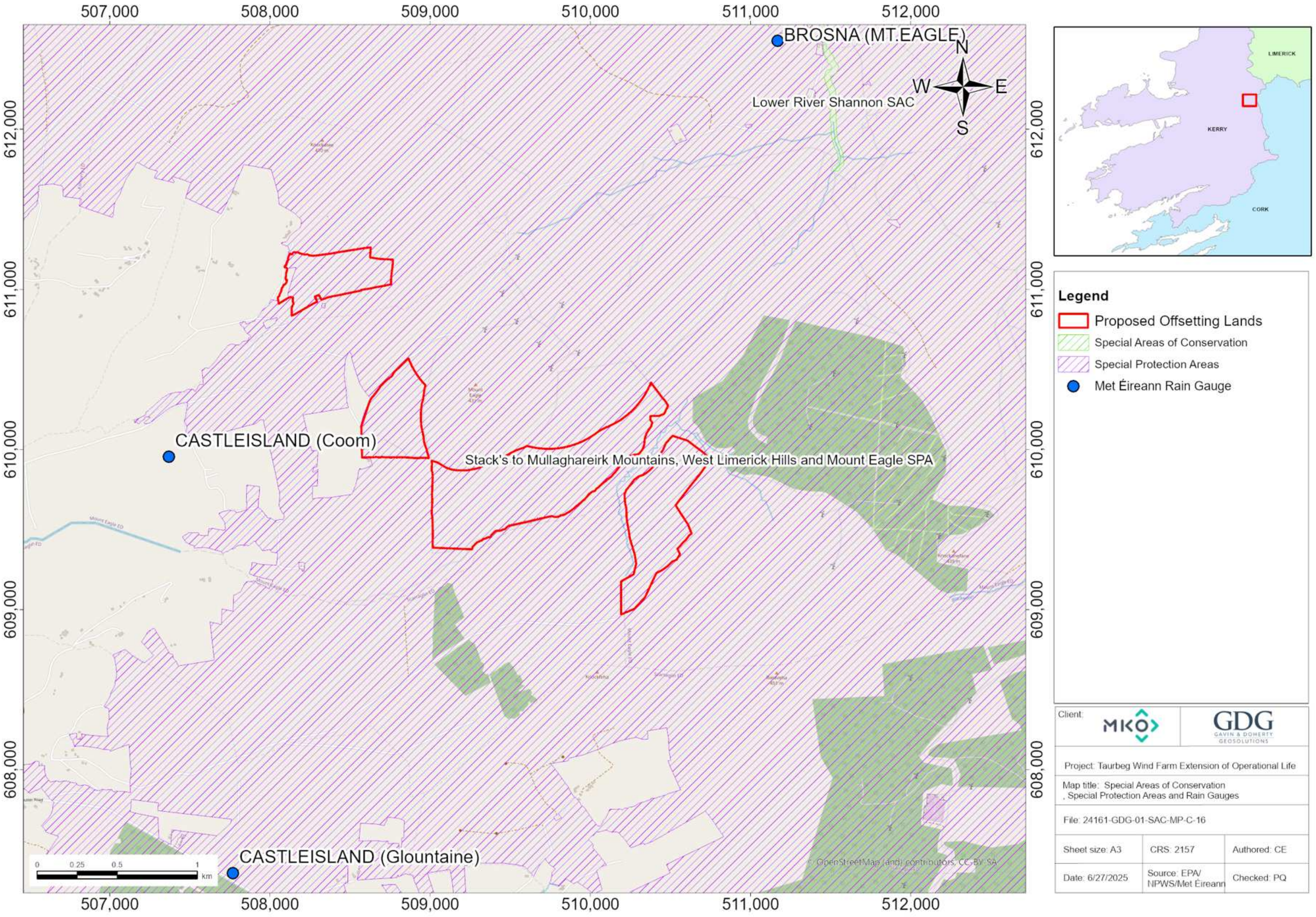


Figure K- 1: Special Areas of Conservation, Special Protection Areas, and Rainfall Gauges (EPA. NPS and Met Éireann).

Appendix L GROUND INVESTIGATION

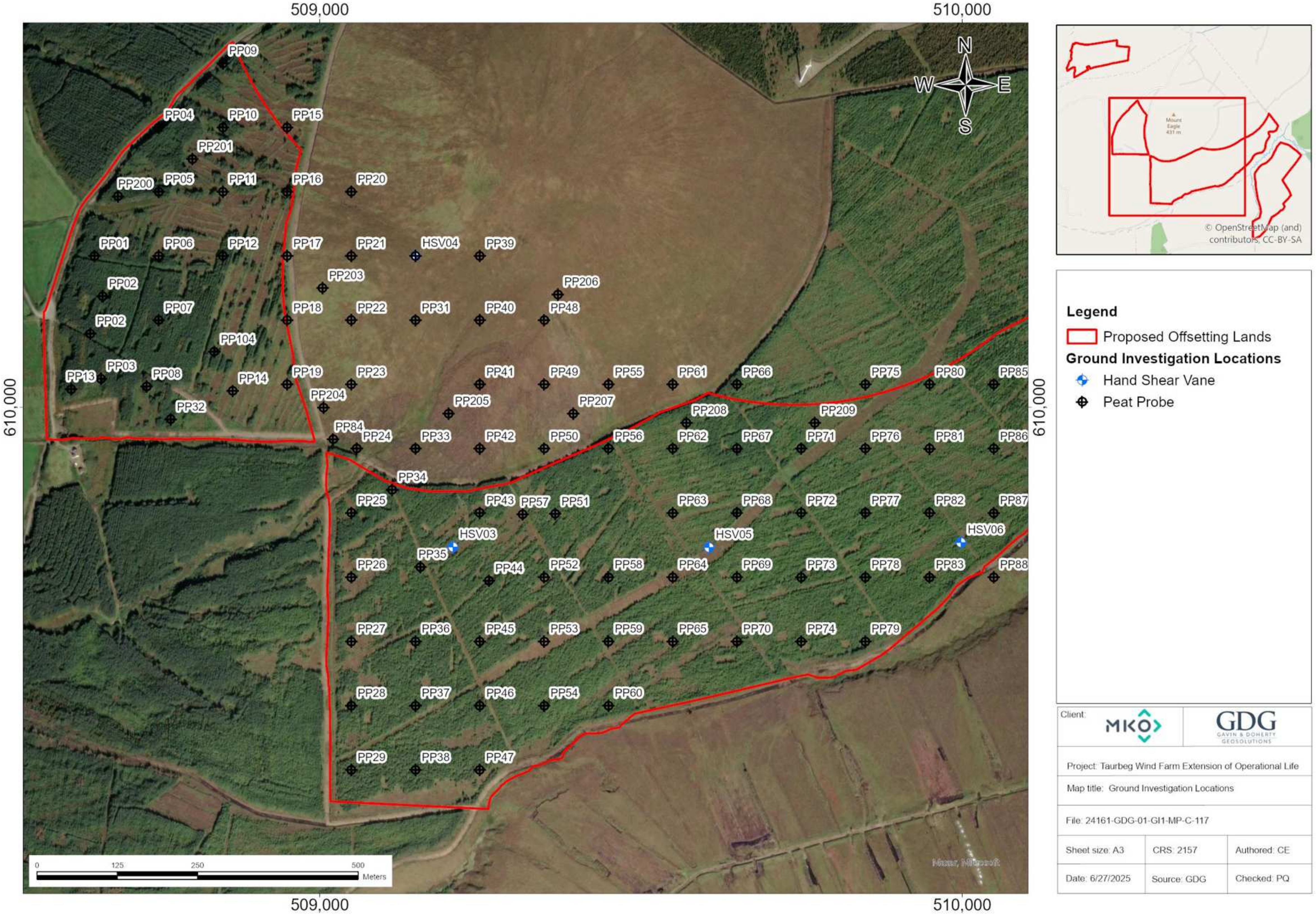


Figure L- 1: Ground Investigation Locations (1 of 2)

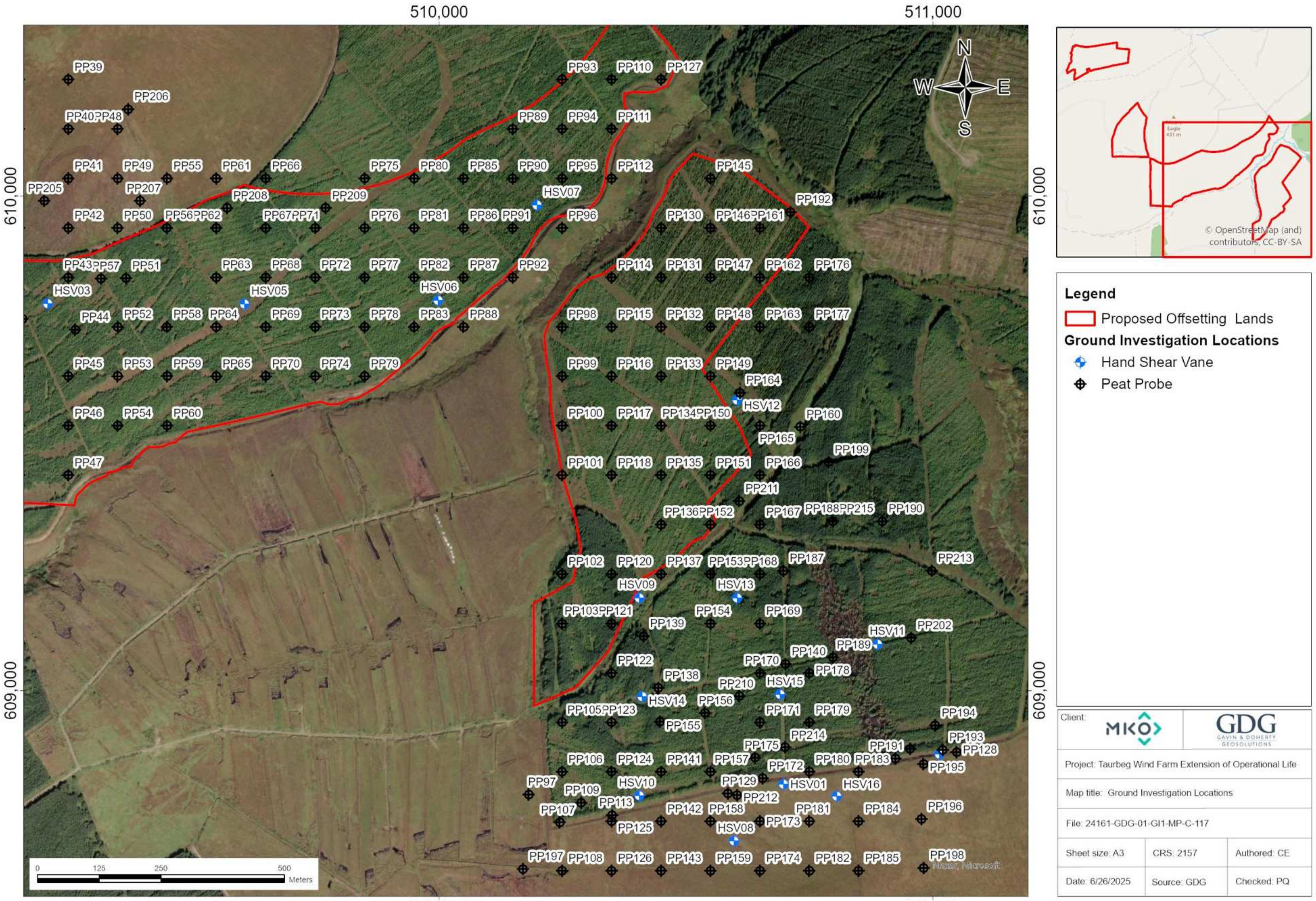


Figure L- 2: Ground Investigation Locations (2 of 2)

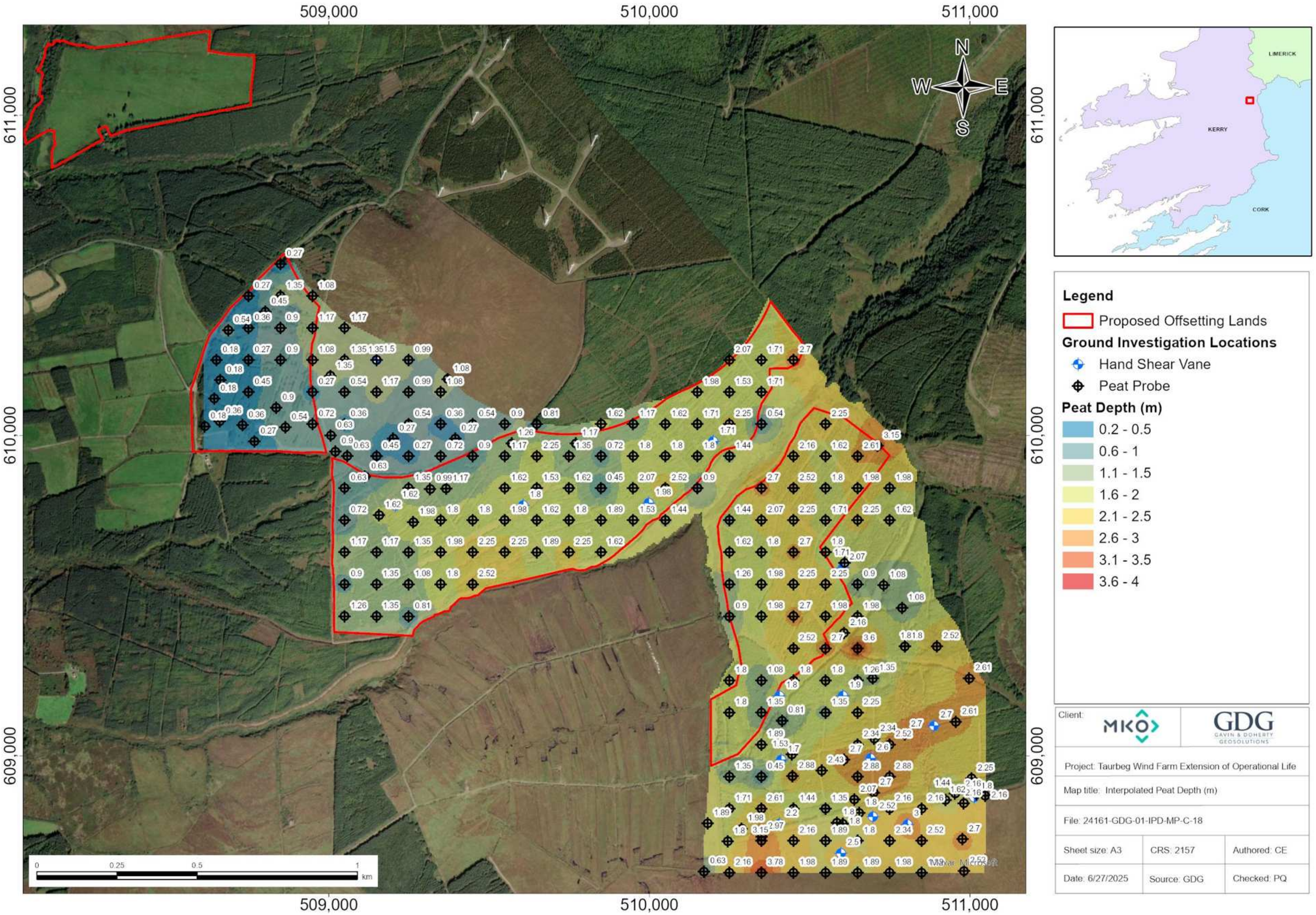


Figure L- 3: Interpolated Peat Depths.

Appendix M FACTOR OF SAFETY

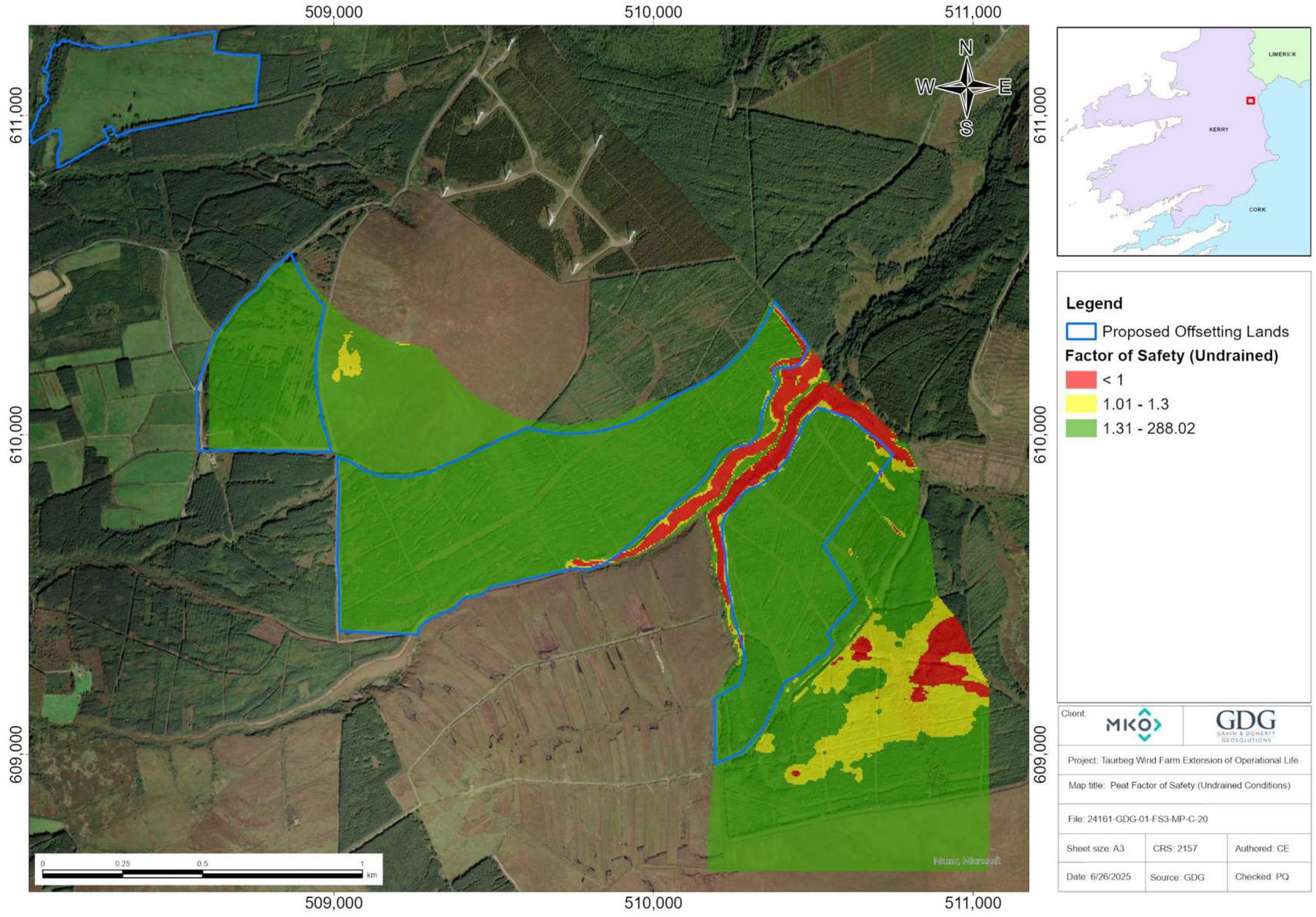


Figure M- 1: Peat Factor of Safety for Undrained Conditions.

***Area 3 contains no peat and so has not been assigned a peat FoS value, as this area was not included in the peat thickness interpolation.**

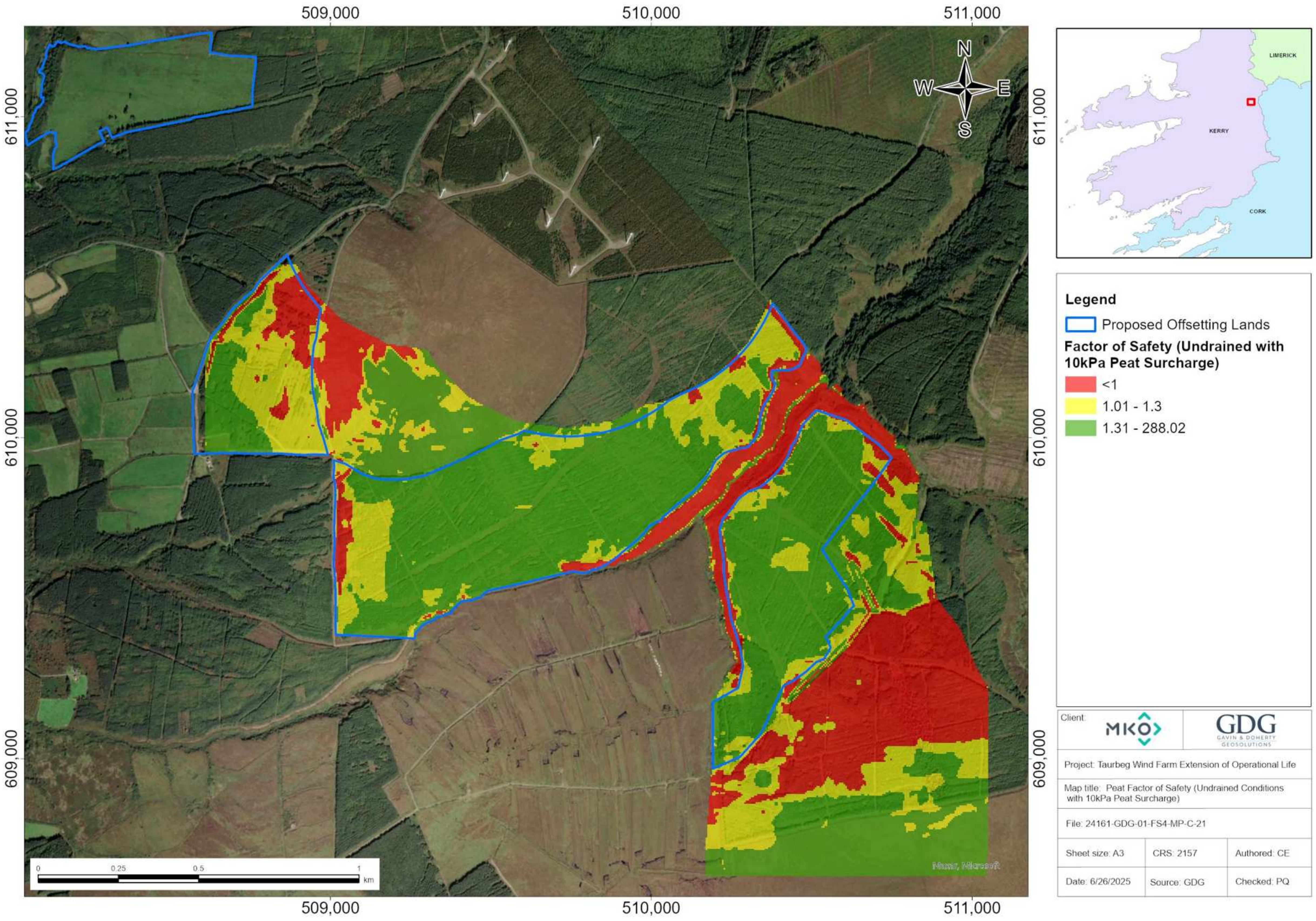


Figure M- 2: Peat Factor of Safety for Undrained Conditions with 10kPa Surcharge.

***The area at the northern entrance boundary contains no peat and so has not been assigned a peat FoS value, as this area was not included in the peat thickness interpolation.**

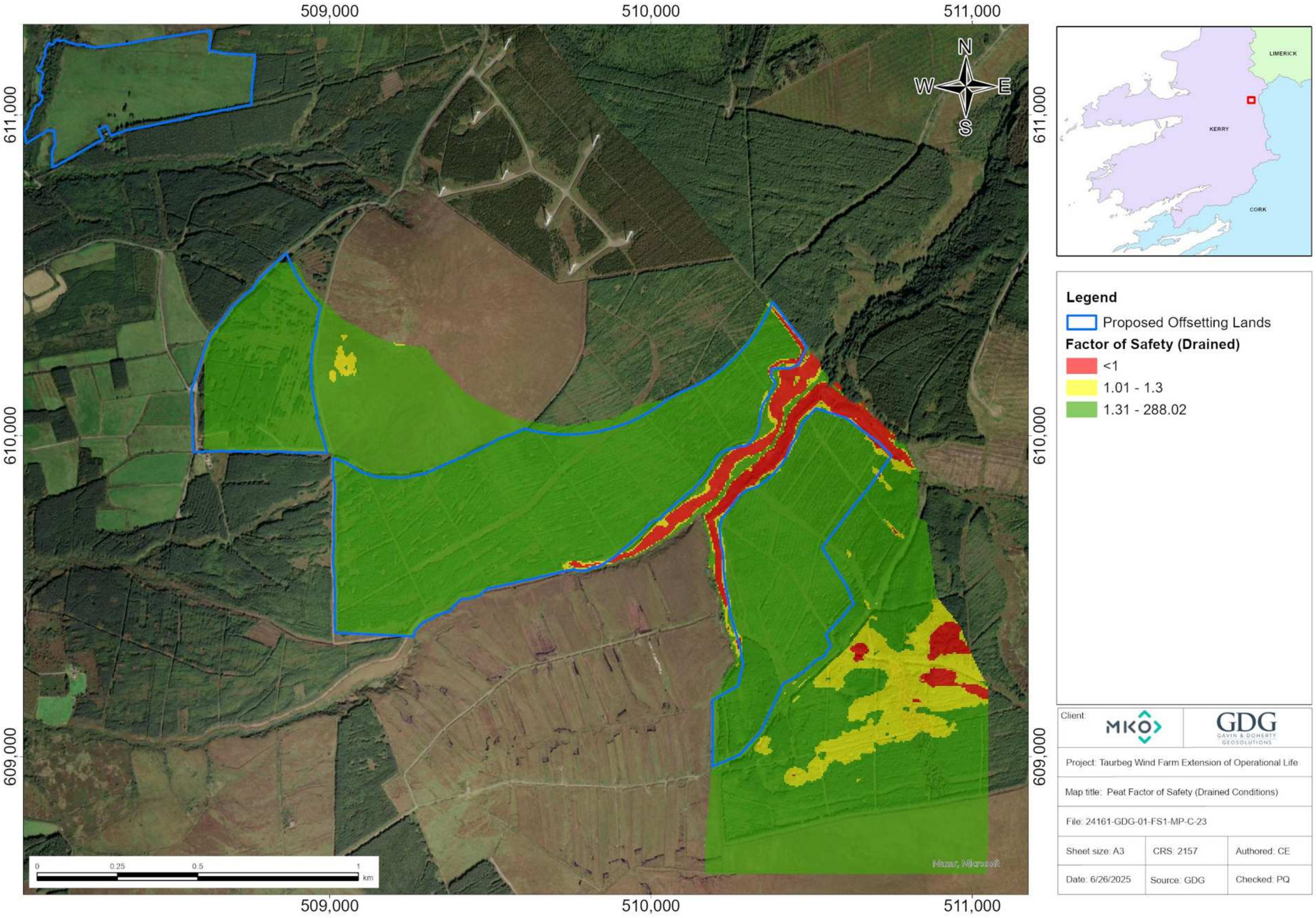


Figure M- 3: Peat Factor of Safety for Drained Conditions.

***The area at the northern entrance boundary contains no peat and so has not been assigned a peat FoS value, as this area was not included in the peat thickness interpolation.**

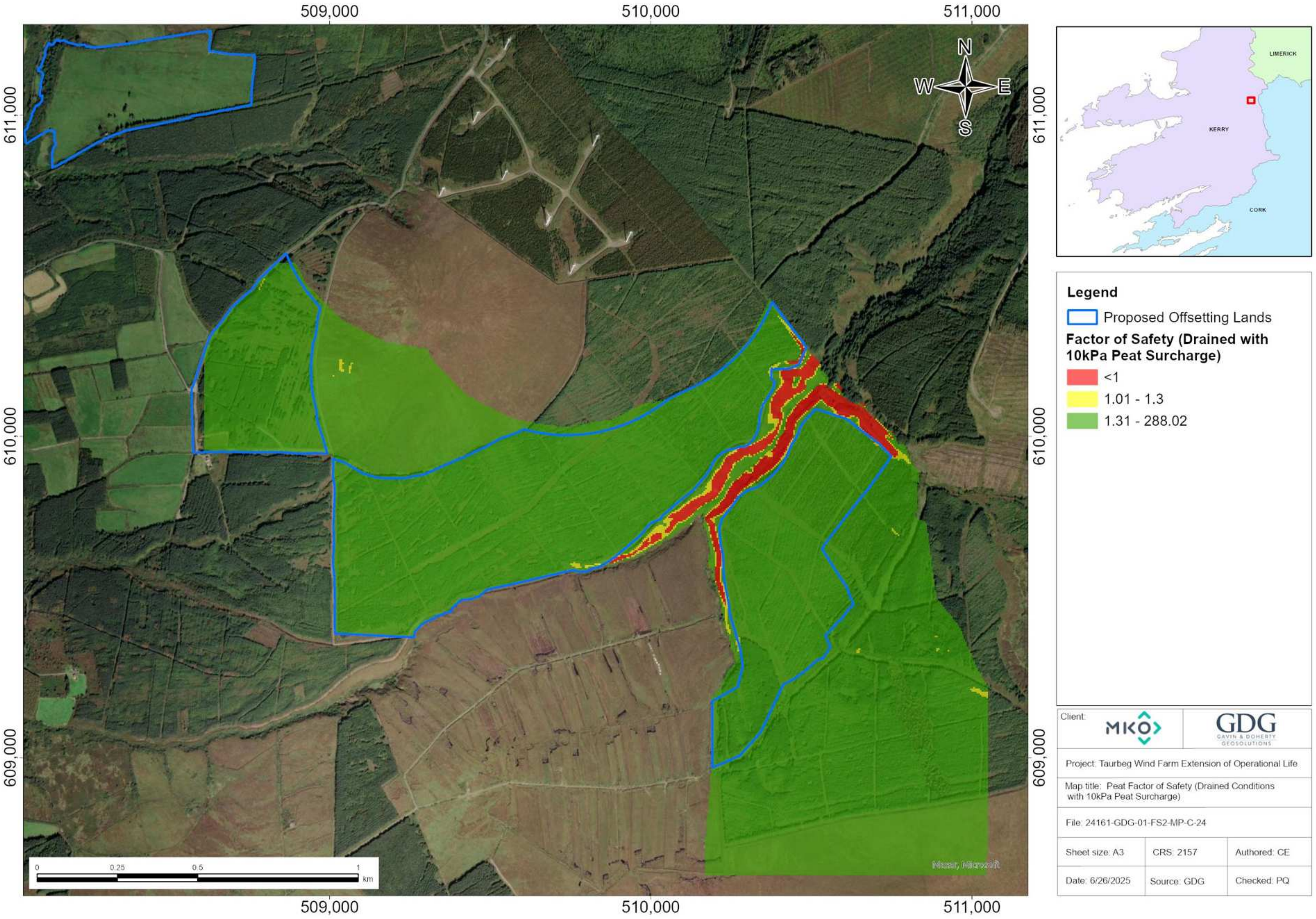


Figure M- 4: Peat Factor of Safety for Drained Conditions with 10kPa Surcharge.

***The area at the northern entrance boundary contains no peat and so has not been assigned a peat FoS value, as this area was not included in the peat thickness interpolation**

Table M- 1: Factor of Safety for Undrained Conditions for GI Locations Within the Proposed Offsetting Measures Boundary.

GI Location	Slope	Cos Slope	Sin Slope	Undrained shear strength	Bulk unit weight of Peat	Peat depth	Factor of Safety	Surcharge	Factor of Safety with Surcharge	Slope
	(º)			Cu (kPa)	Y (kN/m^3)	(m)		(m)		Rad
HSV03	6.1	0.994	0.107	4	10	1.6	2.33	1	1.44	0.106839
HSV05	6.9	0.993	0.120	4	10	1.8	1.87	1	1.20	0.119919
HSV06	5.5	0.995	0.095	4	10	2.0	2.13	1	1.42	0.095198
HSV07	6.4	0.994	0.111	4	10	1.7	2.11	1	1.33	0.111654
PP01	11.8	0.979	0.204	4	10	0.2	11.13	1	1.70	0.205394
PP02	11.8	0.979	0.204	4	10	0.2	11.15	1	1.70	0.205083
PP02	11.3	0.981	0.196	4	10	0.2	11.55	1	1.76	0.197561
PP03	11.9	0.979	0.206	4	10	0.4	5.51	1	1.46	0.207534
PP04	17.4	0.954	0.298	4	10	0.3	5.20	1	1.11	0.302947
PP05	13.2	0.974	0.228	4	10	0.4	5.00	1	1.32	0.230062
PP06	15.5	0.964	0.266	4	10	0.3	5.77	1	1.23	0.2697
PP07	14.8	0.967	0.256	4	10	0.5	3.60	1	1.12	0.2586
PP08	10.8	0.982	0.187	4	10	0.4	6.05	1	1.60	0.18822
PP09	13.3	0.973	0.230	4	10	0.3	6.62	1	1.41	0.232014
PP10	13.2	0.974	0.228	4	10	1.4	1.33	1	0.77	0.230239
PP11	14.3	0.969	0.247	4	10	0.9	1.86	1	0.88	0.249392
PP12	12.2	0.977	0.212	4	10	0.9	2.15	1	1.02	0.213386
PP13	10.6	0.983	0.184	4	10	0.18	12.26	1	1.87	0.185528
PP14	14.6	0.968	0.252	4	10	0.54	3.04	1	1.07	0.254478
PP16	10.2	0.984	0.178	4	10	1.17	1.95	1	1.05	0.178839
PP19	12.5	0.976	0.216	4	10	0.72	2.63	1	1.10	0.217664
PP25	14.0	0.970	0.242	4	10	0.63	2.71	1	1.05	0.244168
PP26	13.7	0.972	0.237	4	10	0.72	2.41	1	1.01	0.239187
PP27	10.3	0.984	0.179	4	10	1.17	1.94	1	1.05	0.180252
PP28	9.5	0.986	0.166	4	10	0.9	2.72	1	1.29	0.166438
PP29	8.8	0.988	0.152	4	10	1.26	2.11	1	1.17	0.153023
PP32	12.4	0.977	0.214	4	10	0.27	7.07	1	1.50	0.216145
PP34	8.7	0.989	0.150	4	10	0.63	4.27	1	1.65	0.150972
PP35	8.1	0.990	0.141	4	10	1.62	1.77	1	1.09	0.141533
PP36	8.7	0.989	0.151	4	10	1.17	2.29	1	1.23	0.151701
PP37	8.5	0.989	0.149	4	10	1.35	2.02	1	1.16	0.149192
PP38	6.3	0.994	0.110	4	10	1.35	2.70	1	1.55	0.110655
PP43	5.3	0.996	0.092	4	10	1.35	3.24	1	1.86	0.092037
PP44	4.5	0.997	0.079	4	10	1.98	2.57	1	1.71	0.078934
PP45	6.3	0.994	0.110	4	10	1.35	2.70	1	1.55	0.110659
PP46	6.3	0.994	0.109	4	10	1.08	3.41	1	1.77	0.109564
PP47	4.2	0.997	0.073	4	10	0.81	6.75	1	3.02	0.073435
PP51	4.4	0.997	0.076	4	10	1.17	4.52	1	2.44	0.075931
PP52	4.2	0.997	0.073	4	10	1.8	3.04	1	1.95	0.07337
PP53	4.1	0.997	0.072	4	10	1.98	2.83	1	1.88	0.071672
PP54	5.4	0.996	0.094	4	10	1.8	2.37	1	1.52	0.09431
PP56	5.7	0.995	0.100	4	10	0.9	4.47	1	2.12	0.100024
PP57	4.5	0.997	0.079	4	10	0.99	5.15	1	2.56	0.078835
PP58	4.0	0.998	0.070	4	10	1.8	3.16	1	2.03	0.07054
PP59	3.7	0.998	0.064	4	10	2.25	2.78	1	1.93	0.064102
PP60	3.3	0.998	0.058	4	10	2.52	2.75	1	1.97	0.057862
PP62	5.9	0.995	0.103	4	10	1.17	3.34	1	1.80	0.103156
PP63	5.2	0.996	0.090	4	10	1.62	2.75	1	1.70	0.090299
PP64	3.9	0.998	0.068	4	10	1.98	2.98	1	1.98	0.068015
PP65	2.8	0.999	0.048	4	10	2.25	3.70	1	2.56	0.048077
PP67	6.5	0.994	0.114	4	10	2.25	1.57	1	1.09	0.11394
PP68	4.7	0.997	0.082	4	10	1.53	3.21	1	1.94	0.081932
PP69	3.1	0.999	0.053	4	10	1.62	4.64	1	2.87	0.053357
PP70	2.9	0.999	0.050	4	10	1.89	4.26	1	2.79	0.049762
PP71	6.9	0.993	0.121	4	10	1.35	2.47	1	1.42	0.120998
PP72	4.4	0.997	0.076	4	10	1.62	3.26	1	2.02	0.076031
PP73	3.1	0.999	0.055	4	10	1.8	4.07	1	2.62	0.054664
PP74	3.7	0.998	0.065	4	10	2.25	2.74	1	1.90	0.065067
PP76	4.5	0.997	0.078	4	10	0.72	7.17	1	3.00	0.077831
PP77	4.0	0.998	0.070	4	10	0.45	12.82	1	3.98	0.069578
PP78	4.7	0.997	0.082	4	10	1.89	2.58	1	1.69	0.08237
PP79	6.3	0.994	0.109	4	10	1.62	2.27	1	1.40	0.109609
PP80	7.9	0.990	0.138	4	10	1.17	2.50	1	1.35	0.138384
PP81	4.8	0.996	0.084	4	10	1.8	2.65	1	1.70	0.084342
PP82	4.4	0.997	0.076	4	10	2.07	2.54	1	1.71	0.076442
PP83	5.3	0.996	0.092	4	10	1.53	2.84	1	1.72	0.092573
PP85	6.5	0.994	0.113	4	10	1.62	2.20	1	1.36	0.113297
PP86	4.9	0.996	0.086	4	10	1.8	2.59	1	1.67	0.086202
PP87	4.5	0.997	0.078	4	10	2.52	2.03	1	1.46	0.078345
PP89	8.0	0.990	0.139	4	10	1.98	1.47	1	0.97	0.139702
PP90	6.3	0.994	0.110	4	10	1.71	2.15	1	1.35	0.109837
PP91	5.3	0.996	0.092	4	10	1.8	2.43	1	1.56	0.092046
PP94	6.3	0.994	0.110	4	10	1.53	2.38	1	1.44	0.1106
PP95	5.8	0.995	0.100	4	10	2.25	1.78	1	1.23	0.100605
PP98	4.9	0.996	0.086	4	10	1.44	3.24	1	1.91	0.086238
PP99	5.8	0.995	0.101	4	10	1.62	2.45	1	1.51	0.101668
PP100	6.8	0.993	0.119	4	10	1.3	2.68	1	1.50	0.119378
PP103	4.8	0.996	0.084	4	10	1.8	2.65	1	1.70	0.084381
PP104	13.4	0.973	0.232	4	10	0.9	1.97	1	0.93	0.233714
PP110	6.7	0.993	0.117	4	10	1.7	2.01	1	1.27	0.117367
PP111	8.5	0.989	0.148	4	10	1.7	1.60	1	1.01	0.148724
PP114	6.2	0.994	0.108	4	10	2.7	1.37	1	1.00	0.108666
PP115	4.8	0.997	0.083	4	10	2.07	2.34	1	1.58	0.082905
PP116	5.6	0.995	0.097	4	10	1.8	2.29	1	1.47	0.097482
PP117	4.8	0.996	0.084	4	10	1.98	2.42	1	1.61	0.083895
PP118	2.8	0.999	0.049	4	10	1.98	4.11	1	2.73	0.049175
PP120	6.0	0.995	0.104	4	10	1.08	3.59	1	1.86	0.1039
PP121	4.8	0.996	0.084	4	10	1.35	3.52	1	2.02	0.084468
PP127	8.7	0.988	0.151	4	10	2.7	0.99	1	0.72	0.151809
PP130	3.9	0.998	0.069	4	10	2.16	2.70	1	1.85	0.068702
PP131	4.6	0.997	0.080	4	10	2.52	2.00	1	1.43	0.079731
PP132	5.1	0.996	0.088	4	10	2.25	2.02	1	1.40	0.088594
PP133	5.5	0.995	0.096	4	10	2.7	1.55	1	1.13	0.096389
PP134	3.1	0.999	0.054	4	10	2.25	3.30	1	2.29	0.053895
PP135	3.6	0.998	0.062	4	10	2.7	2.38	1	1.74	0.062472
PP136	3.9	0.998	0.068	4	10	2.52	2.34	1	1.68	0.06803
PP145	5.2	0.996	0.091	4	10	2.25	1.97	1	1.36	0.090841
PP146	4.0	0.998	0.070	4	10	1.62	3.55	1	2.20	0.069683
PP147	3.9	0.998	0.068	4	10	1.8	3.26	1	2.10	0.06837
PP148	5.0	0.996	0.086	4	10	1.71	2.72	1	1.72	0.086459
PP150	6.0	0.994	0.105	4	10	2.25	1.70	1	1.18	0.105291
PP151	3.9	0.998	0.068	4	10	1.98	2.97	1	1.97	0.068278
PP152	4.6	0.997	0.080	4	10	2.7	1.85	1	1.35	0.080537
PP161	3.6	0.998	0.063	4	10	2.61	2.44	1	1.77	0.062898
PP162	3.0	0.999	0.052	4	10	1.98	3.91	1	2.60	0.051796
PP192	9.4	0.987	0.162	4	10	3.15	0.79	1	0.60	0.1632
PP200	12.4	0.977	0.215	4	10	0.54	3.53	1	1.24	0.216417
PP201	12.4	0.976	0.216	4	10	0.45	4.22	1	1.31	0.217245
PP208	7.9	0.990	0.138	4	10	1.26	2.33	1	1.30	0.138083
PP209	8.3	0.989	0.145	4	10	1.17	2.38	1	1.28	0.145596

Undrained conditions

$$F = \frac{c_u}{\gamma z \sin\alpha \cos\alpha}$$

Where,

F = Factor of Safety
c_u = Undrained strength
γ = Bulk unit weight of material
z = Depth to failure plane assumed as depth of peat
α = Slope angle

Table M- 2: Factor of Safety for Drained Conditions for GI Locations Within the Proposed Offsetting Measures Boundary.

Proposed infrastructure	Drained shear strength	Bulk unit weight of Peat	Peat depth	Bulk unit weight of water	Height of water table above failure surface	Slope	Cos Slope	Cos^2 Slope	Sin Slope	ϕ'	Tan ϕ'	**FoS**	Surcharge (m)	**FoS Surcharge**
	Cu (kPa)	Y (kN/m^3)	(m)	Y (kN/m^3)	(m)	(º)								
HSV03	4	10	1.6	9.8	1.62	6.1	0.994	0.989	0.107	25	0.466	2.42	1	3.15
HSV05	4	10	1.8	9.8	1.80	6.9	0.993	0.986	0.120	25	0.466	1.95	1	2.63
HSV06	4	10	2.0	9.8	1.98	5.5	0.995	0.991	0.095	25	0.466	2.23	1	3.12
HSV07	4	10	1.7	9.8	1.71	6.4	0.994	0.988	0.111	25	0.466	2.20	1	2.92
PP01	4	10	0.2	9.8	0.18	11.8	0.979	0.958	0.204	16	0.287	11.16	1	2.87
PP02	4	10	0.2	9.8	0.18	11.8	0.979	0.959	0.204	25	0.466	11.19	1	3.61
PP02	4	10	0.2	9.8	0.18	11.3	0.981	0.961	0.196	13	0.231	11.57	1	2.74
PP03	4	10	0.4	9.8	0.36	11.9	0.979	0.958	0.206	24	0.445	5.55	1	3.02
PP04	4	10	0.27	9.8	0.27	17.4	0.954	0.911	0.298	25	0.466	5.23	1	2.29
PP05	4	10	0.36	9.8	0.36	13.2	0.974	0.948	0.228	25	0.466	5.04	1	2.80
PP06	4	10	0.27	9.8	0.27	15.5	0.964	0.929	0.266	25	0.466	5.80	1	2.56
PP07	4	10	0.45	9.8	0.45	14.8	0.967	0.935	0.256	25	0.466	3.63	1	2.34
PP08	4	10	0.36	9.8	0.36	10.8	0.982	0.965	0.187	25	0.466	6.09	1	3.41
PP09	4	10	0.27	9.8	0.27	13.3	0.973	0.947	0.230	25	0.466	6.66	1	2.97
PP10	4	10	1.35	9.8	1.35	13.2	0.974	0.948	0.228	25	0.466	1.37	1	1.64
PP11	4	10	0.90	9.8	0.90	14.3	0.969	0.939	0.247	25	0.466	1.89	1	1.86
PP12	4	10	0.90	9.8	0.90	12.2	0.977	0.955	0.212	25	0.466	2.19	1	2.17
PP13	4	10	0.18	9.8	0.18	10.6	0.983	0.966	0.184	25	0.466	12.31	1	3.98
PP14	4	10	0.54	9.8	0.54	14.6	0.968	0.937	0.252	25	0.466	3.08	1	2.24
PP16	4	10	1.17	9.8	1.17	10.2	0.984	0.968	0.178	25	0.466	2.00	1	2.27
PP19	4	10	0.72	9.8	0.72	12.5	0.976	0.953	0.216	25	0.466	2.68	1	2.35
PP25	4	10	0.63	9.8	0.63	14.0	0.970	0.942	0.242	25	0.466	2.74	1	2.21
PP26	4	10	0.72	9.8	0.72	13.7	0.972	0.944	0.237	25	0.466	2.45	1	2.14
PP27	4	10	1.17	9.8	1.17	10.3	0.984	0.968	0.179	25	0.466	1.99	1	2.25
PP28	4	10	0.90	9.8	0.90	9.5	0.986	0.973	0.166	25	0.466	2.78	1	2.78
PP29	4	10	1.26	9.8	1.26	8.8	0.988	0.977	0.152	25	0.466	2.17	1	2.55
PP32	4	10	0.27	9.8	0.27	12.4	0.977	0.954	0.214	25	0.466	7.11	1	3.18
PP34	4	10	0.63	9.8	0.63	8.7	0.989	0.977	0.150	25	0.466	4.33	1	3.55
PP35	4	10	1.62	9.8	1.62	8.1	0.990	0.980	0.141	25	0.466	1.83	1	2.38
PP36	4	10	1.17	9.8	1.17	8.7	0.989	0.977	0.151	25	0.466	2.35	1	2.67
PP37	4	10	1.35	9.8	1.35	8.5	0.989	0.978	0.149	25	0.466	2.08	1	2.51
PP38	4	10	1.35	9.8	1.35	6.3	0.994	0.988	0.110	25	0.466	2.78	1	3.38
PP43	4	10	1.35	9.8	1.35	5.3	0.996	0.992	0.092	25	0.466	3.34	1	4.07
PP44	4	10	1.98	9.8	1.98	4.5	0.997	0.994	0.079	25	0.466	2.69	1	3.76
PP45	4	10	1.35	9.8	1.35	6.3	0.994	0.988	0.110	25	0.466	2.78	1	3.38
PP46	4	10	1.08	9.8	1.08	6.3	0.994	0.988	0.109	25	0.466	3.49	1	3.85
PP47	4	10	0.81	9.8	0.81	4.2	0.997	0.995	0.073	25	0.466	6.88	1	6.58
PP51	4	10	1.17	9.8	1.17	4.4	0.997	0.994	0.076	25	0.466	4.64	1	5.33
PP52	4	10	1.80	9.8	1.80	4.2	0.997	0.995	0.073	25	0.466	3.17	1	4.30
PP53	4	10	1.98	9.8	1.98	4.1	0.997	0.995	0.072	25	0.466	2.96	1	4.15
PP54	4	10	1.80	9.8	1.80	5.4	0.996	0.991	0.094	25	0.466	2.47	1	3.35
PP56	4	10	0.90	9.8	0.90	5.7	0.995	0.990	0.100	25	0.466	4.57	1	4.61
PP57	4	10	0.99	9.8	0.99	4.5	0.997	0.994	0.079	25	0.466	5.26	1	5.59
PP58	4	10	1.80	9.8	1.80	4.0	0.998	0.995	0.070	25	0.466	3.29	1	4.47
PP59	4	10	2.25	9.8	2.25	3.7	0.998	0.996	0.064	25	0.466	2.93	1	4.26
PP60	4	10	2.52	9.8	2.52	3.3	0.998	0.997	0.058	25	0.466	2.91	1	4.37
PP62	4	10	1.17	9.8	1.17	5.9	0.995	0.989	0.103	25	0.466	3.43	1	3.92
PP63	4	10	1.62	9.8	1.62	5.2	0.996	0.992	0.090	25	0.466	2.85	1	3.73
PP64	4	10	1.98	9.8	1.98	3.9	0.998	0.995	0.068	25	0.466	3.12	1	4.37
PP65	4	10	2.25	9.8	2.25	2.8	0.999	0.998	0.048	25	0.466	3.90	1	5.68
PP67	4	10	2.25	9.8	2.25	6.5	0.994	0.987	0.114	25	0.466	1.66	1	2.40
PP68	4	10	1.53	9.8	1.53	4.7	0.997	0.993	0.082	25	0.466	3.32	1	4.25
PP69	4	10	1.62	9.8	1.62	3.1	0.999	0.997	0.053	25	0.466	4.81	1	6.31
PP70	4	10	1.89	9.8	1.89	2.9	0.999	0.998	0.050	25	0.466	4.45	1	6.15
PP71	4	10	1.35	9.8	1.35	6.9	0.993	0.985	0.121	25	0.466	2.55	1	3.10
PP72	4	10	1.62	9.8	1.62	4.4	0.997	0.994	0.076	25	0.466	3.38	1	4.43
PP73	4	10	1.80	9.8	1.80	3.1	0.999	0.997	0.055	25	0.466	4.24	1	5.77
PP74	4	10	2.25	9.8	2.25	3.7	0.998	0.996	0.065	25	0.466	2.88	1	4.20
PP76	4	10	0.72	9.8	0.72	4.5	0.997	0.994	0.078	25	0.466	7.29	1	6.53
PP77	4	10	0.45	9.8	0.45	4.0	0.998	0.995	0.070	25	0.466	12.95	1	8.63
PP78	4	10	1.89	9.8	1.89	4.7	0.997	0.993	0.082	25	0.466	2.69	1	3.72
PP79	4	10	1.62	9.8	1.62	6.3	0.994	0.988	0.109	25	0.466	2.36	1	3.07
PP80	4	10	1.17	9.8	1.17	7.9	0.990	0.981	0.138	25	0.466	2.57	1	2.93
PP81	4	10	1.80	9.8	1.80	4.8	0.996	0.993	0.084	25	0.466	2.76	1	3.74
PP82	4	10	2.07	9.8	2.07	4.4	0.997	0.994	0.076	25	0.466	2.66	1	3.78
PP83	4	10	1.53	9.8	1.53	5.3	0.996	0.991	0.092	25	0.466	2.94	1	3.76
PP85	4	10	1.62	9.8	1.62	6.5	0.994	0.987	0.113	25	0.466	2.28	1	2.97
PP86	4	10	1.80	9.8	1.80	4.9	0.996	0.993	0.086	25	0.466	2.70	1	3.66
PP87	4	10	2.52	9.8	2.52	4.5	0.997	0.994	0.078	25	0.466	2.15	1	3.23
PP89	4	10	1.98	9.8	1.98	8.0	0.990	0.981	0.139	25	0.466	1.53	1	2.13
PP90	4	10	1.71	9.8	1.71	6.3	0.994	0.988	0.110	25	0.466	2.23	1	2.97
PP91	4	10	1.80	9.8	1.80	5.3	0.996	0.992	0.092	25	0.466	2.53	1	3.43
PP94	4	10	1.53	9.8	1.53	6.3	0.994	0.988	0.110	25	0.466	2.47	1	3.15
PP95	4	10	2.25	9.8	2.25	5.8	0.995	0.990	0.100	25	0.466	1.87	1	2.72
PP98	4	10	1.44	9.8	1.44	4.9	0.996	0.993	0.086	25	0.466	3.34	1	4.18
PP99	4	10	1.62	9.8	1.62	5.8	0.995	0.990	0.101	25	0.466	2.54	1	3.31
PP100	4	10	1.26	9.8	1.26	6.8	0.993	0.986	0.119	25	0.466	2.76	1	3.26
PP103	4	10	1.80	9.8	1.80	4.8	0.996	0.993	0.084	25	0.466	2.76	1	3.74
PP104	4	10	0.90	9.8	0.90	13.4	0.973	0.946	0.232	25	0.466	2.01	1	1.98
PP110	4	10	1.71	9.8	1.71	6.7	0.993	0.986	0.117	25	0.466	2.09	1	2.78
PP111	4	10	1.71	9.8	1.71	8.5	0.989	0.978	0.148	25	0.466	1.66	1	2.19
PP114	4	10	2.70	9.8	2.70	6.2	0.994	0.988	0.108	25	0.466	1.46	1	2.22
PP115	4	10	2.07	9.8	2.07	4.8	0.997	0.993	0.083	25	0.466	2.45	1	3.48
PP116	4	10	1.80	9.8	1.80	5.6	0.995	0.991	0.097	25	0.466	2.39	1	3.24
PP117	4	10	1.98	9.8	1.98	4.8	0.996	0.993	0.084	25	0.466	2.53	1	3.54
PP118	4	10	1.98	9.8	1.98	2.8	0.999	0.998	0.049	25	0.466	4.30	1	6.04
PP120	4	10	1.08	9.8	1.08	6.0	0.995	0.989	0.104	25	0.466	3.68	1	4.06
PP121	4	10	1.35	9.8	1.35	4.8	0.996	0.993	0.084	25	0.466	3.63	1	4.43
PP127	4	10	2.70	9.8	2.70	8.7	0.988	0.977	0.151	25	0.466	1.05	1	1.59
PP130	4	10	2.16	9.8	2.16	3.9	0.998	0.995	0.069	25	0.466	2.84	1	4.09
PP131	4	10	2.52	9.8	2.52	4.6	0.997	0.994	0.080	25	0.466	2.12	1	3.17
PP132	4	10	2.25	9.8	2.25	5.1	0.996	0.992	0.088	25	0.466	2.12	1	3.08
PP133	4	10	2.70	9.8	2.70	5.5	0.995	0.991	0.096	25	0.466	1.64	1	2.50
PP134	4	10	2.25	9.8	2.25	3.1	0.999	0.997	0.054	25	0.466	3.48	1	5.07
PP135	4	10	2.70	9.8	2.70	3.6	0.998	0.996	0.062	25	0.466	2.53	1	3.86
PP136	4	10	2.52	9.8	2.52	3.9	0.998	0.995	0.068	25	0.466	2.48	1	3.72
PP145	4	10	2.25	9.8	2.25	5.2	0.996	0.992	0.091	25	0.466	2.07	1	3.01
PP146	4	10	1.62	9.8	1.62	4.0	0.998	0.995	0.070	25	0.466	3.69	1	4.83
PP147	4	10	1.80	9.8	1.80	3.9	0.998	0.995	0.068	25	0.466	3.40	1	4.62
PP148	4	10	1.71	9.8	1.71	5.0	0.996	0.993	0.086	25	0.466	2.83	1	3.77
PP150	4	10	2.25	9.8	2.25	6.0	0.994	0.989	0.105	25	0.466	1.79	1	2.60
PP151	4	10	1.98	9.8	1.98	3.9	0.998	0.995	0.068	25	0.466	3.10	1	4.35
PP152	4	10	2.70	9.8	2.70	4.6	0.997	0.994	0.080	25	0.466	1.96	1	2.99
PP161	4	10	2.61	9.8	2.61	3.6	0.998	0.996	0.063	25	0.466	2.59	1	3.92
PP162	4	10	1.98	9.8	1.98	3.0	0.999	0.997	0.052	25	0.466	4.09	1	5.73
PP192	4	10	3.15	9.8	3.15	9.4	0.987	0.974	0.162	25	0.466	0.85	1	1.33
PP200	4	10	0.54	9.8	0.54	12.4	0.977	0.954	0.215	25	0.466	3.57	1	2.63
PP201	4	10	0.45	9.8	0.45	12.4	0.976	0.954	0.216	25	0.466	4.27	1	2.78
PP208	4	10	1.26	9.8	1.26	7.9	0.990	0.981	0.138	25	0.466	2.40	1	2.82
PP209	4	10	1.17	9.8	1.17	8.3	0.989	0.979	0.145	25	0.466	2.45	1	2.78

Drained conditions

$$F = \frac{c' + (\gamma z - \gamma_w h_w)\cos^2 \alpha \tan \phi'}{\gamma z \sin \alpha \cos \alpha}$$

Where,

F = Factor of Safety
c' = Effective cohesion
γ = Bulk unit weight of material
z = Depth to failure plane assumed as depth of peat
γ_w = Unit weight of water
h_w = Height of water table above failure plane
α = Slope angle
ϕ' = Effective friction angle

Appendix N PEAT STABILITY RISK ASSESSMENT

N.1 LIKELIHOOD SCORE

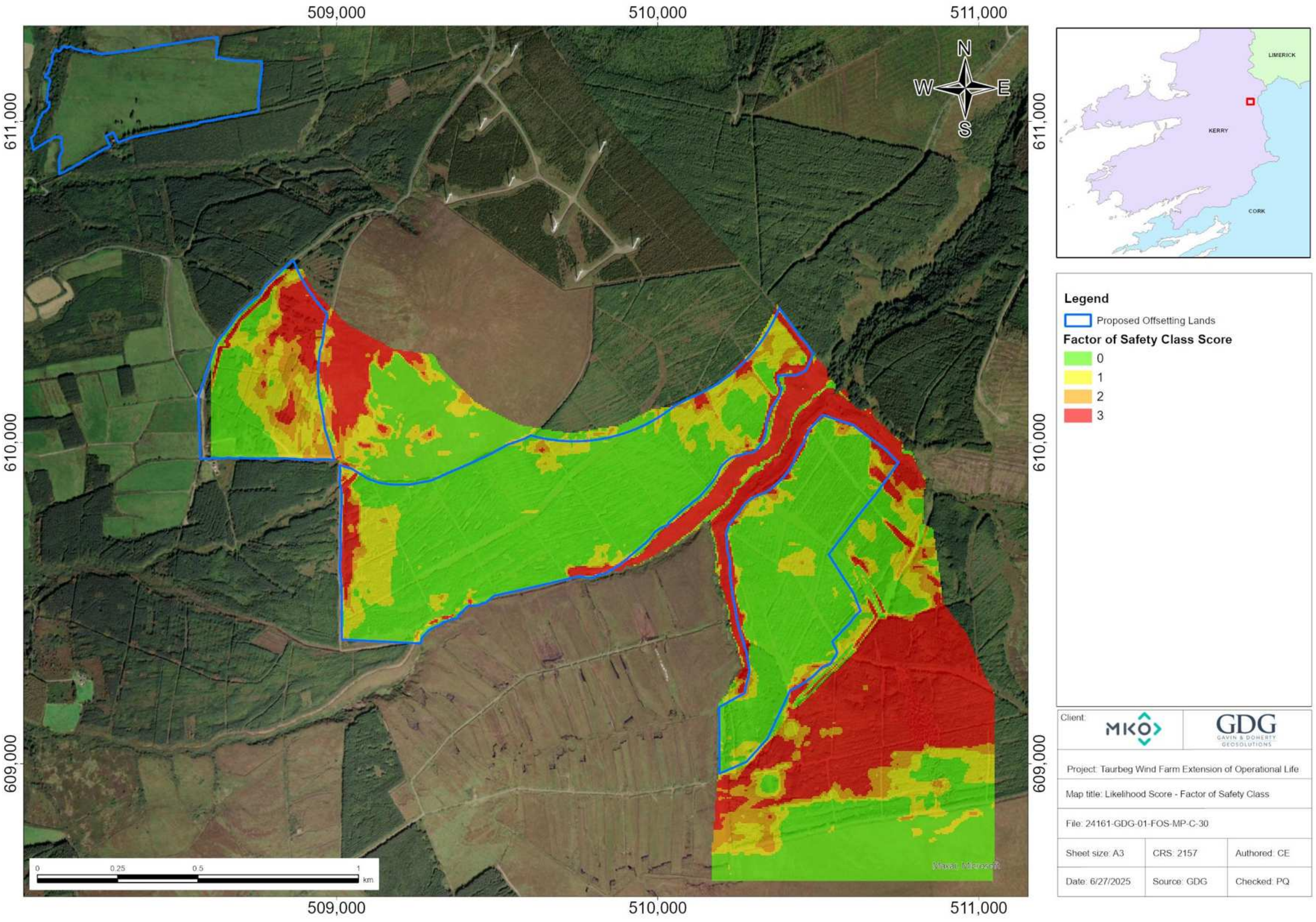


Figure N- 1: Peat Landslide Likelihood Score – Factor of Safety Class.

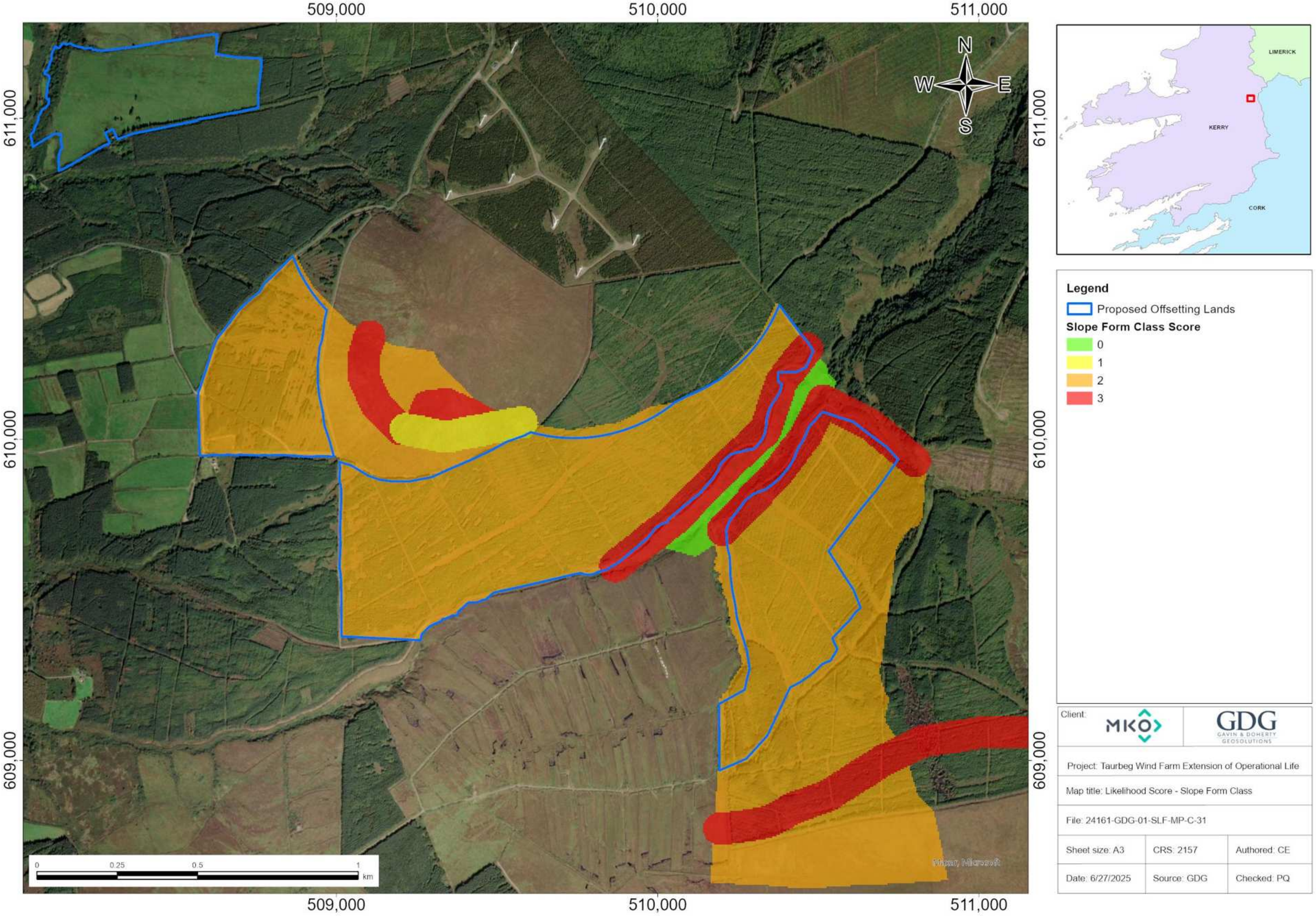


Figure N- 2: Peat Landslide Likelihood Score – Slope Form Class.

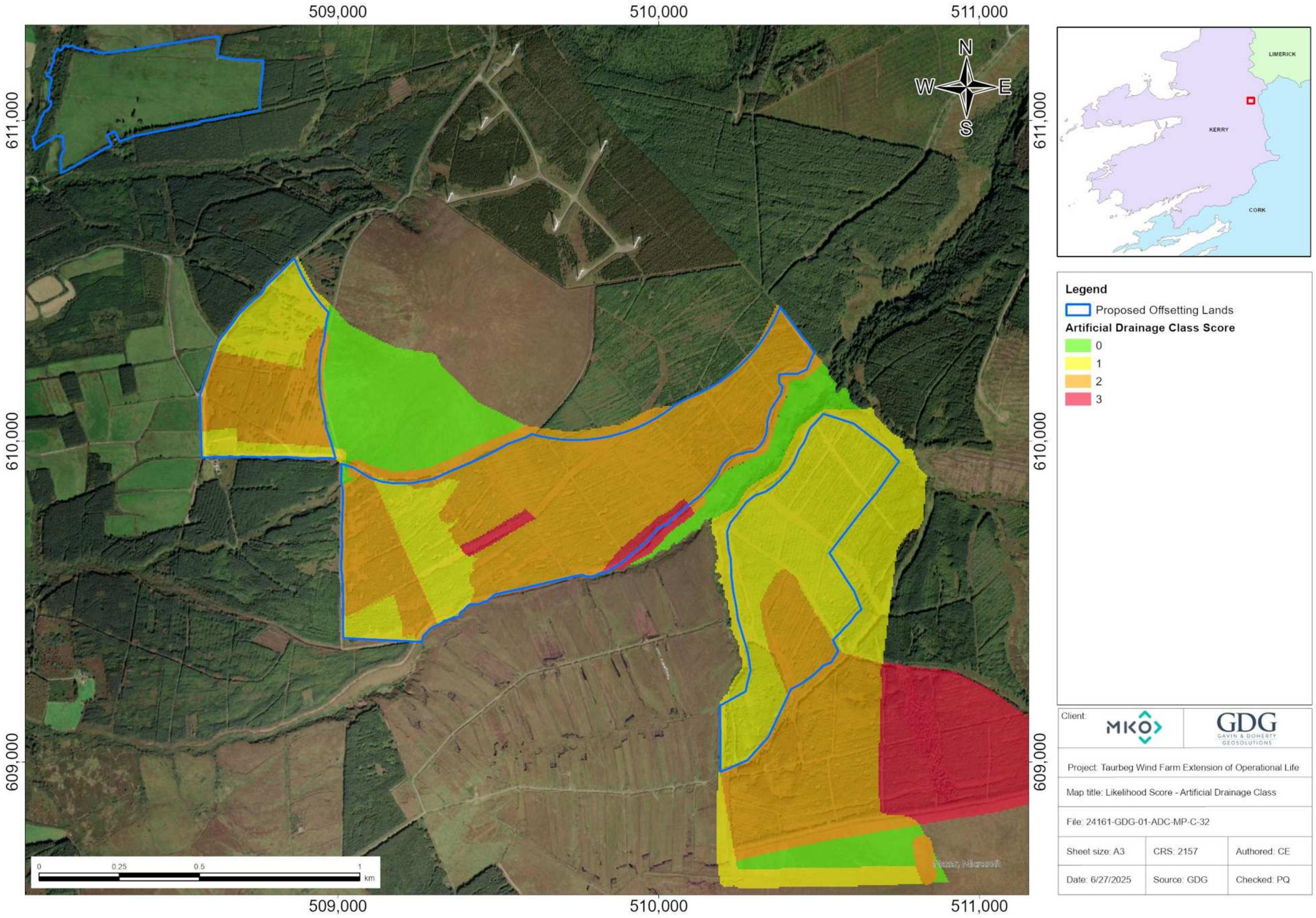
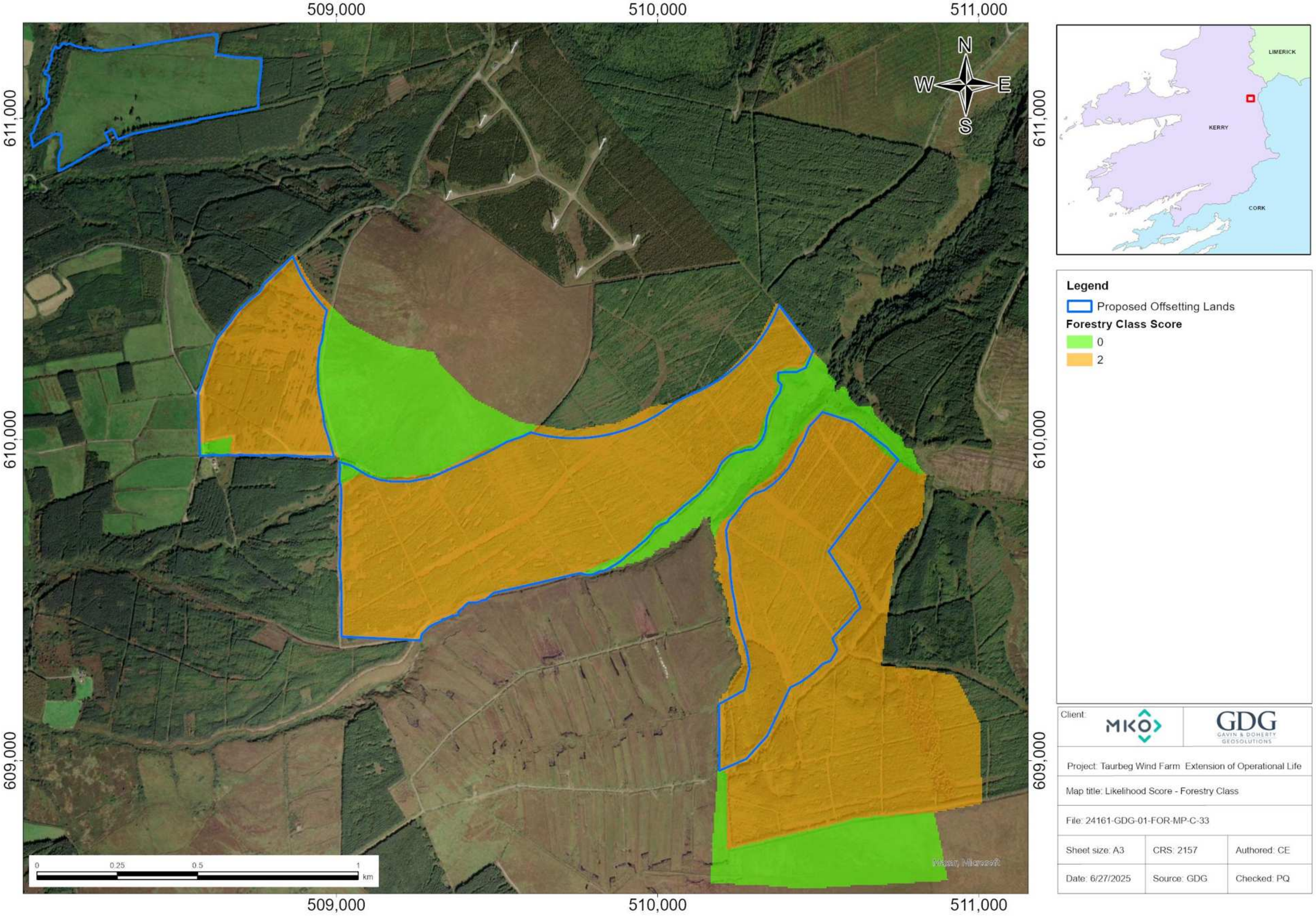


Figure N- 3: Peat Landslide Likelihood Score – Artificial Drainage Class.



Client:

Project: Taurbeg Wind Farm Extension of Operational Life

Map title: Likelihood Score - Forestry Class

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Date: 6/27/2025	Source: GDG	Checked: PQ

Figure N- 4: Peat Landslide Likelihood Score – Forestry Class.

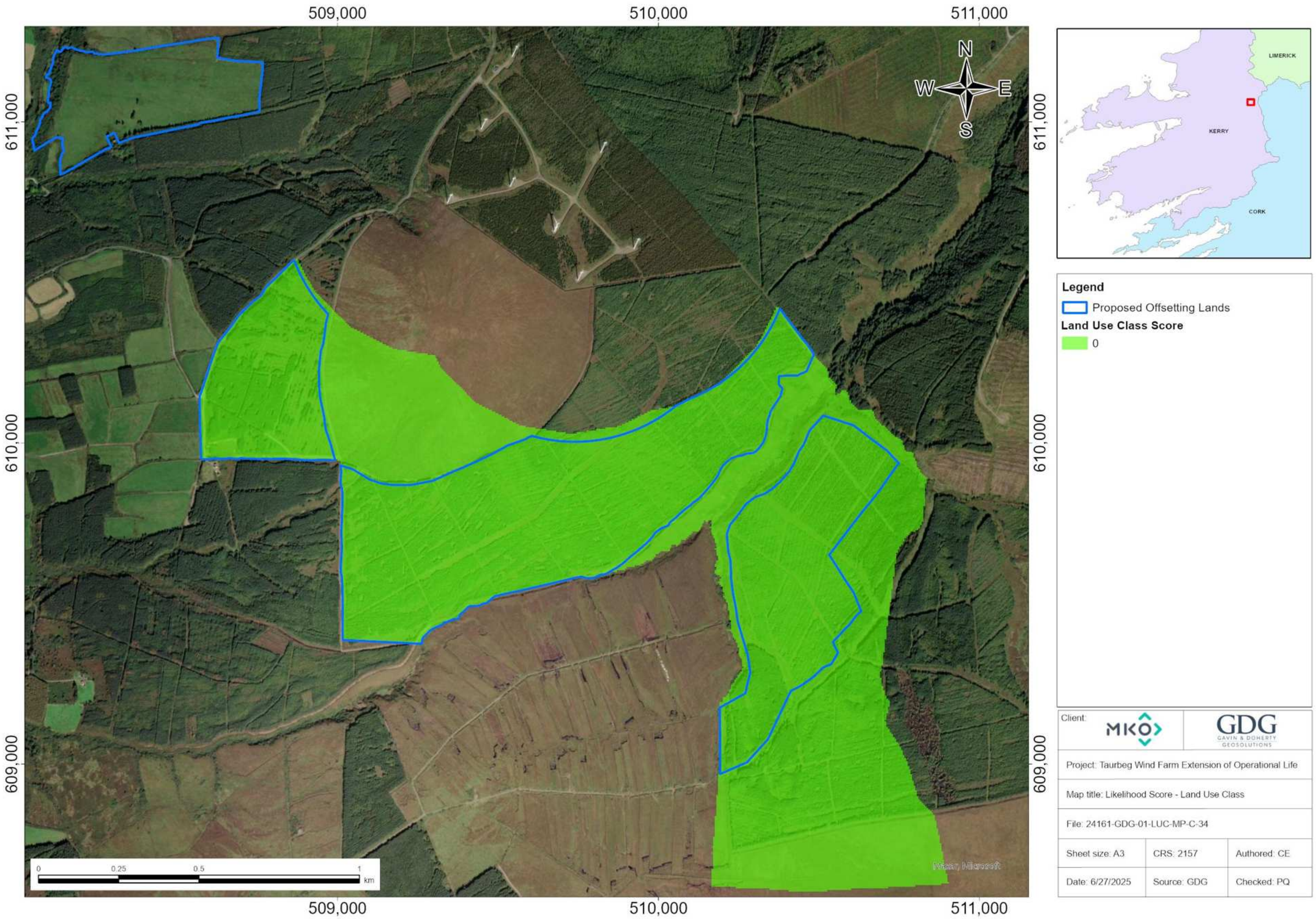

Figure N- 5: Peat Landslide Likelihood Score – Land Use Class.

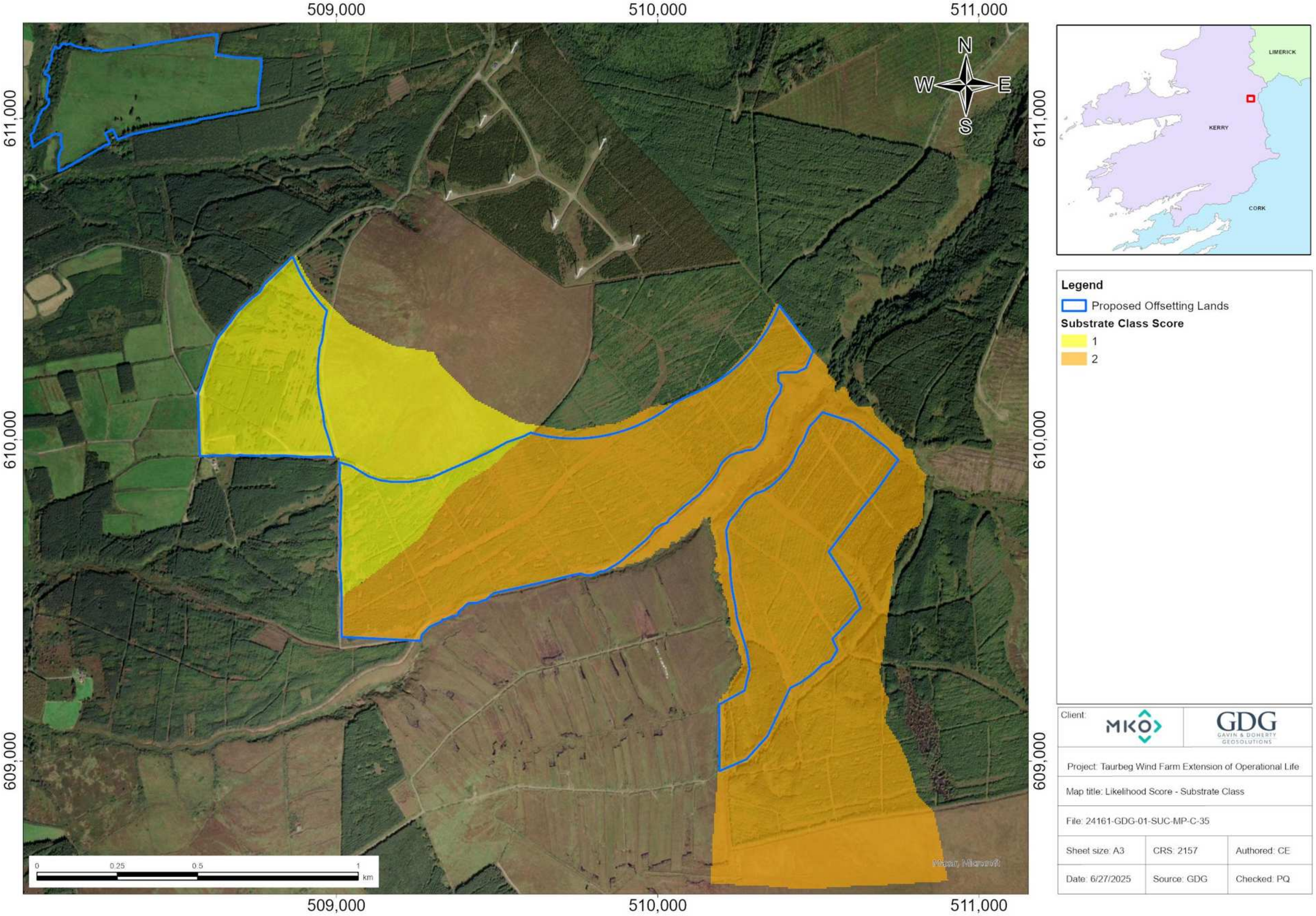

Figure N- 6: Peat Landslide Likelihood Score – Substrate Class.

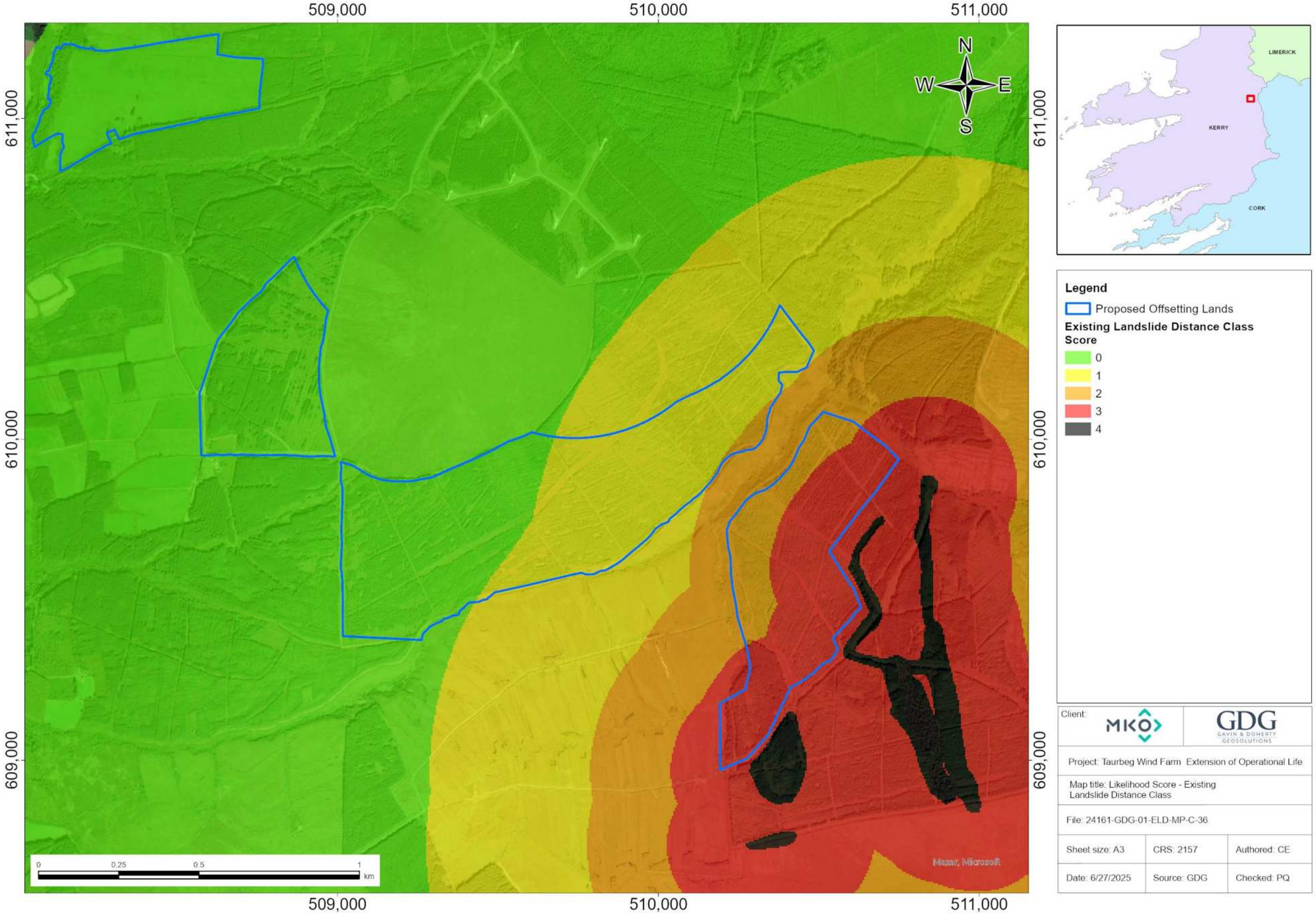

Figure N- 7: Peat Landslide Likelihood Score – Existing Landslide Distance Class

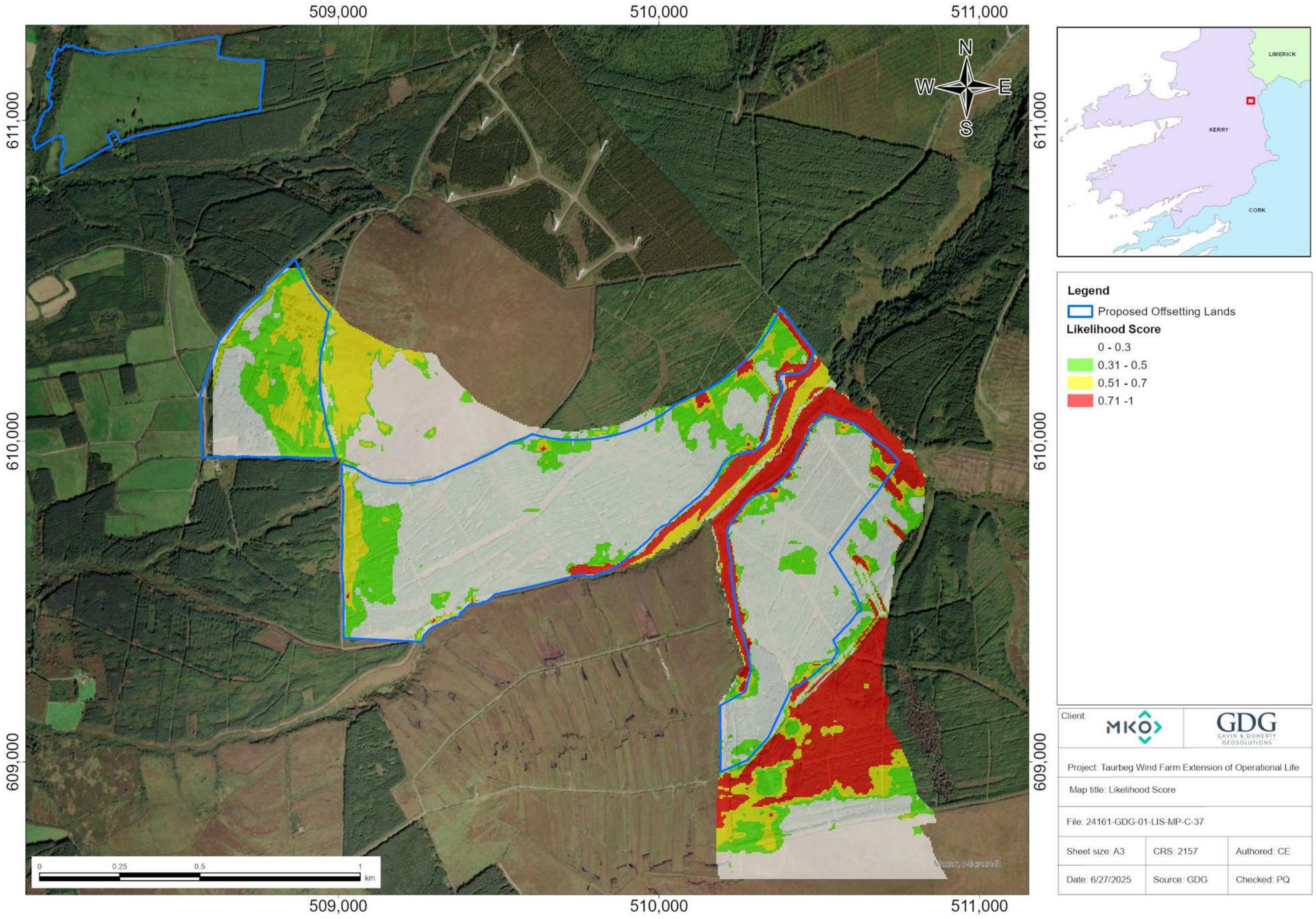

Figure N- 8: Peat Landslide Likelihood Score.

N.2 CONSEQUENCE SCORE

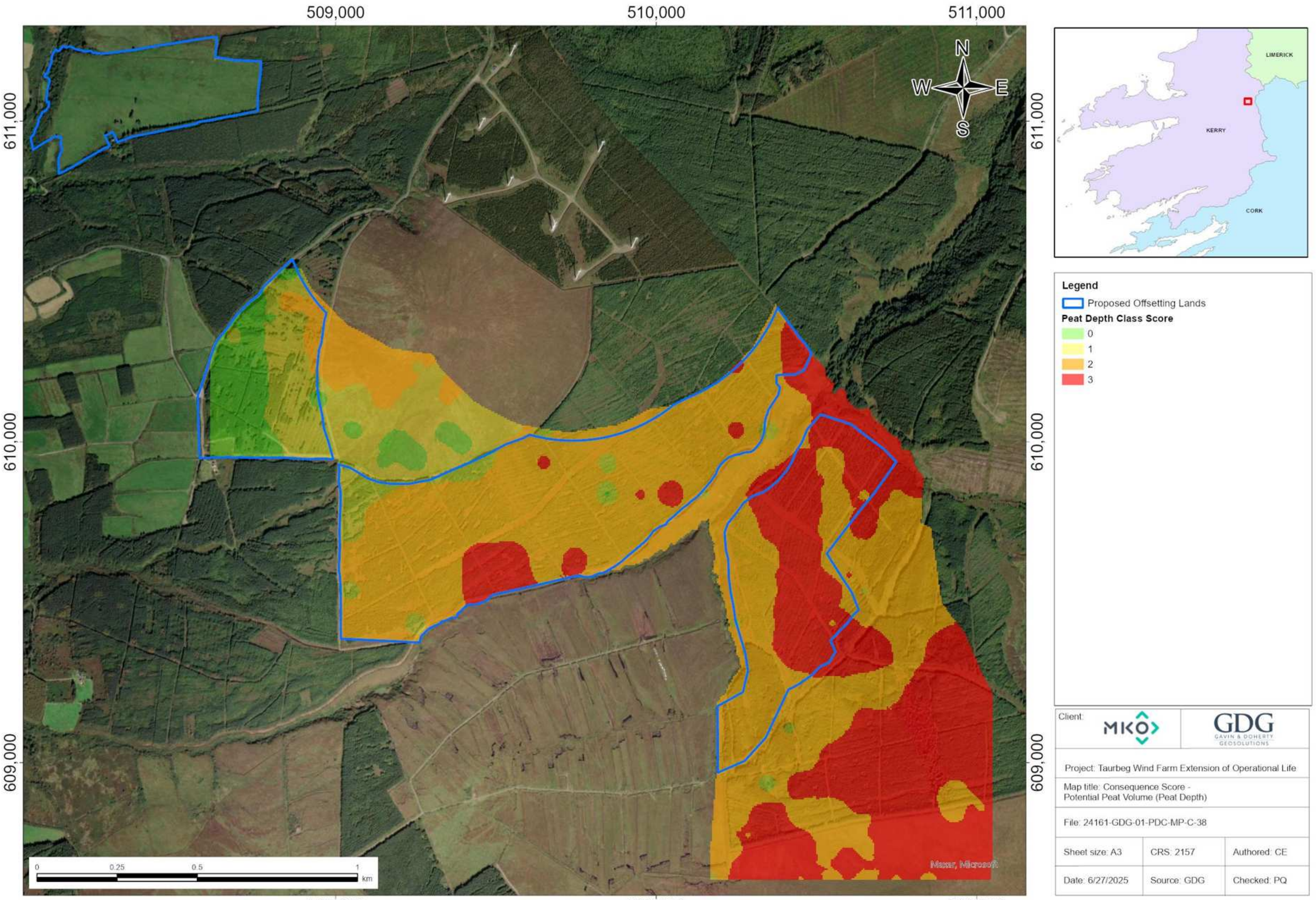

Figure N- 9: Peat Landslide Adverse Consequence Score – Potential Peat Volume (Peat Depth) Class.

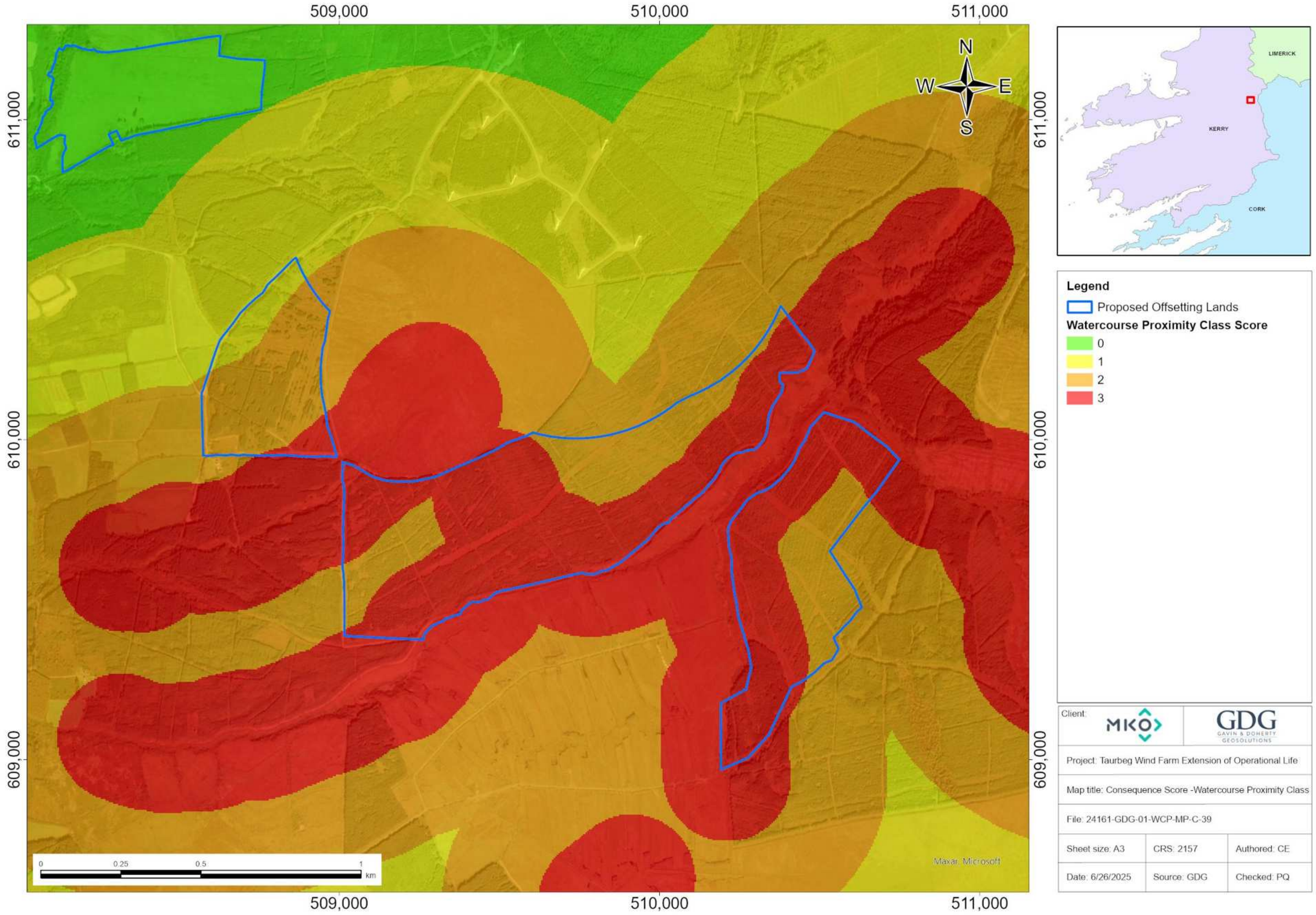

Figure N- 10: Peat Landslide Adverse Consequence Score – Watercourse Proximity Class.

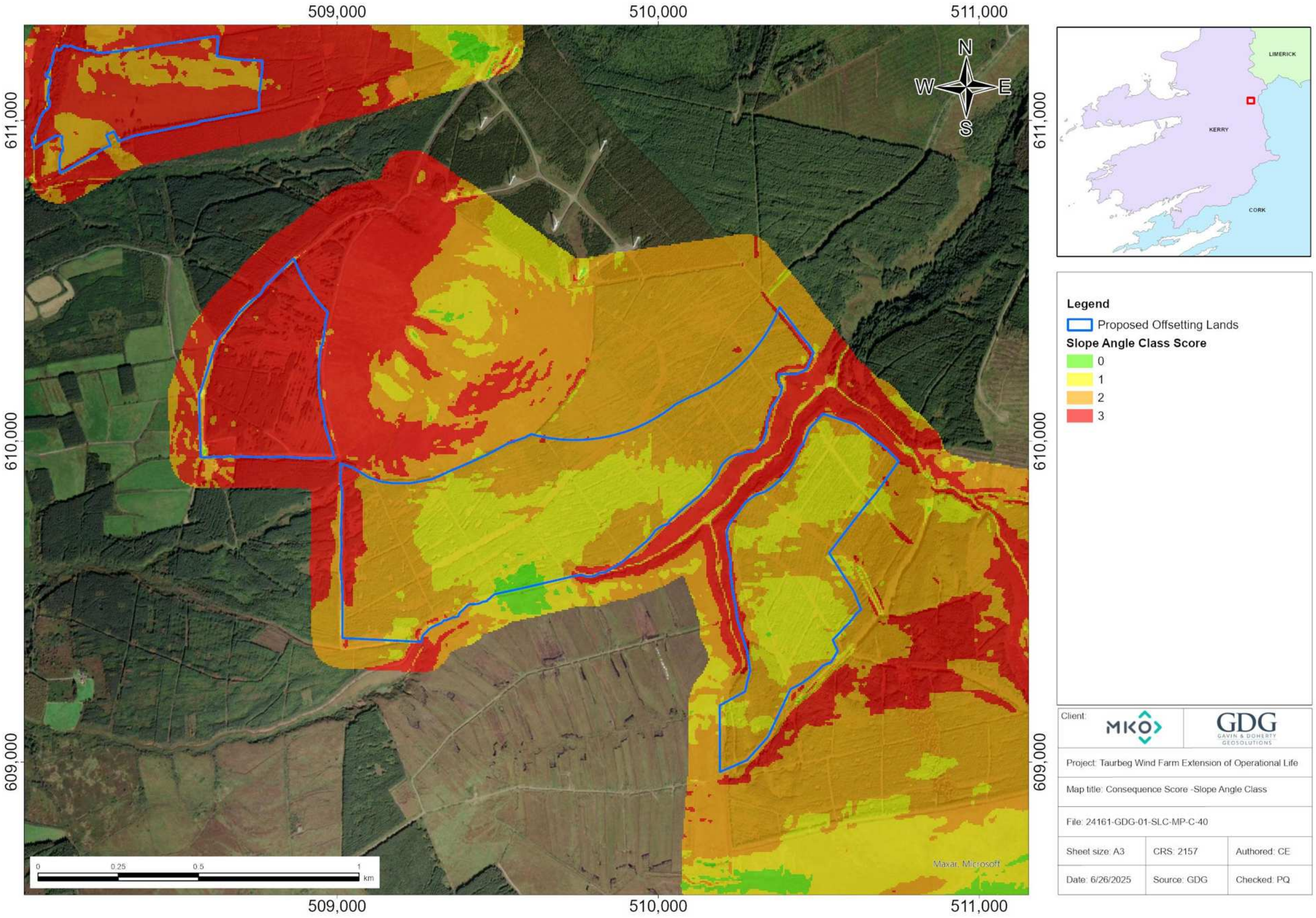

Figure N- 11: Peat Landslide Adverse Consequence Score – Slope Angle Class.

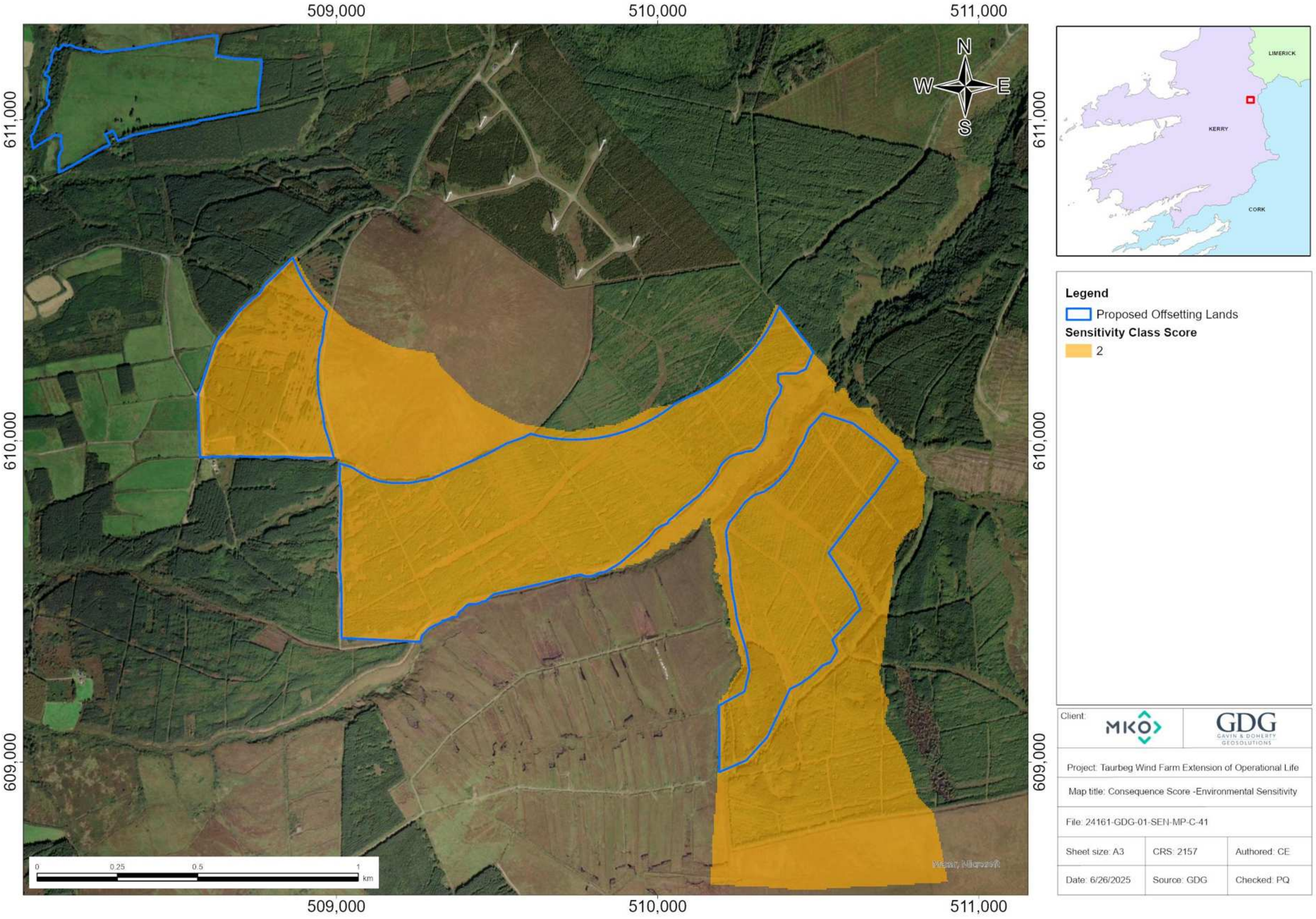

Figure N- 12: Peat Landslide Adverse Consequence Score – Environmental Sensitivity Class.

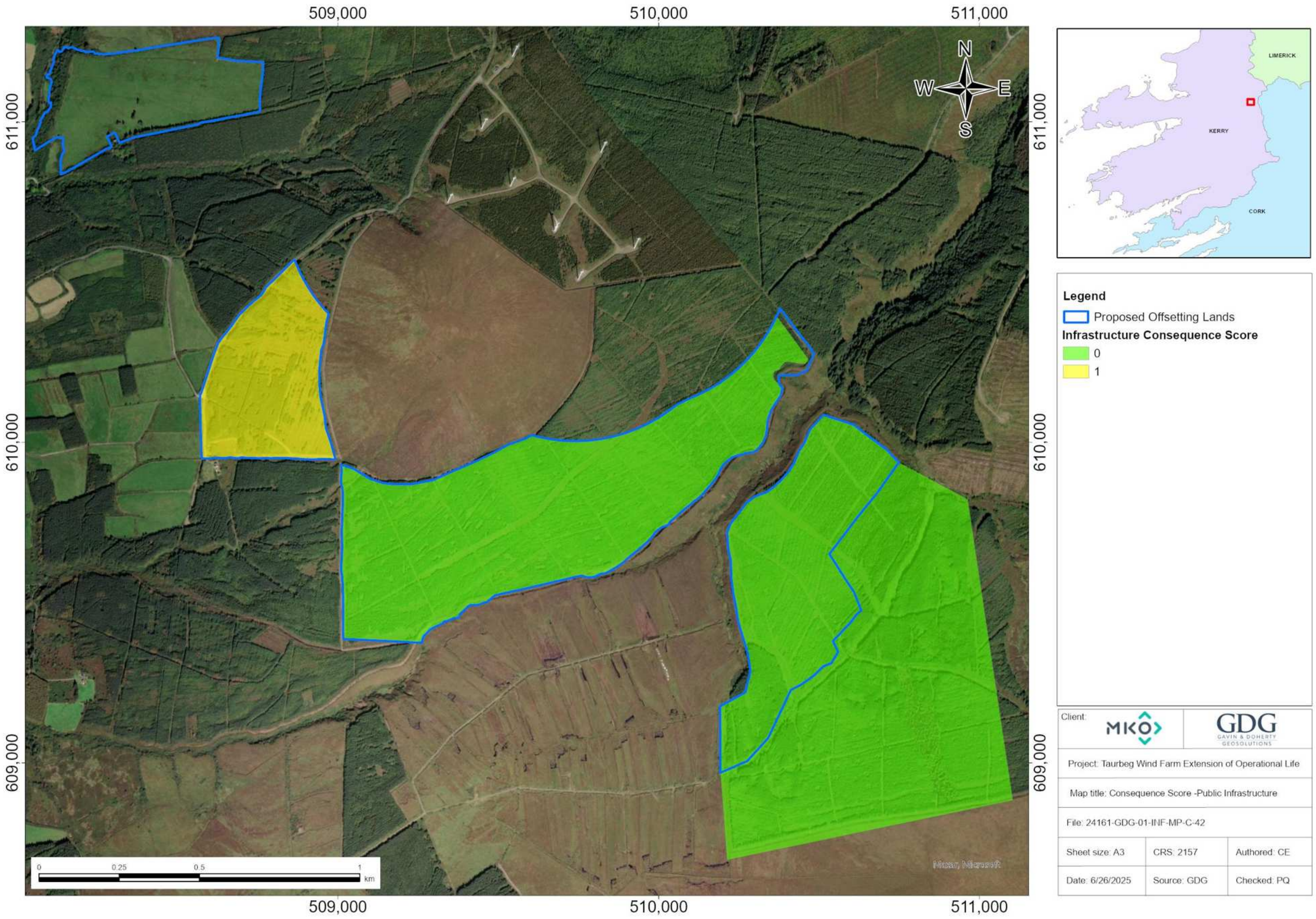

Figure N- 13: Peat Landslide Adverse Consequence Score – Public Infrastructure Class.

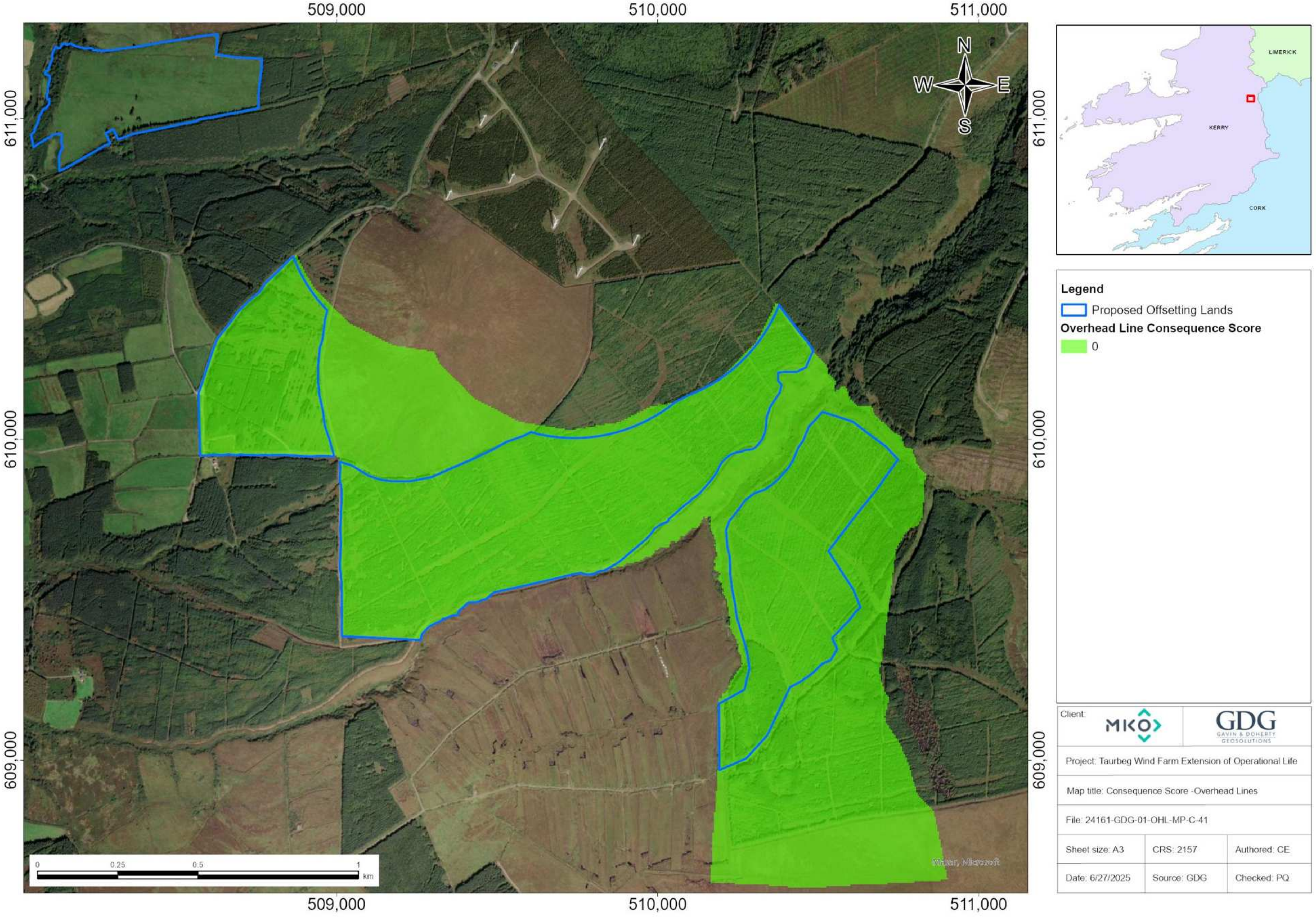

Figure N- 14: Peat Landslide Adverse Consequence Score – Overhead Line Class.

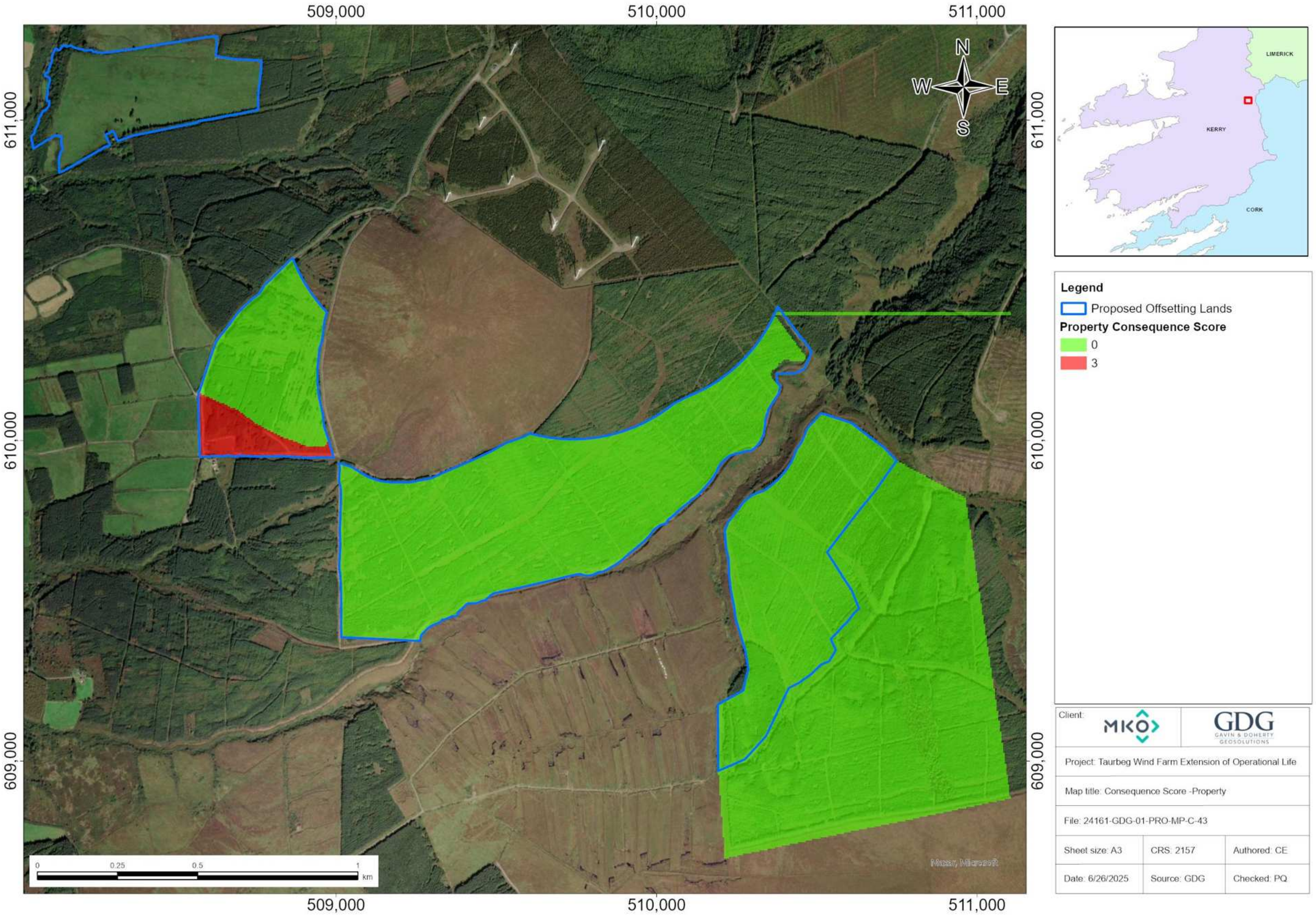

Figure N- 15: Peat Landslide Adverse Consequence Score – Buildings/Property Class.

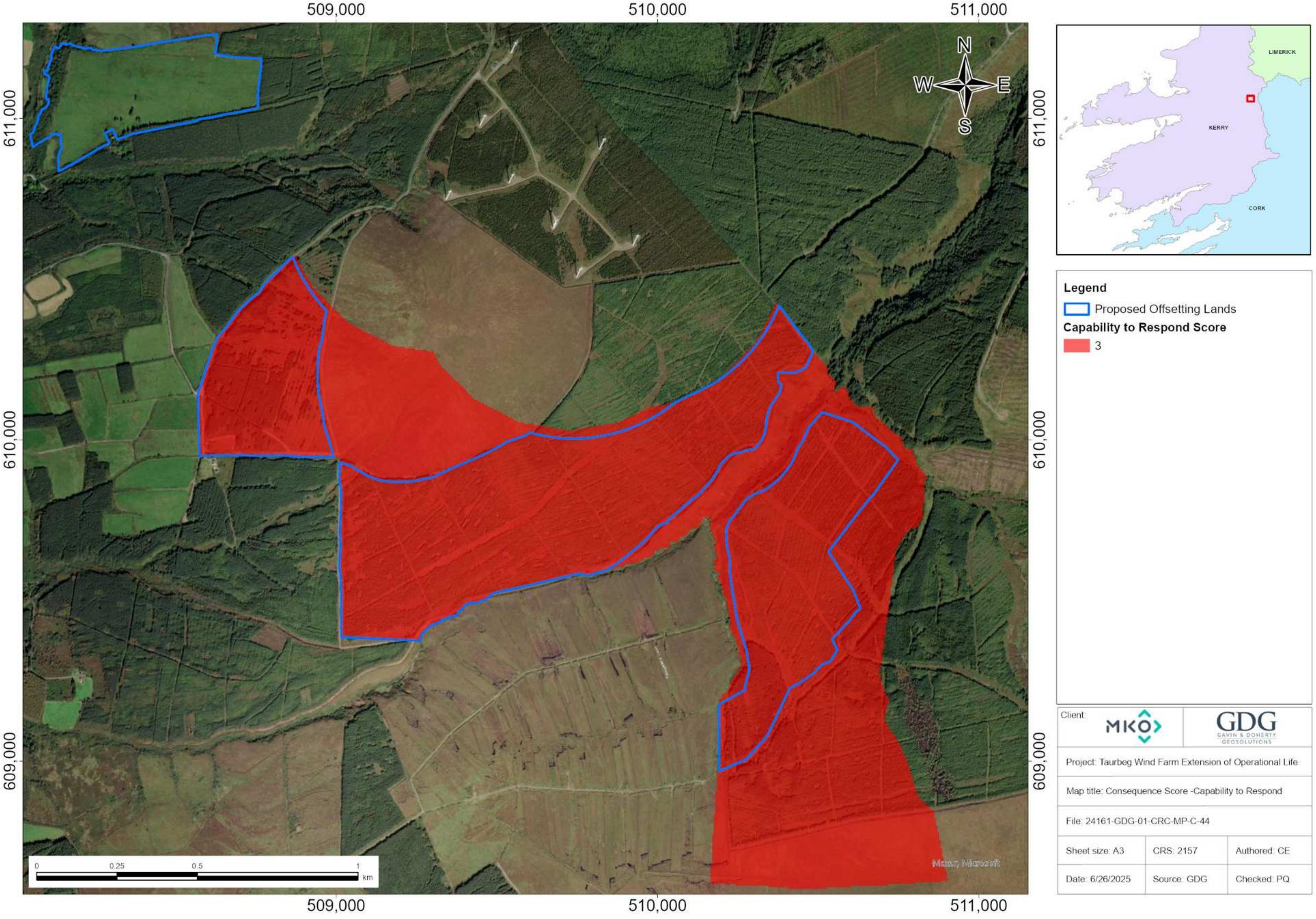

Figure N- 16 Peat Landslide Adverse Consequence Score – Capability to Respond Class.

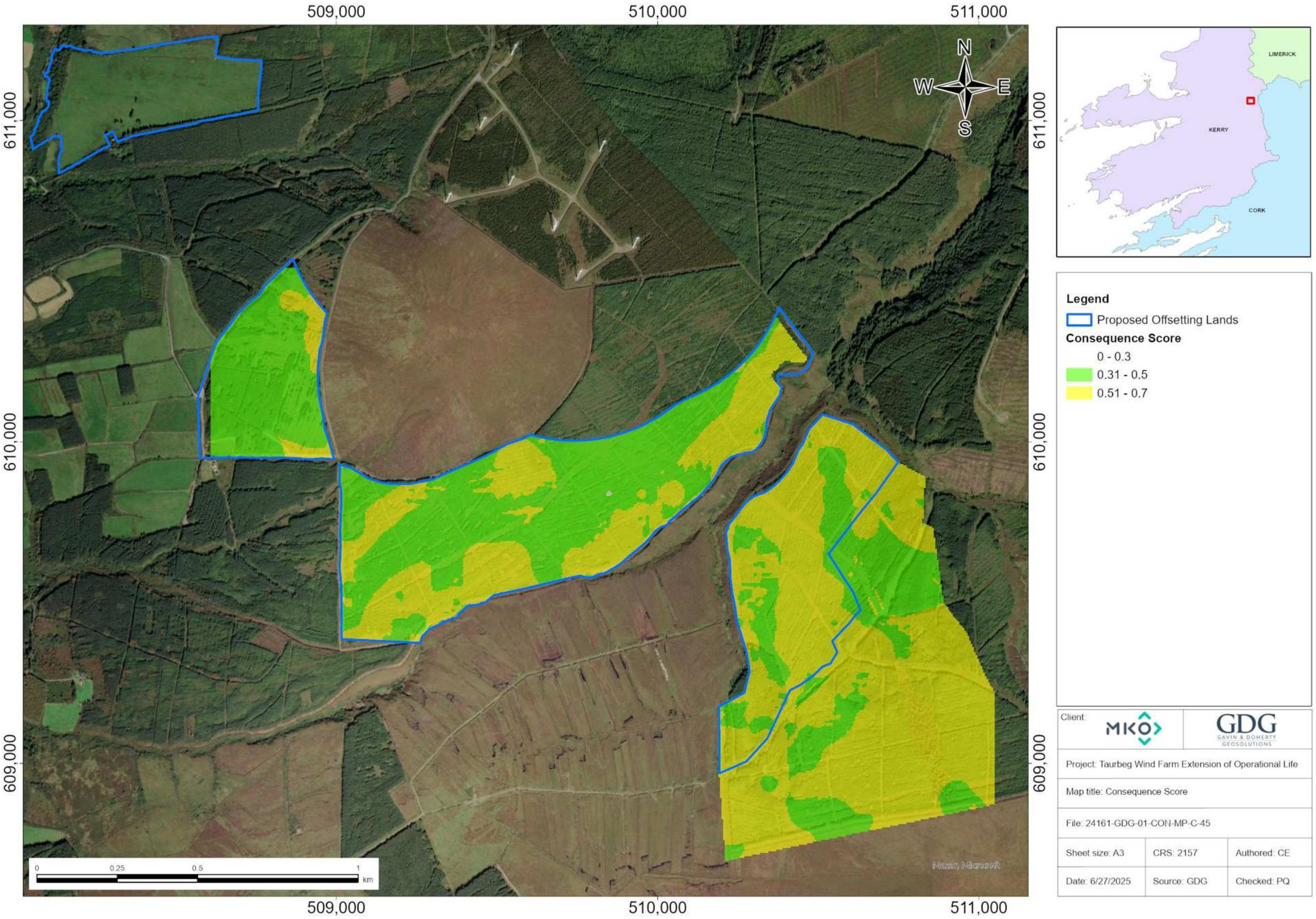

Figure N- 17: Peat Landslide Adverse Consequence Score.

N.3 RISK SCORE

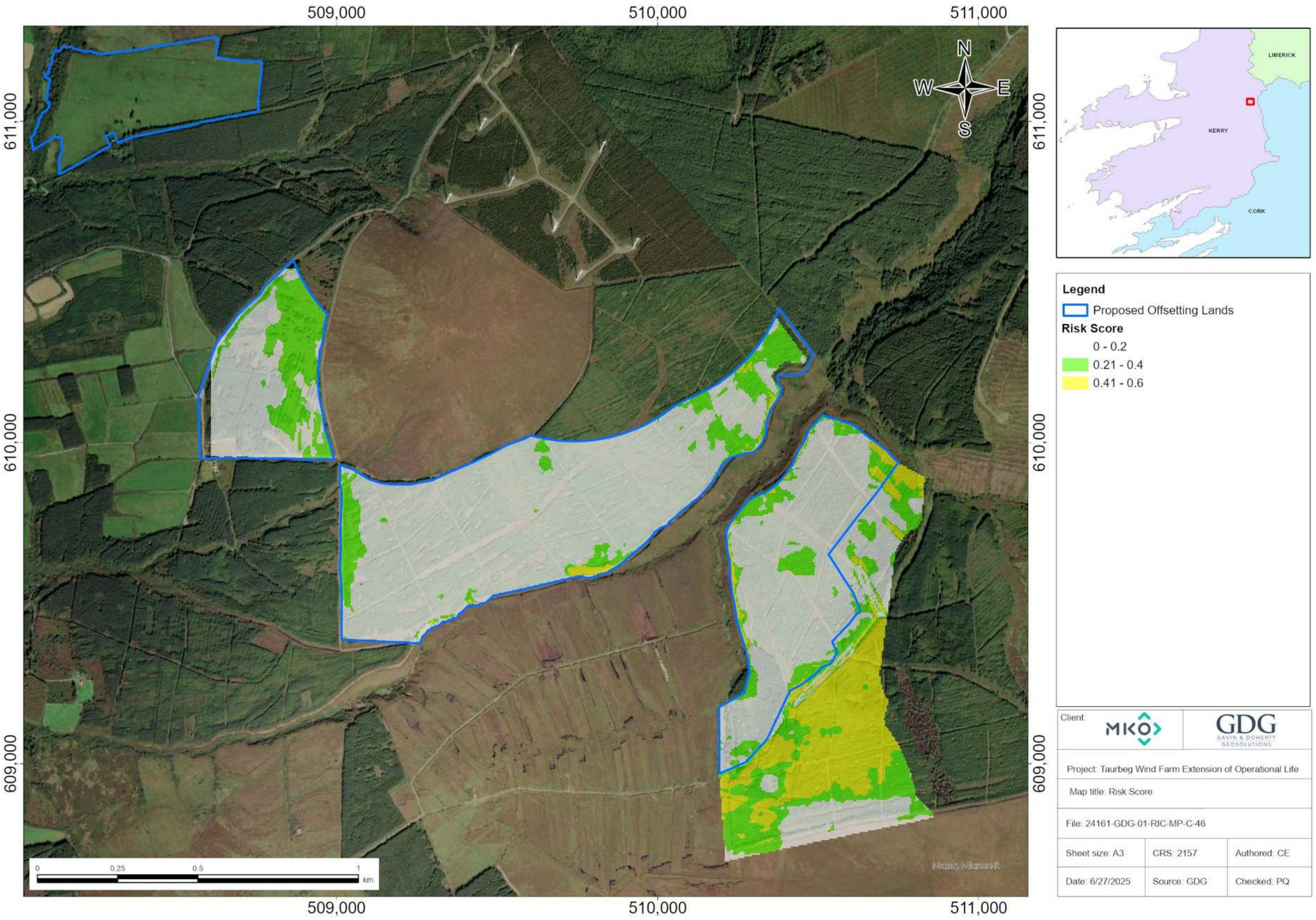

Figure N- 18: Qualitative Risk Score.

Appendix O SAFETY BUFFER AREAS AND FELLED MATERIAL RESTRICTION AREAS

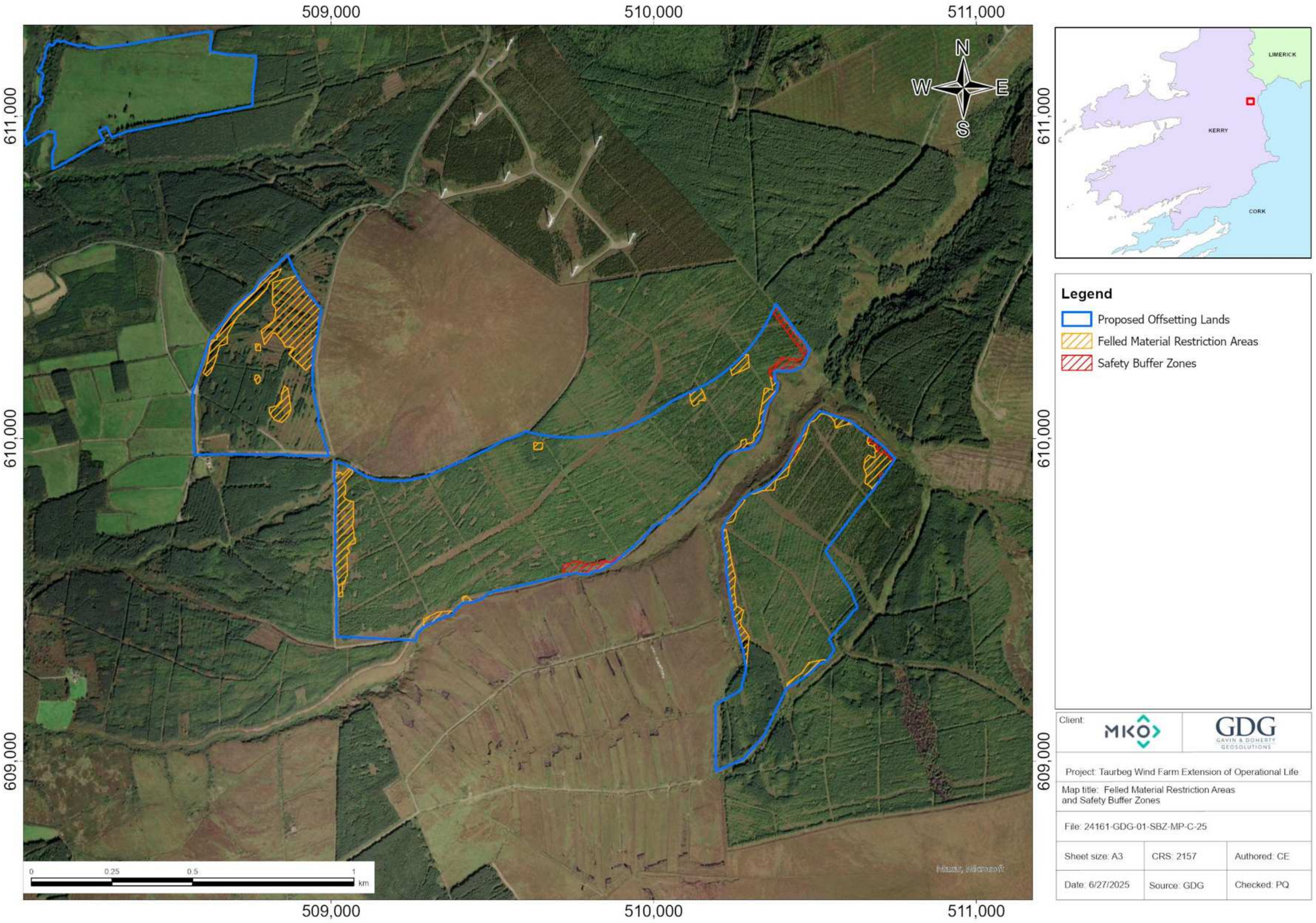

Figure O- 1: Safety Buffer and Felled Material Restriction areas.

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APPENDIX 8-2

Whiteford Geoservices Site Investigation Report

GROUND INVESTIGATION FOR PROPOSED WIND FARM SITE AT TAURBEG, ROCKCHAPEL, CO. CORK

Report No. 386/04

Prepared by

Whiteford *Geoservices Ltd*

on behalf of

RES Group Ltd

16th June 2004

Whiteford *Geoservices Ltd*
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CONTENTS

Appendix

1.0 Purpose and Scope of Works

Introduction

A geotechnical site investigation was requested by Mr Alan McMahon of RES Group Ltd to be carried out at the site of a proposed wind farm near to Rockchapel, Co. Cork, Republic of Ireland.

The purpose of this investigation was to assess the suitability of the ground for the construction of wind turbines on a site extending to approximately 2km^2 at Taurbeg.

Survey Date

The ground investigation took place between Monday 24th May and Friday 4th June 2004. The trial pit, CBR testing and Ground Resistance Tests were executed by the following staff members:-

Alistair Burns	CBR Tests / Ground Resistance Tests
Mark Heggen	CBR Tests / Ground Resistance Tests
John Whiteford	Trial Pit Analysis
John Rickert	Trial Pit Analysis

Generally fair to good weather conditions were experienced throughout the fieldwork period.

Survey Procedure

Renewable Energy Systems proposes to construct 11 wind turbines and 1 electrical sub-station on a site covering 2000m by 2000m.

The purpose of this investigation was as follows:-

- To determine ground conditions prevailing at the location of each proposed sub-station and turbine bases, as well as along proposed access roads, so that the engineer might adequately assess quantities of construction materials required.

This geotechnical investigation consisted of four parts. *These are as follows.*

- A ground investigation comprising of the excavation of 12 trial pits. Trial pits were sited at each planned turbine base and sub-station so that representative ground information could be obtained. Each trial pit was to continue until rock or a suitable bearing stratum had been encountered.
- In-situ CBR testing was to be used to assess soils along the route of proposed access roads. This would then be used to accurately calculate stone thickness for road base construction.
- Ground resistance tests were used to determine grounding parameters at the site of all turbines and the sub station.
- Additional ground investigation was carried out at the site of turbine bases where the trial pits carried out had not located rock.

2.0 Environmental Site Setting

Site Location

The site is located approximately 1 mile from Rockchapel, near Newmarket, Co. Cork and is approached by the minor road. Unmettled roads then provide access onto the proposed wind farm development.

(Refer to map below and location plan in appendix for site location details)

The proposed wind farm site is currently classified as peat bog, the lower reaches of which are grazed by sheep.

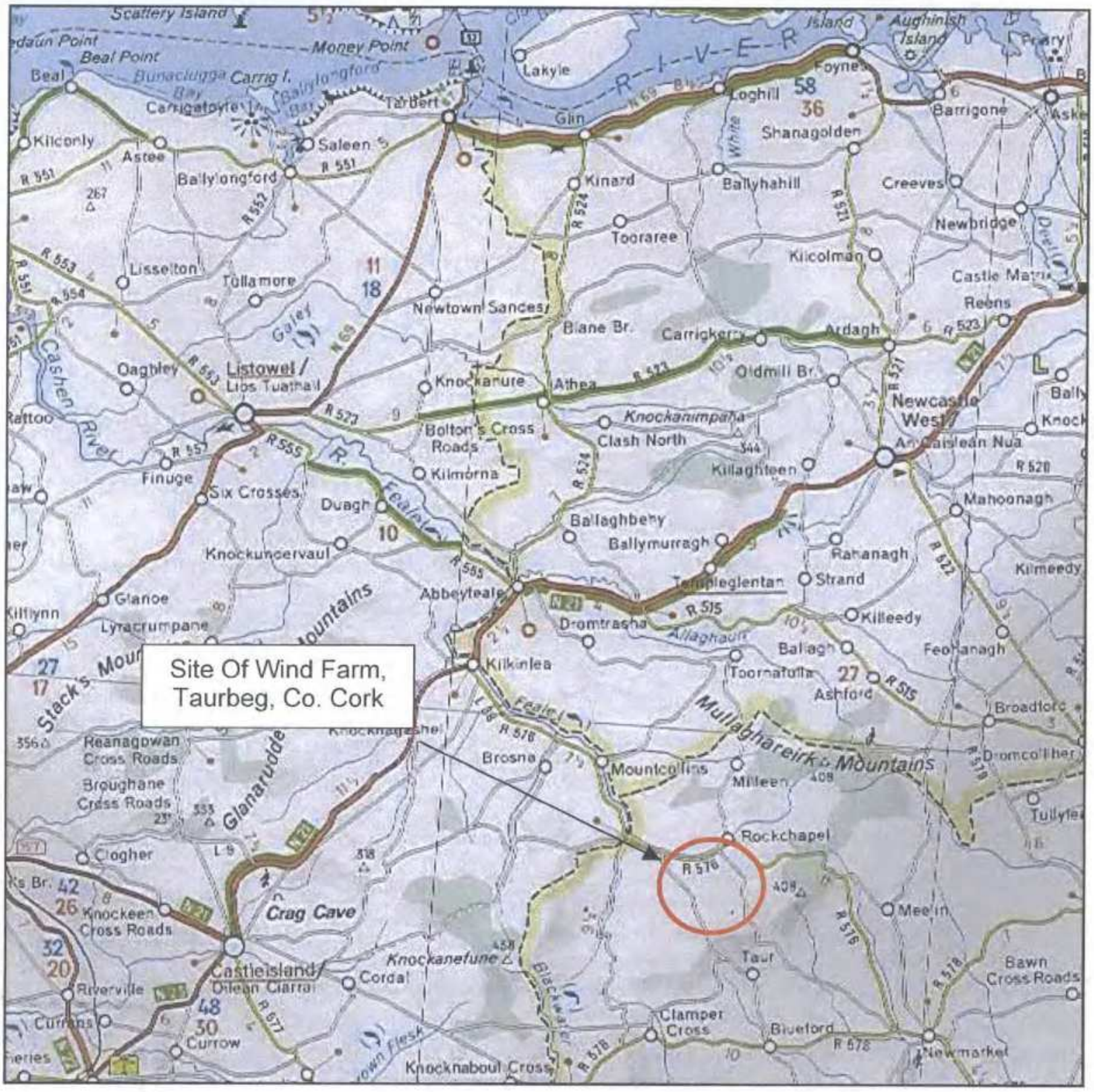

Figure 1 - Site Location Map

Reproduced from Ordnance Survey N.I. Discover 1:50 000 Series, Sheet 12

Geology

A study was made of available geological and hydro-geological information, including Geological Survey Memoirs. These were used to assess the potential for any contaminant migration from the site.

In general contaminants spilled or leaked at the ground surface will move downwards until they encounter an impermeable stratum or the groundwater table. They then start to spread laterally in a direction governed by the geological topography or groundwater gradient. It is therefore important that the geology and hydrogeology of the site are well known prior to commercial use.

Research into the geology of the area was made using the following sources:

1. Geological Survey Of Ireland, "Geological Map Of Ireland", 1:750 000, 3rd Edition, 1962.

This shows that the following general drift and solid geology can be expected at the site of Taurbeg Wind Farm:-

- Surface deposits consisting of peat, clayey sands and clayey gravels (the latter two being the weathering products of the underlying rock)
- Solid geology consisting of Coal Measures overlying the Millstone Grit and Flagstone Series overlying sandstone & shale of the Yordale and Pendleside Series.

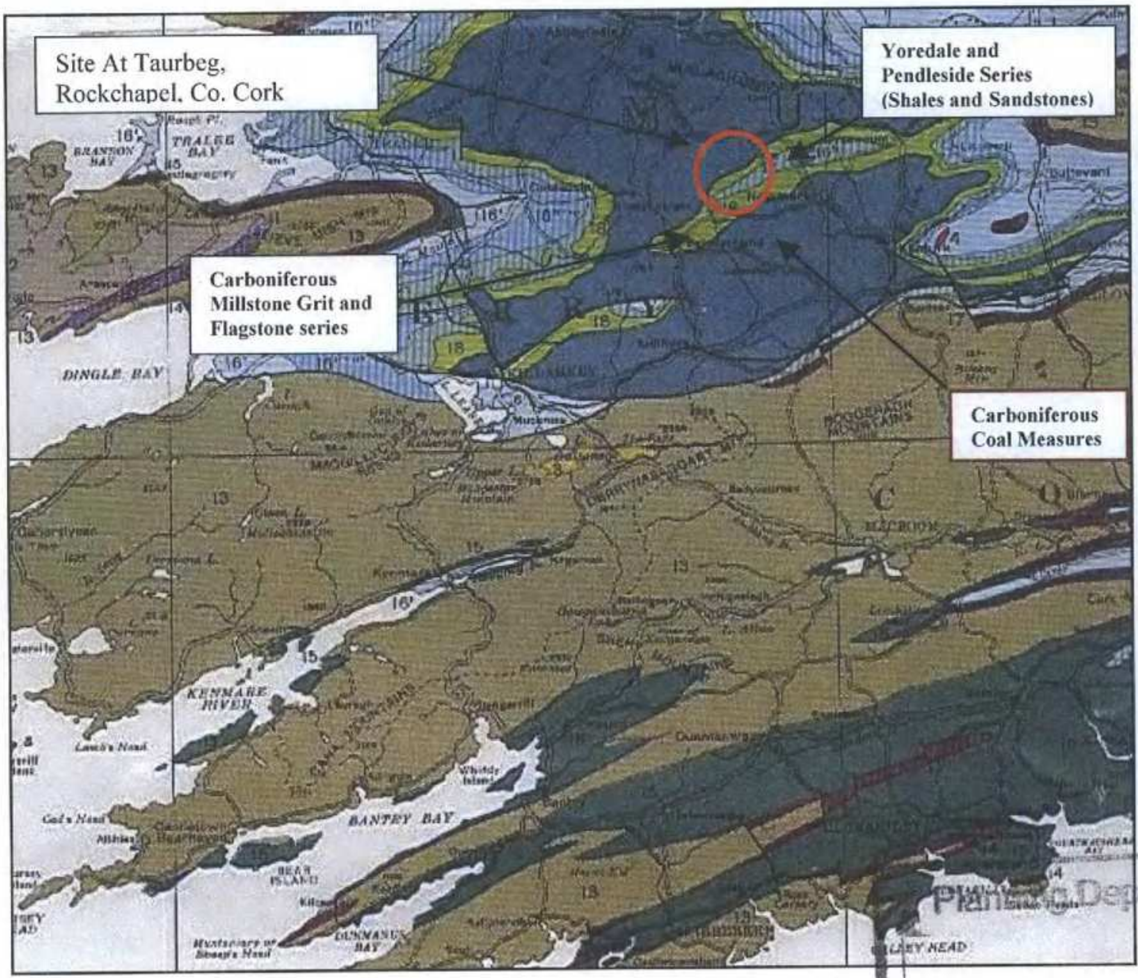

Figure 2 - Geology of the Site

Reproduced from British Geological Survey, "1:750 000 Geological Map Of Ireland)
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3.0 Environmental Assessment Procedure

Trial Pit Investigation

Please refer to appendix for location of trial pits and the logs obtained.

Trial pits were carried out using a 12T tracked excavator with a maximum reach of 5.5m. All due care and attention was given to ensuring that pits were excavated with a minimum of impact on the surrounding environment and the ground returned to a satisfactory state on completion.

Site investigation was carried out in line with the recommendations outlined in "Specification and Method of Measurement for Site Investigation", Dept. of Transport, 1987.

Penetrometer and vane tests were conducted within the granular and cohesive materials encountered to ascertain the compressive strength.

This information was later used to determine the calculated allowable bearing pressures of each soil horizon to provide recommendations for foundation design.

Borehole Investigation

Please refer to appendix for location of boreholes and the logs obtained.

Trial pits were carried out using a Dando Terrier site investigation boring rig. All due care and attention was given to ensuring that pits were excavated with a minimum of impact on the surrounding environment and the ground returned to a satisfactory state on completion.

Site investigation was carried out in line with the recommendations outlined in "Specification and Method of Measurement for Site Investigation", Dept. of Transport, 1987.

CBR – Insitu Testing.

In-situ CBR tests were carried out along the route of the proposed access roads at intervals of 100m. Additional, CBR tests were carried out along the main access road for a distance of approximately 1.5km at intervals of 200m.

At each position a series of 4 tests were carried out at 0m, 0.15m, 0.45m and 0.75m depth, where penetration was possible. These readings were repeated once to check consistency.

A Mexecone manufactured by L.Farnell & Co was used for this purpose.

Ground Resistivity Testing

Two orthogonal vertical electrical resistivity soundings were conducted at the location of each turbine and proposed sub-station.

This was carried out using the Schlumberger Palmer configuration.

A Megger Det 2/2 Ground Resistance Meter was used to collect the information in all cases.

Please refer to the appendix for details of the electrodes separations used.

Laboratory Testing

A single sample was removed from each proposed turbine and sub station location and tested for the following:-

1. Sulphate Content
2. pH

The results of all testing is given in section 4.0 and the appendix.

4.0 Results of Geotechnical Investigation

Turbine Bases

Soil Stratigaphy – Turbine Bases and Sub-Station

Analysis of the trial pit records shows that the following table approximates to the general site stratigraphy.

Layer	Soil Type	Thickness (m)	Description
Layer 1	Peat	0.2 – 1.7m	Dark brown compressible plastic PEAT.
Layer 2	Soft to Firm Sandy Clay	0.3 – 1.0m	Soft to firm yellow brown sandy CLAY or blue grey homogeneous CLAY
Layer 3	Medium Dense Coarse Gravel / Gravelly Clay	0.88m – 3.75m	Blue Grey highly discoloured crystalline SHALE. (Highly weathered)
Layer 4	Weak Rock	0.30 – 1.25m	Dark grey disintegrated thinly laminated MUDSTONE / SILTSTONE and yellowish green decomposed SANDSTONE
Layer 5	Strong Rock	N/A	Fresh to discoloured MUDSTONE / SILTSTONE and SANDSTONE

Table 1 – Approximate Soil Stratigraphy

Groundwater

Water was struck during the survey, in the following trial pits

TP1	No water struck
TP2	No water struck
TP3	Water seepage at 0.4m
TP4	No water struck
TP5	No water struck
TP6	No water struck
TP7	Water seepage at 0.4m
TP8	Water seepage at 0.6m and at 2.9m
TP9	No water struck
TP10	No water struck
TP11	Water seepage at 1.2m. Water struck at 1.9m – slight flow.
TP12	No water struck
BH1	No water struck
BH2	No water struck

Geotechnical Design Parameters – Turbine Bases

The following outline geotechnical profile has been determined on the basis of visual examination of soil samples, basic in-situ testing and by applying approximate average engineering parameters for the soil types observed.

Layer	Soil Type	Depth to top (m)	Approx. Density (kN/m^3)	Allowable Bearing Pressure (kN/m^2)
Layer 1	Peat	0	1600	Not suitable
Layer 2	Soft to Firm Sandy Clay	0 – 1.7	2000	10 - 50
Layer 3	Medium Dense Coarse Gravel / Gravelly Clay	0.7 – 2.2	2200	Generally 150 - 200
Layer 4	Weak Rock	0.86 – 2.5	2500	>1000
Layer 5	Strong Rock	1.3 – 5.9	2500	>5000

Table 2 - Geotechnical Parameters

Summary of Trial Pit and Borehole Data

Analysis of the trial pit records shows that the following table

Turbine No. / Substation	Trial pit No.	Location		Peat Thickness (m)	Depth to Refusal on Strong Rock (m)	Depth at which an allowable bearing pressure in excess of 150kN/m2 is available (m)
		Easting	Northing			
T1	TP7	122699	111332	0.42	N/A	1.5
T2	TP2	122453	111906	0.2	3.7	1.85
T3	TP4	122016	111912	0.4	3.7	1.95
T5	TP3	122290	112182	0.51	3.3	2.5
T6	TP12	122626	112212	N/A	2.85	1.3
T7	TP11	122889	112129	Between 0.6m and 1.15m	3.6	1.15
T8	TP5	122169	111647	1.7	4.3	2.1
T9	TP10	122902	111596	0.65	2.55	0.9
T10	TP8	122914	110925	0.75	3.55	2.0
T11	TP9	123006	111237	1.05	2.6	1.25
T12	TP6	122467	111590	1.2	N/A	1.4
T12	TP6A	122487	111584	1.2	N/A	2.2
Substation	TP1	122532	111994	0.52	2.85	0.86
T1	BH1	122674	111348	2.5	5.5	2.5
T12	BH2	122464	111545	1.1	4.0	2.0

Table 3 – Summary of Ground Conditions

Summary of Laboratory Test Data

The following table outlines the findings of the laboratory testing programme. Please refer to the appendix for full details of the test results.

Turbine location	**Depth**	**Classification (rock / gravel / sand / silt / clay)**	**Sulphate Content (g/l)**	**pH**
1	0.5	Clay	0.5	7.5
2	1.5	Clay	0.4	7.9
3	2.0	Gravel	0.6	8.0
5	1.5	Gravel	1.1	8.3
6	0.8	Sand	0.7	7.2
7	1.5	Gravel	0.3	7.5
8	4.3	Gravel	0.3	7.6
9	2.5	Clay	0.4	8.2
10	1.5	Gravel	0.3	7.0
11	2.0	Clay	0.5	7.8
12	1.8	Clay	0.6	7.4
Substation	1.2	Clay	0.4	7.4

Table 4 – Laboratory Test Results

CBR In-Situ Testing

Please refer to the appendix for details of the CBR values obtained.

Ground Resistance Testing

Please refer to the appendix for results of the testing carried out at turbine and substation locations.

5.0 RECOMMENDATIONS

Turbine Bases

It is recommended that bases for the wind turbines be located on the strong rock layer (MUDSTONE / SILTSTONE / SANDSTONE) layer found at a depth of 2.9 to 4.1m below ground level at each base and sub-station location.

The effective density of this material is in approx of 25kN/m^3.

Chemical tests find that soils are generally slightly alkaline with pH ranging from 7.0 – 8.3. Sulphate content was generally low and varied between 0.3g/l and 1.1g/l. Soil conditions are not expected to be aggressive to concrete. Class 1 concrete is recommended.

In-Situ tests carried out provide an allowable bearing capacity of greater than 5000kN/m^2 for this Strong Rock layer.

Sides of excavations are stable and unlikely to collapse. All excavations below 1.0m should however be adequately supported.

Water was only found to be present in measurable volumes within trial pit 11, at the site of turbine T7. This is unlikely to cause problems for the design as proposed as only a slight flow was observed. It is recommended that excavations are not left open / exposed to wet weather for longer than absolutely necessary, to prevent possible degradation of sensitive clays and gravelly clays..

Conditions would appear to be suitable for the emplacement of foundations (described previously) as follows:-

Turbine T1	Bases placed at 5.8m b.g.l.
Turbine T2	Bases placed at 3.7m b.g.l
Turbine T3	Bases placed at 3.7m b.g.l
Turbine T5	Bases placed at 3.3m b.g.l
Turbine T6	Bases placed at 2.85m b.g.l
Turbine T7	Bases placed at 3.6m b.g.l
Turbine T8	Bases placed at 4.3m b.g.l
Turbine T9	Bases placed at 2.55m b.g.l
Turbine T10	Bases placed at 3.55m b.g.l
Turbine T11	Bases placed at 2.6m b.g.l
Turbine T12	Bases placed at 4.0m b.g.l
Substation	Strip Foundations placed at 0.86m b.g.l on weathered sandstone

Access Roads

CBR In-Situ test results show that a value in excess of 3% is generally achieved at 0.45m depth beneath the peat layer. Minimal quantities of road base material, are likely to be required, for non-floating road construction.

The findings of this report are based entirely on field observations and analysis of trial pi, borehole and In-Situ test data.

6.0 SUMMARY

- The site is currently moorland, used for peat harvesting with the lower reaches employed for grazing sheep.
- Ground water was not found to be a major feature of the ground investigation. Generally the clays were found to be impervious to ground water, which tended to enter the hole through the surface peat layer. This peat layer was, at the time of the investigation, relatively firm underfoot.
- Soils tested exhibit a generally slightly alkaline pH and sulphate content was found to be low. Class 1 concrete is recommended.
- The underlying rock stratum is classified as sedimentary rock, generally Mudstone, Siltone and Sandstone, which show evidence of partial metamorphism. These rocks date from the Carboniferous period and are likely to be contain coal measures in places. These rocks were found to occur in a highly to slightly weathered condition.
- The strong rock identified was, capable of bearing loads in excess of 5000KN/m2 was found generally at depths of between 2m and 4m below ground level. There are two notable exceptions to this case at the current locations of turbine T1 and T12. At turbine T1 rock was located at 5.5m below ground level. The current location of T12 appears to be within a sediment filled gulley. It is recommended that this turbine location is adjusted 30 – 40m south of its current location, where rock is found closer to the surface (4.0m depth in borehole BH2.
- Should new access roads be considered CBR In-Situ testing shows that a value of >2% is generally available at 0.15m depth, below the peat layer . None of the CBR In-Situ tests did penetrated more than 0.45m below the peat. These results are in agreement with the results of the trial pit investigation.

The site is suitable for the proposed wind farm development

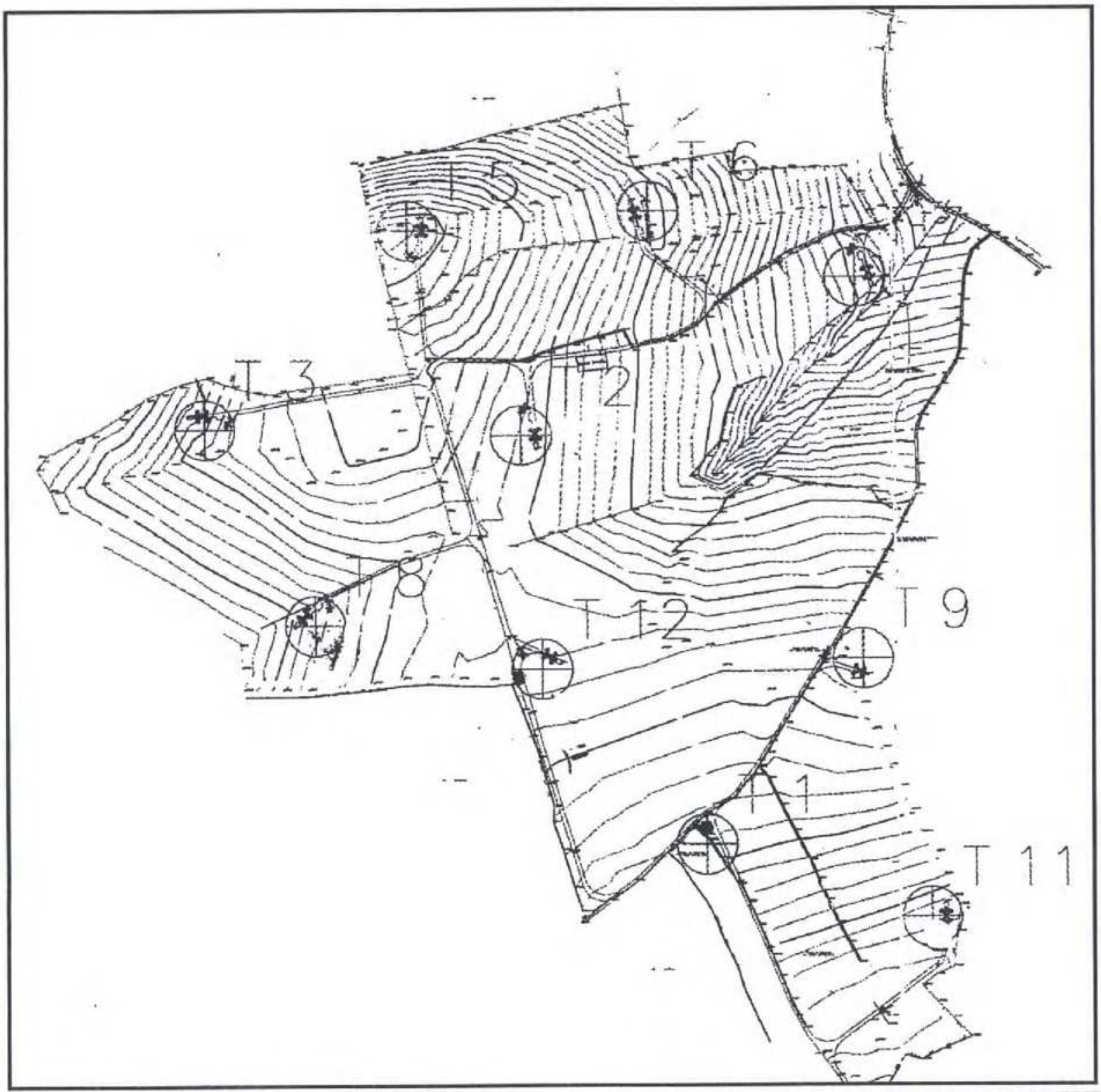
For Whiteford Geoservices Ltd

J Whiteford BSc FGS MEAGE MEEGS

Date: 16 June 2004

APPENDIX

Location Plans


T 5
T 6
T 3
T 2
T 8
T 12
T 9
T 1
T 11

Trial Pit Logs

Project No: 386/04

Log of Trial Pit: TP1

Project: Taurbeg Wind Farm

Client: RES Group Ltd

Location: Substation

Position Ref: E = 122532, N = 111994

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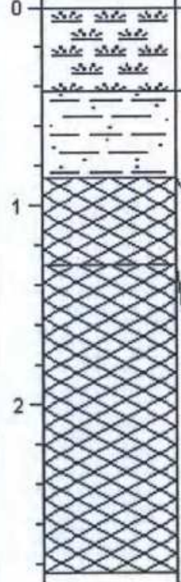
SUBSURFACE PROFILE

Depth	Symbol	Description	Elevation
0		Ground Surface	0
		PEAT Dark brown, highly plastic PEAT	-0.42
		Yellow - Brown Sandy CLAY Soft mottled yellow and brown sandy CLAY with numerous angular cobbles of fine grained sandstone.	-0.86
1		**Weathered SANDSTONE** Disintegrated medium to fine grained, partially crystalline light grey SILTSTONE / SANDSTONE, tinged with dark yellow. Highly to moderately weathered (Grade III - IV).	-1.3
2		**SANDSTONE** Discoloured medium to fine grained slightly crystalline light grey siltstone / sandstone. Slightly weathered (Grade II - III). Becoming light grey and yellow grey, fresh to slightly discoloured tabular medium to fine grained sandstone. Moderately strong to strong. Very difficult to excavate below this level with 12 tonne machine. Evidence of bedding unclear.	-2.85
3		End of Borehole	
4			
5			



REMARKS

No water struck

Photos 1 and 2 of pit at 1.2m

No contamination observed

No services encountered

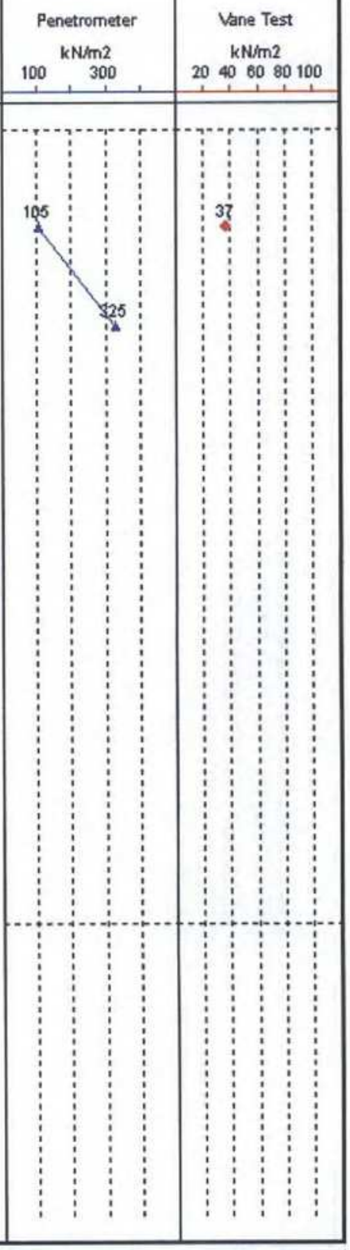
Schmidt Hammer
At 1.0m = 22MPa
At 1.3m = 36MPa

Sides stable to 1.3m
Sides tend to collapse after 1.3m

Sample taken at 1.3m

Photo 3 - Spoil

Photo 4 - Base of pit



Method: Trial Pit

Date: 24/5/04

Hole Size: 4m x 1m

Whiteford Geoservices Ltd
Unit 2 Curran Business Park
Portland Road
Larne BT40 1DH

Datum: Ground Level

Checked by: JW

Sheet: 1 of 1

Project No: 386/04

Log of Trial Pit: TP2

Project: Taurbeg Wind Farm

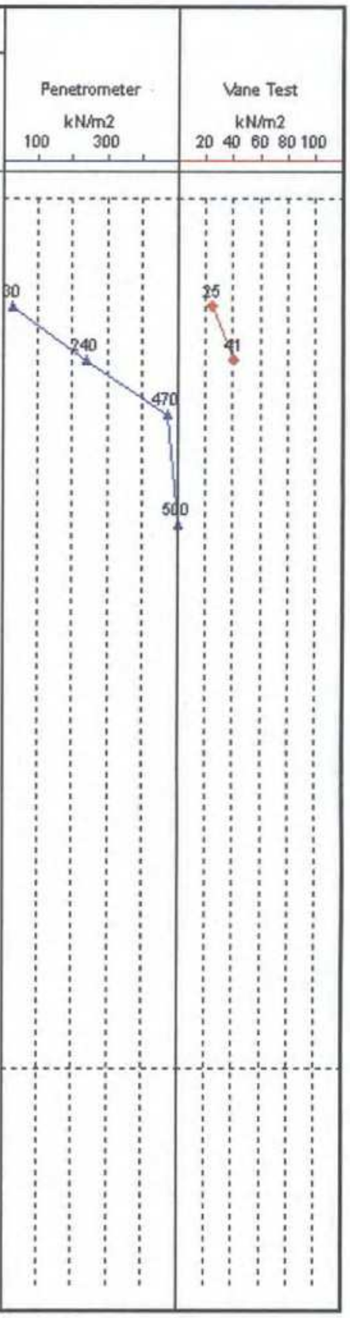
Client: RES Group Ltd

Location: Turbine 2

Position Ref: E = 122453, N = 111906

SUBSURFACE PROFILE

Depth	Description	Elevation	REMARKS
0	Ground Surface	0	
	PEAT Firm dark brown, fibrous PEAT	-0.2	No water struck
	Brown Sandy CLAY Softto firm, light brown sandy very gravelly CLAY	-0.5 -0.75	No contamination observed
1	**Blue - Grey CLAY** Soft to firm blue - grey organic CLAY with rootlets.		No services encountered No Schmidt Hammer test due to depth of pit
	Medium Dense SAND Medium dense mottled light green and blue gravelly fine SAND with numerous sub-angular boulders of sandstone.	-1.85	Sides liable to collapse Sample taken at 1.5m
2	(Completely weathered and decomposed sandstone. Weathering Grade - (IV - V)		Photo 5 - Spoil (2.0m) Photo 6 - Base (2.0m)
	Dark Grey SANDSTONE Dark grey thinly bedded (2cm) partially disintegrated fine grained SILTSTONE / SANDSTONE. Very weak - weak. Sub-vertically bedded dipping to the north at 70 degrees.	-3	Photo 7 - Base of pit Photo 8 - Spoil
3	**Yellow Brown SANDSTONE** Yellow brown slightly to highly discoloured fine grained thinly bedded tabular / bocky SILTSTONE / SANDSTONE. Moderately weak, becoming moderately strong at base.	-3.7	
4	End of Borehole		
5			



Method: Trial Pit

Date: 24/5/04

Hole Size: 4m x 1.25m

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Larne BT40 1DH

Datum: Ground Level

Checked by: JW

Sheet: 1 of 1

Project No: 386/04

Log of Trial Pit: TP3

Project: Taurbeg Wind Farm

Client: RES Group Ltd

Location: Turbine 5

Position Ref: E = 122290, N = 112182

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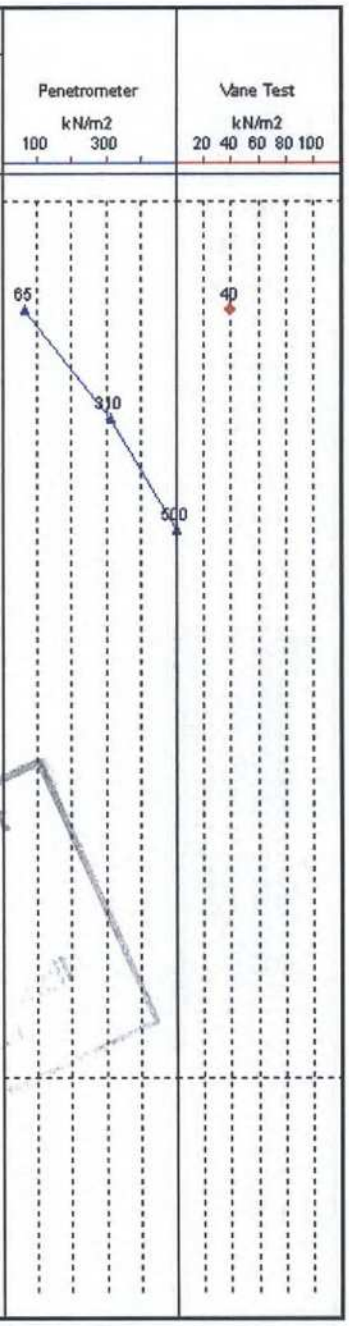
SUBSURFACE PROFILE

Description	Elevation	REMARKS
Ground Surface	0	
PEAT Firm dark brown, spongy PEAT	-0.51	No water struck
Brown Sandy CLAY Soft light brown sandy organic CLAY	-0.75	No contamination observed No services encountered
Blue Coarse GRAVEL Medium dense fine sandy blue coarse GRAVEL (Totally decomposed SANDSTONE). Weathering Grade IV - V, very weak	-1.35	No Schmidt Hammer test available due to depth of pit
Dense Orange GRAVEL Dense orange mottled brown very coarse angular GRAVEL in a fine sandy matrix (Decomposed SANDSTONE with corestones). Weathering Grade III - IV. Very weak.	-2.5	Sides liable to collapse below 1.5m Sample taken at 1.5m Photo 9 - Pit Photo 10 -Spoil
Yellow - Grey SANDSTONE Yellowish grey, discoloured fine grained, thickly bedded (5 - 10 cm) tabular to blocky partially crystalline SANDSTONE, moderately weak.	-3.1	
Yellow - Grey SANDSTONE Yellowish grey, partially discoloured thinly bedded (2 -3cm), planar to tabular partially crystalline SANDSTONE, moderately strong to strong.	-3.3	
End of Borehole		



Method: Trial Pit

Date: 24/5/04

Hole Size: 4m x 1m

Whiteford Geoservices Ltd
Unit 2 Curran Business Park
Portland Road
Larne BT40 1DH

Datum: Ground Level

Checked by: JW

Sheet: 1 of 1

Project No: 386/04

Log of Trial Pit: TP4

Project: Taurbeg Wind Farm

Client: RES Group Ltd

Location: Turbine 3

Position Ref: E = 122016, N = 111912

SUBSURFACE PROFILE

Description	Elevation
Ground Surface	0
PEAT Firm dark brown, spongy PEAT.	-0.4
Gravelly Sandy CLAY Light brown very gravelly very sandy CLAY.	-0.75
Coarse GRAVEL Medium dense coarse blue GRAVEL, very fine sandy matrix (Totally decomposed SANDSTONE) Weathering Grade IV - V.	-1.4
Dense GRAVEL Dense yellowish - brown coarse angular GRAVEL in a fine sandy matrix (Decomposed SANDSTONE with corestones). Weathering Grade IV - V.	-1.95
Grey MUDSTONE Dark grey disintegrated, thinly laminated MUDSTONE / SILTSTONE. Weak, sub vertically dipping beds - 70 degrees towards north.	-3.2
Grey MUDSTONE Dark grey partially discoloured thinly laminated MUDSTONE / SILTSTONE. Moderately strong, subvertically dipping beds - 70 degrees towards north.	-3.7
End of Borehole	

REMARKS

Water seepage at 0.4m

No contamination observed

No services encountered

No Schmidt Hammer test at 2.0m Rock Strength <1 MPa

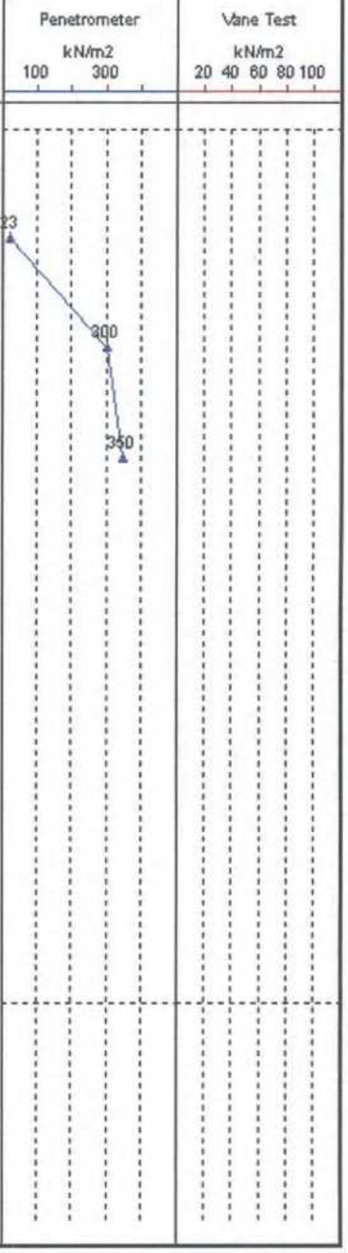
Sides liable to collapse below 2.0m

Sample taken at 2.0m

Photo 11 - Pit

Photo 12 -Spoil

No standing water on completion



Method: Trial Pit

Date: 24/5/04

Hole Size: 4m x 1.3m

Whiteford Geoservices Ltd
Unit 2 Curran Business Park
Portland Road
Larne BT40 1DH

Datum: Ground Level

Checked by: JW

Sheet: 1 of 1

Project No: 386/04

Log of Trial Pit: TP5

Project: Taurbeg Wind Farm

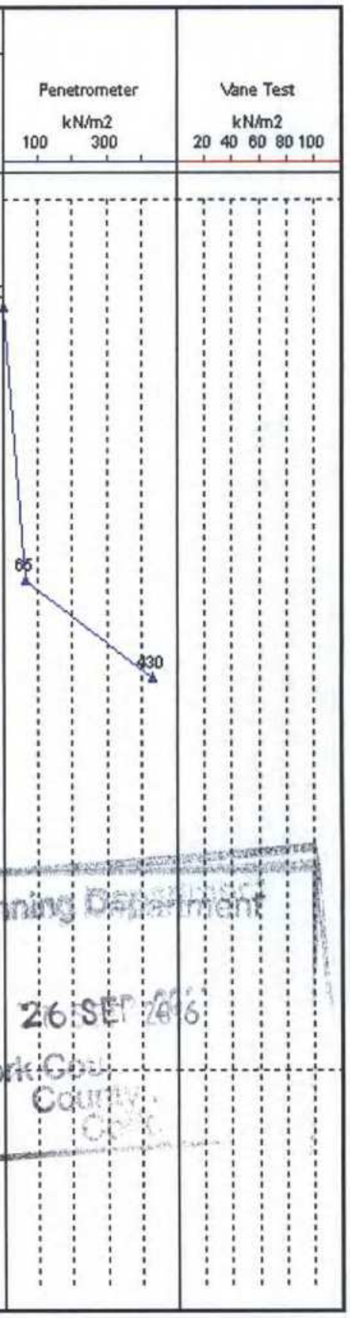
Client: RES Group Ltd

Location: Turbine 8

Position Ref: E = 122169, N = 111647

SUBSURFACE PROFILE

Depth	Description	Elevation	REMARKS
0	Ground Surface	0	
0 – 1.7	***PEAT*** Brown to dark brown, spongy PEAT.	-1.7	No contamination observed No services encountered Sides very unstable
1.7 – 2.1	***Gravelly Sandy CLAY*** Soft light brown very sandy very coarse gravelly CLAY	-2.1	Sample taken at 4.3m Photo 13 - Pit Photo 14 -Spoil
2.1 – 4.1	***Coarse GRAVEL*** Medium dense to dense, blue - grey coarse angular GRAVEL, very fine sandy matrix (Totally disintegrated MUDSTONE / SILTSTONE). Weathering Grade IV. Very weak.	-4.1	
4.1 – 4.3	***Grey MUDSTONE*** Dark grey, thinly laminated MUDSTONE / SILTSTONE. Moderately strong, subvertically dipping beds - 70 degrees towards north.	-4.3	
	End of Borehole		



Method: Trial Pit

Date: 24/5/04

Hole Size: 5m x 1.5m

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Unit 2 Curran Business Park
Portland Road
Larne BT40 1DH

Datum: Ground Level

Checked by: JW

Sheet: 1 of 1

Project No: 386/04

Log of Trial Pit: TP6

Project: Taurbeg Wind Farm

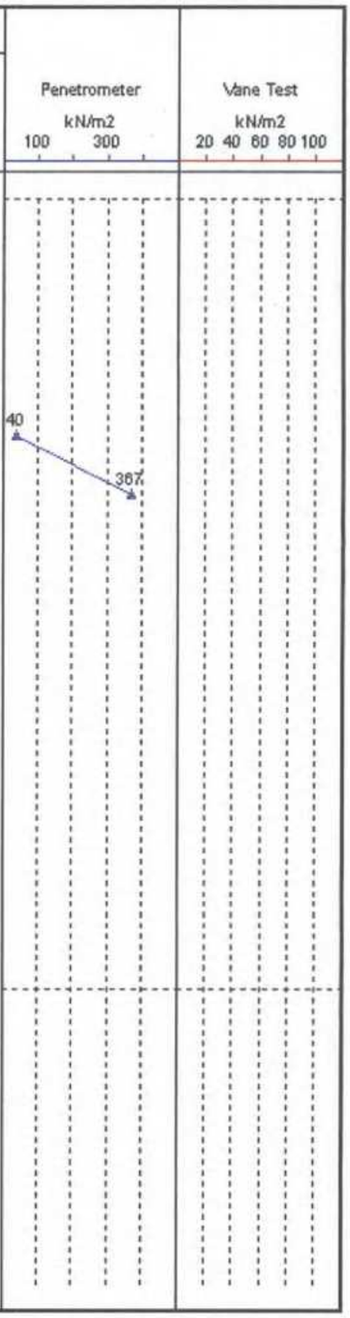
Client: RES Group Ltd

Location: Turbine 12

Position Ref: E = 122467, N = 111590

SUBSURFACE PROFILE

Depth	Symbol	Description	Elevation	REMARKS
0		Ground Surface	0	
1		**PEAT** Brown to dark brown, spongy PEAT.	-1.2	No water struck No contamination observed No services encountered No rock encountered
		Light brown CLAY Soft to very soft light brown sandy CLAY.	-1.4	
2 3 4 5		**Gravelly Sandy CLAY** Firm to stiff mottled yellow and green very coarse gravelly fine grained sandy CLAY. Becoming very dense sandy clayey very coarse sub-angular GRAVEL towards base.	-5.25	No obstructions encountered Sample taken at 1.8m Photo - Pit Photo - Spoil Sides stable No standing water on completion End of hole at 5.25m - at limit of reach of excavator
		End of Borehole		



Method: Trial Pit

Date: 24/5/04

Hole Size: 4m x 1.5m

Whiteford Geoservices Ltd
Unit 2 Curran Business Park
Portland Road
Larne BT40 1DH

Datum: Ground Level

Checked by: JW

Sheet: 1 of 1

Project No: 386/04

Log of Trial Pit: TP6A

Project: Taurbeg Wind Farm

Client: RES Group Ltd

Location: Turbine 12

Position Ref: E = 122487, N = 111584

SUBSURFACE PROFILE

Depth	Symbol	Description	Elevation	REMARKS	Penetrometer kN/m2 100 300	Vane Test kN/m2 20 40 60 80 100
0		Ground Surface	0			
1		***PEAT*** Very soft, brown to dark brown, plastic PEAT.	-1.2	No water struck No contamination observed No services encountered		
2		***Light brown CLAY*** Soft to very soft light brown - grey sandy CLAY.	-2.2	No obstructions encountered Sample taken at 1.8m No photo taken		
3 4		***Gravelly Sandy CLAY*** Firm light bluish - green sandy, very gravelly CLAY. Dense cobbles and boulders of sandstone at base.	-4.65	Sides stable No standing water on completion		
5		End of Borehole		End of hole at 4.65m No rock encountered		

Method: Trial Pit

Date: 24/5/04

Hole Size: 5m x 1.5m

Whiteford Geoservices Ltd
Unit 2 Curran Business Park
Portland Road
Larne BT40 1DH

Datum: Ground Level

Checked by: JW

Sheet: 1 of 1

Project No: 386/04

Log of Trial Pit: TP7

Project: Taurbeg Wind Farm

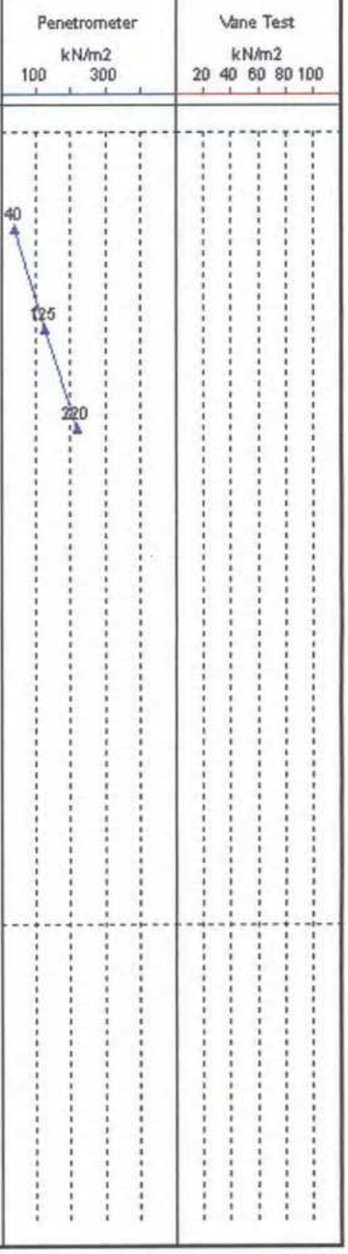
Client: RES Group Ltd

Location: Turbine 1

Position Ref: E = 122699, N = 111332

SUBSURFACE PROFILE

Depth	Symbol	Description	Elevation	REMARKS
		Ground Surface	0	
0		**PEAT** Firm dark brown, spongy PEAT.	-0.42	Water seepage at 0.4m
		Slightly Sandy CLAY Soft light brown slightly sandy gravelly CLAY.	-0.71	No contamination observed No services encountered
1		**Gravelly CLAY** Firm bluish - grey very sandy gravelly CLAY	-1.1	No Schmidt Hammer test
2		**Gravelly CLAY** Firm yellow very gravelly CLAY. Gravel consists of disintegrated very weak mudstone fragments.	-2.45	Sides liable to collapse below 1.5m Photo 15 - Pit Photo 16 -Spoil
3 4		**Gravelly CLAY** Stiff yellow, very gravelly CLAY (completely disintegrated MUDSTONE). Weathering grade (IV)	-4.6	No standing water on completion
5		End of Borehole		



Method: Trial Pit

Date: 25/5/04

Hole Size: 4m x 1m

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Unit 2 Curran Business Park
Portland Road
Larne BT40 1DH

Datum: Ground Level

Checked by: JW

Sheet: 1 of 1

Project No: 386/04

Log of Trial Pit: TP8

Project: Taurbeg Wind Farm

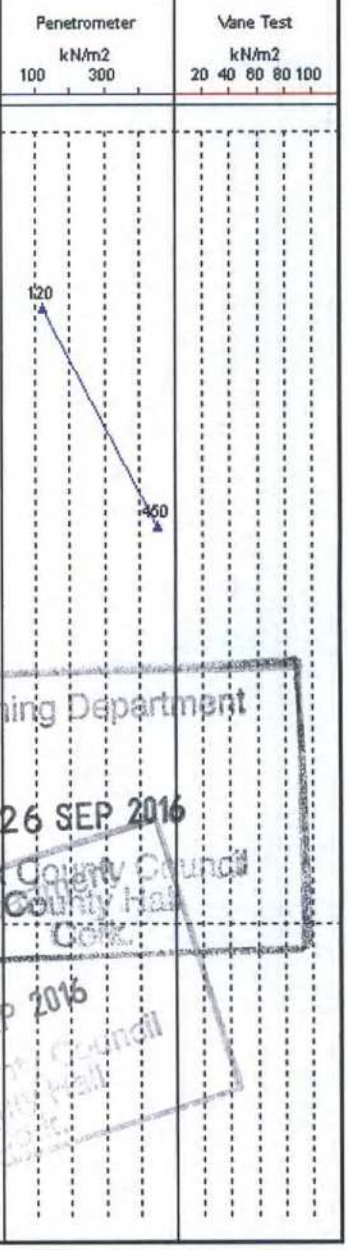
Client: RES Group Ltd

Location: Turbine 10

Position Ref: E = 122914, N = 110925

SUBSURFACE PROFILE

Description	Elevation	REMARKS
Ground Surface	0	
PEAT Firm very dark brown PEAT.	-0.75	No services encountered No contamination observed Water seepage at 0.6m
Brown Sandy CLAY Firm, light brown homogeneous CLAY.	-0.92	No Schmidt Hammer test available due to depth of pit
Blue - Grey CLAY Firm greenish blue - grey gravelly clay.	-1.08	Sides liable to collapse below 1.0m
Clayey GRAVEL Dense greenish - blue - grey sandy clayey angular coarse GRAVEL (Disintegrated MUDSTONE). Corestones present but no fabric. Weathering grade IV.	-2.9	Sample taken at 1.5m Photo 17 - Pit Photo 18 - Spoil Water seepage at 2.90m
Dark Grey SILTSTONE Dark grey partially discoloured to fresh fine grained SILTSTONE. Strong - very strong, weathering grade (I - II). No evidence of dipping strata. Rock fragments flaggy in nature (shaley in appearance).	-3.55	No standing water on completion.
End of Borehole		



Method: Trial Pit

Date: 25/5/04

Hole Size: 5m x 1m

Whiteford Geoservices Ltd
Unit 2 Curran Business Park
Portland Road
Larne BT40 1DH

Datum: Ground Level

Checked by: JW

Sheet: 1 of 1

Project No: 386/04

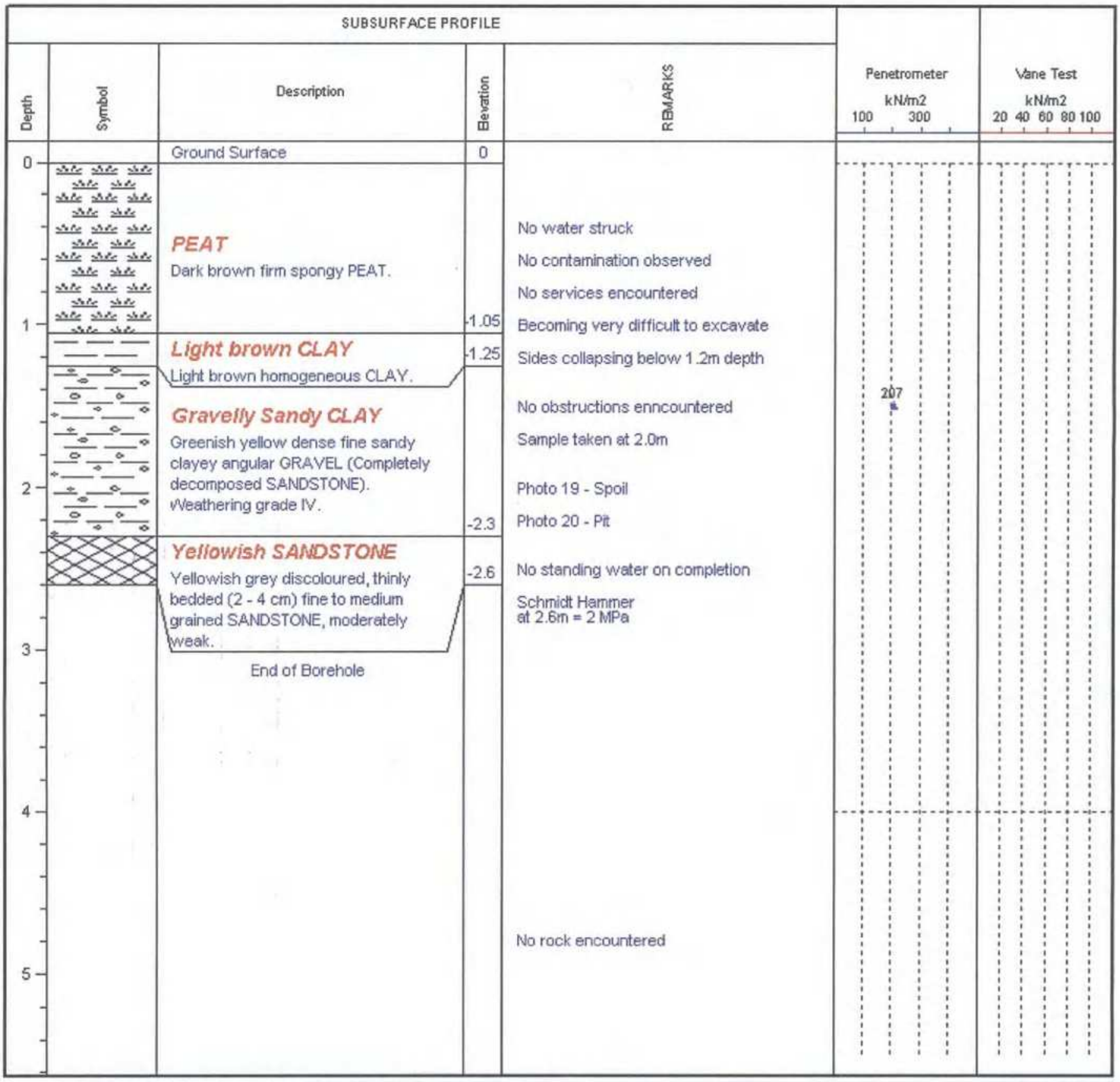
Log of Trial Pit: TP9

Project: Taurbeg Wind Farm

Client: RES Group Ltd

Location: Turbine 11

Position Ref: E = 123006, N = 111237



Depth	Description	Elevation	REMARKS	Penetrometer kN/m2	Vane Test kN/m2
0	Ground Surface	0			
	PEAT Dark brown firm spongy PEAT.	-1.05	No water struck No contamination observed No services encountered Becoming very difficult to excavate		
	Light brown CLAY Light brown homogeneous CLAY.	-1.25	Sides collapsing below 1.2m depth	207	
	Gravelly Sandy CLAY Greenish yellow dense fine sandy clayey angular GRAVEL (Completely decomposed SANDSTONE). Weathering grade IV.	-2.3	No obstructions enncountered Sample taken at 2.0m Photo 19 - Spoil Photo 20 - Pit		
	Yellowish SANDSTONE Yellowish grey discoloured, thinly bedded (2 - 4 cm) fine to medium grained SANDSTONE, moderately weak.	-2.6	No standing water on completion Schmidt Hammer at 2.6m = 2 MPa		
	End of Borehole				
			No rock encountered		

Method: Trial Pit

Date: 25/5/04

Hole Size: 5m x 1.5m

Whiteford Geoservices Ltd
Unit 2 Curran Business Park
Portland Road
Larne BT40 1DH

Datum: Ground Level

Checked by: JW

Sheet: 1 of 1

Project No: 386/04

Log of Trial Pit: TP10

Project: Taurbeg Wind Farm

Client: RES Group Ltd

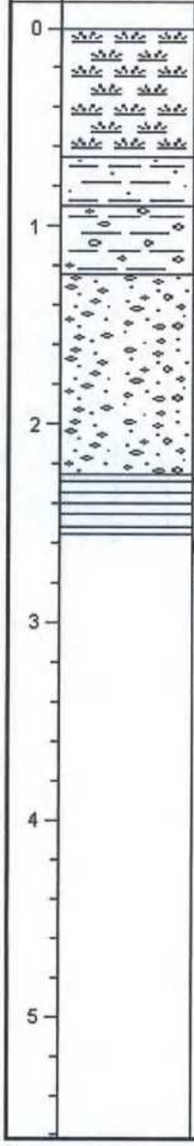
Location: Turbine 9

Position Ref: E = 122902, N = 111596

SUBSURFACE PROFILE

Depth | Symbol | Description | Elevation | REMARKS

Ground Surface | 0



PEAT

Dark brown, spongy PEAT.

Brown Sandy CLAY

Soft to firm light brown homogeneous CLAY.

Sandy GRAVEL

Medium dense greenish grey very clayey sandy GRAVEL (Decomposed SANDSTONE). Weathering grade IV-V.

Yellow Brown GRAVEL

Yellow brown medium dense to dense very sandy GRAVEL. (Disintegrated SANDSTONE). Corestones evident. Weathering grade IV.

Rose - Red SANDSTONE

Rose - red highly discoloured, medium to fine grained flaggy SANDSTONE, moderately weak. Black staining.

End of Borehole

Elevation: 0, -0.65, -0.9, -1.24, -2.25, -2.55

No water struck

No contamination observed

No services encountered

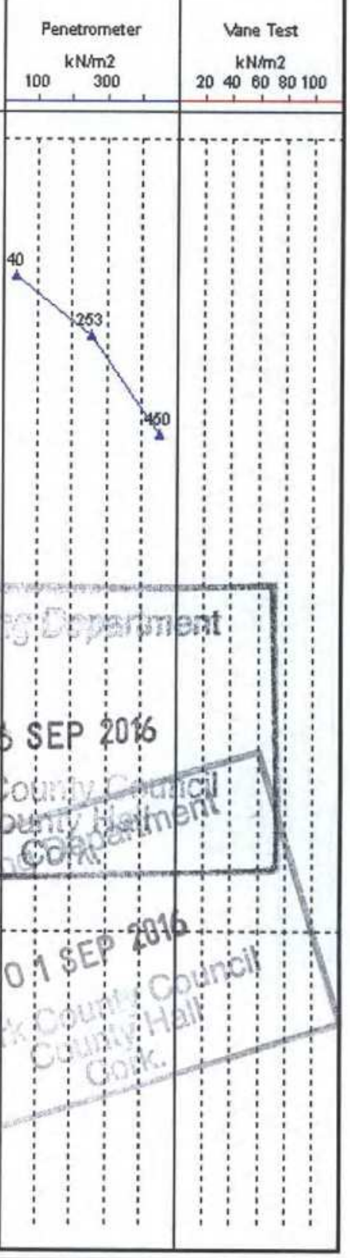
No Schmidt Hammer test available due to depth of pit

Sides unstable

Sample taken at 1.5m

Photo 21 - Pit

Photo 22 -Spoil



Method: Trial Pit

Date: 25/5/04

Hole Size: 5m x 1m

Whiteford Geoservices Ltd
Unit 2 Curran Business Park
Portland Road
Larne BT40 1DH

Datum: Ground Level

Checked by: JW

Sheet: 1 of 1

Project No: 386/04

Log of Trial Pit: TP11

Project: Taurbeg Wind Farm

Client: RES Group Ltd

Location: Turbine 7

Position Ref: E = 122889, N = 112129

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SUBSURFACE PROFILE

Description	Elevation
Ground Surface	0
TOPSOIL Light brown, sandy TOPSOIL.	-0.6
PEAT Black firm PEAT.	-1.15
Medium Dense GRAVEL Yellow mottled green, medium dense very sandy clayey coarse GRAVEL (Decomposed Sandstone). Weathering grade V.	-3.2
Grey SANDSTONE Greenish grey, highly discoloured flaggy, fine to medium grained thickly bedded SANDSTONE, moderately strong at base.	-3.6
End of Borehole	

REMARKS

No contamination observed

No services encountered

No penetrometer results in gravel

Water seepage at 1.20m

Sides unstable

Sample taken at 1.5m

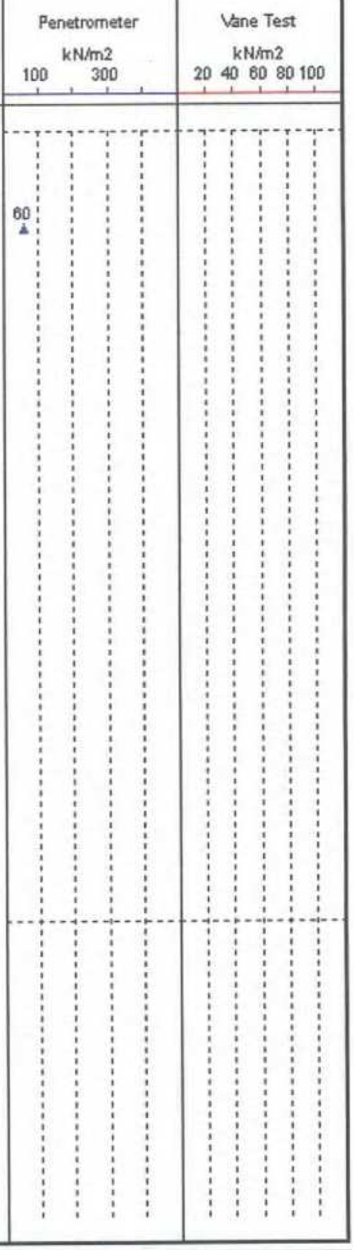
Water struck at 1.90m - small flow (c. 0.5 l/min)

Photo 23 - Pit

Photo 24 -Spoil

No Schmidt Hammer test available due to depth of pit

No standing water on completion



Method: Trial Pit

Date: 25/5/04

Hole Size: 4m x 1m

Whiteford Geoservices Ltd
Unit 2 Curran Business Park
Portland Road
Larne BT40 1DH

Datum: Ground Level

Checked by: JW

Sheet: 1 of 1

Project No: 386/04

Project: Taurbeg Wind Farm

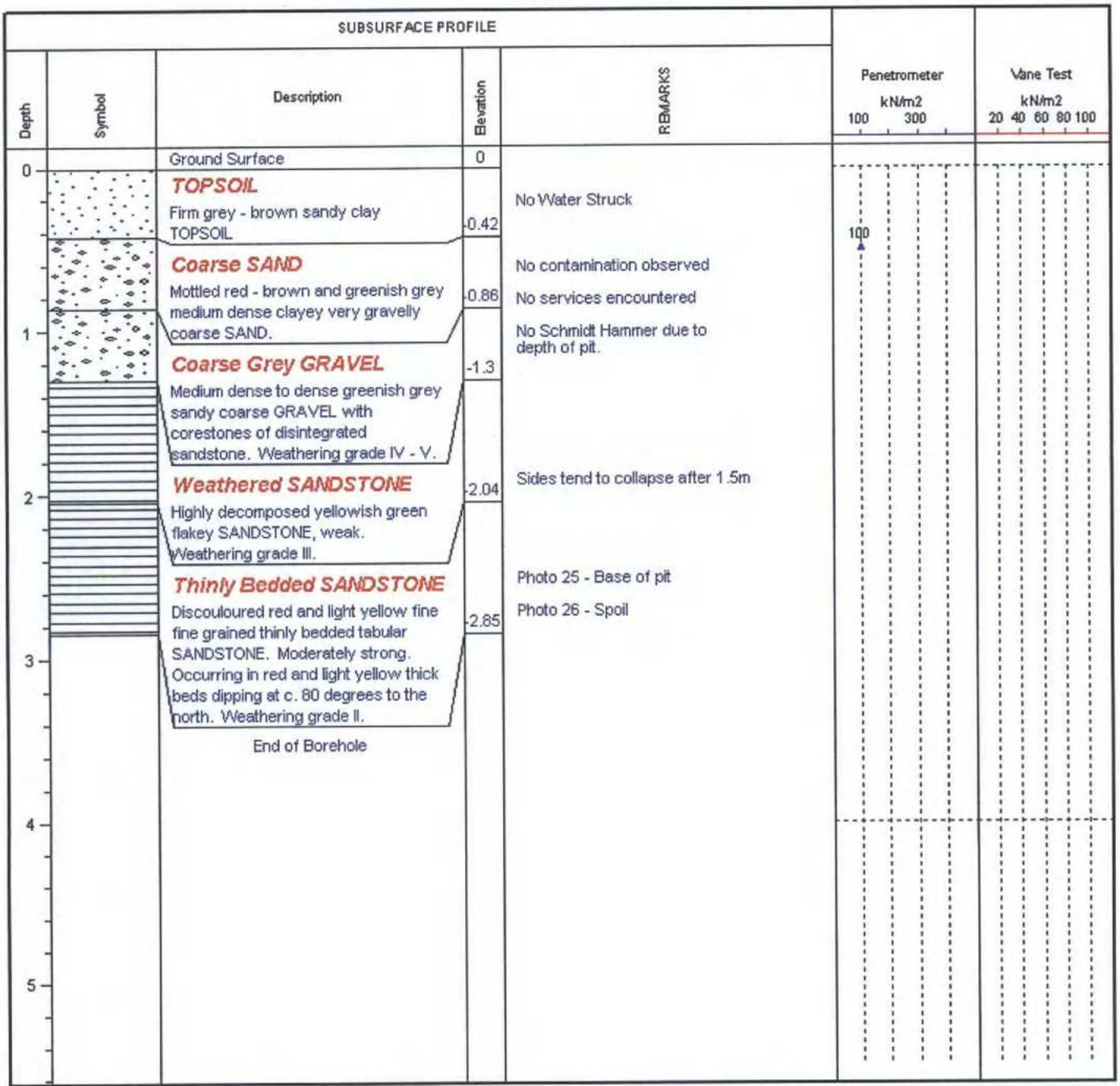
Client: RES Group Ltd

Location: Turbine 6

Log of Trial Pit: TP12

Position Ref: E = 122626, N = 112212

whiteford geoservices



Description	Elevation	REMARKS	Penetrometer kN/m2
Ground Surface	0		
TOPSOIL Firm grey - brown sandy clay TOPSOIL	-0.42	No Water Struck	100
Coarse SAND Mottled red - brown and greenish grey medium dense clayey very gravelly coarse SAND.	-0.86	No contamination observed No services encountered No Schmidt Hammer due to depth of pit.	
Coarse Grey GRAVEL Medium dense to dense greenish grey sandy coarse GRAVEL with corestones of disintegrated sandstone. Weathering grade IV - V.	-1.3		
Weathered SANDSTONE Highly decomposed yellowish green flakey SANDSTONE, weak. Weathering grade III.	-2.04	Sides tend to collapse after 1.5m	
Thinly Bedded SANDSTONE Discouloured red and light yellow fine fine grained thinly bedded tabular SANDSTONE. Moderately strong. Occurring in red and light yellow thick beds dipping at c. 80 degrees to the north. Weathering grade II.	-2.85	Photo 25 - Base of pit Photo 26 - Spoil	
End of Borehole			

Method: Trial Pit

Date: 25/5/04

Hole Size: 4m x 1m

Whiteford Geoservices Ltd
Unit 2 Curran Business Park
Portland Road
Larne BT40 1DH

Datum: Ground Level

Checked by: JW

Sheet: 1 of 1

Borehole Logs

Project No: 386/04

Project: Taurbeg Wind Farm

Client: RES Group Ltd

Location: Turbine T1

Borehole No: 1

Position: E = 122674, N = 111348

Engineer: RES Group Ltd

Depth	Symbol	Description	Elevation	Sample No.	Sample Type	Observations
0		Ground Surface	0			No contamination observed No water struck
0 – 2.5		***PEAT*** Dark brown firm PEAT	-2.5			
2.5 – 5.1		***Very Gravelly CLAY*** Firm to stiff yellow very gravelly CLAY with occasional angular shards of slitstone / mudstone	-5.1			
5.1 – 5.5		***Weathered MUDSTONE*** Yellowish grey discoloured fine grained mudstone, weak. Weathering grade (III)	-5.5			
		End of Borehole				

Bored By: ASAP Ltd

Bore Method: Dando Terrier

Bore Date: 12/06/04

Whiteford Geoservices
Unit 2 Curran Business Park
Larne
BT40 1DH

Hole Size: 110mm dia.

Datum: Below Ground Level

Sheet: 1 of 1

Project No: 386/04

Project: Taurbeg Wind Farm

Client: RES Group Ltd

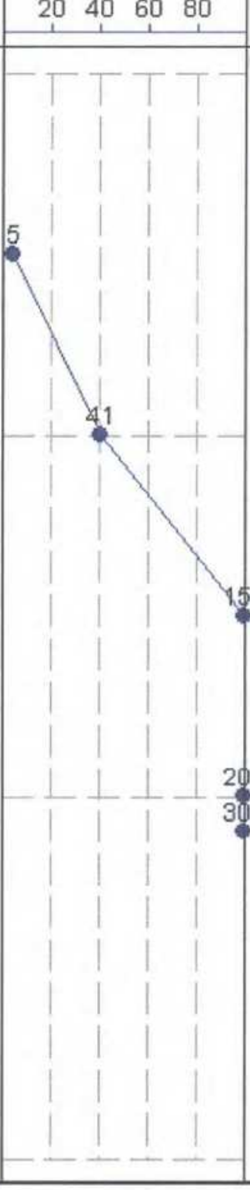
Location: Turbine T12

Borehole No: 2

Position: E = 122464, N = 111545

Engineer: RES Group Ltd

Depth	Symbol	Description	Elevation	Sample No.	Sample Type	SPT Blows	Observations
0		Ground Surface	0				
0 – 1.1		***PEAT*** Dark brown firm PEAT	-1.1			5	No contamination observed No water struck
1.1 – 4		***Firm Gravelly CLAY*** Firm to stiff green sandy gravelly CLAY	-4			41 156 200	
4 – 4.2		***Weathered SANDSTONE*** Yellow highly discoloured fine to medium grained sandstone, weak to moderately weak. Weathering grade (II - III)	-4.2			300	
		End of Borehole					



Bored By: ASAP Ltd

Bore Method: Dando Terrier

Bore Date: 12/06/04

Whiteford Geoservices
Unit 2 Curran Business Park
Larne
BT40 1DH

Hole Size: 110mm dia.

Datum: Below Ground Level

Sheet: 1 of 1

CBR In-Situ Test Results

CALIFORNIA BEARING RATIO LOG SHEET

PROJECT NAME: Taurbeg SI 386-04

OPERATOR: Al Burns

CBR TEST	GPS Co-ordinates		IN-SITU CBR TEST RESULTS (%)			
			Depth below peat layer			
NUMBER	Easting	Northing	0	0.15	0.45	0.75
1	122988	112235	14/refusal			
2	122925	112106	14/refusal			
3	122815	112151	14/refusal			
4	122371	112097	1.5	14/refusal		
5	122632	112143	2	5	14/refusal	
6	122598	112225	14/refusal			
7	122653	112038	2	1.5	14/refusal	
8	122555	122018	2	7	14/refusal	
9	122310	112104	2.6	5	10/refusal	
10	122311	112204	2.5	14/refusal		
11	122226	111966	2.5	7	14/refusal	
12	122127	111950	14/refusal			
13	121989	111930	5	14/refusal		
14	122346	111908	5	12/refusal		
15	122466	111885	0.5	10/refusal		
16	122373	111812	4	12/refusal		
17	122292	111732	2	5	10/refusal	
18	122201	111692	2	14/refusal		
19	122134	111640	Peat too	deep to	take CBR	
20	122401	111716	3	10/refusal		
21	122499	111591	2	10/refusal		
22	122457	111524	2	4	10/refusal	
23	122486	111428	4	2	14/refusal	

CBR TEST	GPS Co-ordinates		IN-SITU CBR TEST RESULTS (%)			
			Depth below peat layer			
NUMBER	Easting	Northing	0	0.15	0.45	0.75
24	122515	111332	3	2.5	10/refusal	
25	122574	111275	10/refusal			
26	122649	111340	2	10/refusal		
27	122739	111292	2	10/refusal		
28	122780	111200	1.5	10/refusal		
29	122819	111108	1	10/refusal		
30	122932	111116	3	10/refusal		
31	123012	111176	Peat too	deep to	take CBR	
32	123026	111263	Peat too	deep to	take CBR	
33	122875	111026	2	10	14/refusal	
34	122953	110910	1.5	10/refusal		
35	122726	111403	2	10/refusal		
36	122786	111483	2	10/refusal		
37	122837	11568	10/refusal			
38	122916	111575	2	10/refusal		
39	122931	111721	14/refusal			
40	122982	111811	14/refusal			
41	122987	111919	14/refusal			
42	123044	112013	14/refusal			
43	123052	112105	14/refusal			
44	123088	112152	14/refusal			
45	122697	111343	1.5	14/refusal		
46	122446	111904	1.5	14/refusal		
47	122013	111913	1.5	14/refusal		
48	122292	112185	2	8	14/refusal	
49	122621	112211	2.5	3	14/refusal	

CBR TEST	GPS Co-ordinates		IN-SITU CBR TEST RESULTS (%)			
			Depth below peat layer			
NUMBER	Easting	Northing	0	0.15	0.45	0.75
50	122902	112120	2	14/refusal		

APPENDIX 9-1

FLOOD RISK ASSESSMENT

HYDRO
ENVIRONMENTAL
SERVICES

22 Lower Main St
Dungarvan
Co.Waterford
Ireland

tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

TAURBEG WIND FARM
EXTENSION OF OPERATIONAL LIFE

FLOOD RISK ASSESSMENT

FINAL REPORT

Prepared for:

TAURBEG LTD

Prepared by:

HYDRO-ENVIRONMENTAL SERVICES

DOCUMENT INFORMATION

Document Title:	**Taurbeg Wind Farm Extension of Operational Life** **Flood Risk Assessment**
Issue Date:	**13th June 2025**
Project Number:	**P1688-0**
Project Reporting History:	**-**
Current Revision No:	**P1688-0_FRA_Rev_F0**
Author(s):	**Michael Gill** **Conor McGettigan** **Nitesh Dalal**
Signed:	Michael Gill **Michael Gill B.A., B.A.I., M.Sc., MIEI** **Managing Director – Hydro-Environmental Services**

Disclaimer:
This report has been prepared by HES with all reasonable skill, care and diligence within the terms of the contract with the client, incorporating our terms and conditions and taking account of the resources devoted to it by agreement with the client. We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above. The flood risk assessment undertaken as part of this study is site specific and the report findings cannot be applied to other sites outside of the survey area which is defined by the site boundary. This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies upon the report at their own risk.

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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) was engaged by MKO Ireland (MKO), acting on behalf of the Applicant, to undertake a Flood Risk Assessment (FRA) for a planning application for the proposed extension of life of Taurbeg Wind Farm, Co. Cork (*i.e.* the Proposed Project).

The following assessment is carried out in accordance with '*The Planning System and Flood Risk Management Guidelines for Planning Authorities*' (DoEHLG, 2009).

This FRA is intended to supplement the Environmental Impact Assessment Report (EIAR) submitted as part of the Proposed Project application.

As detailed in Section 1.1.1 of the EIAR, this FRA uses for the following terminology: 'Proposed Lifetime Extension', 'the Site', the 'Proposed Offsetting Measures' and the 'Proposed Project'.

1.2 STATEMENT OF QUALIFICATIONS

Hydro-Environmental Services (HES) are a specialist hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core area of expertise and experience is hydrology and hydrogeology, including flooding assessment and surface water modelling. We routinely work on surface water monitoring and modelling, and prepare flood risk assessment reports.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIARs for Slievecallan WF, Cahermurphy (Phase I & II) WF, Carrownagowan WF, and Croagh WF and over 100 other wind farm related projects across the country.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with over 4 years' experience in environmental consultancy in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor has prepared the Land, Soils and Geology and Hydrology and Hydrogeology Chapters for numerous wind farm EIAR projects. Conor routinely completes WFD Assessments for a wide variety of projects including wind farms, quarries and proposed residential developments.

Nitesh Dalal (B.Tech, PG Dip., MSc) is an Environmental Scientist with over 7 years' experience in environmental consultancy and environmental management in India. Nitesh holds a M.Sc. in Environmental Science from University College Dublin (2024), a PG Diploma in Health, Safety and Environment from Annamalai University, India (2021) and B.Tech. in Environmental Engineering (2016) from Guru Gobind Singh Indraprastha University, India (2016).

1.3 REPORT LAYOUT

This FRA report has the following format:

- Section 2 describes the site setting and details of the Proposed Project;
- Section 3 outlines the hydrological and geological characteristics of the local area;
- Section 4 presents a site-specific flood risk assessment (FRA) which was carried out in accordance with the above-mentioned guidelines;
- Section 5 Planning policy and responses to those policies outlined in this FRA and completes a justification test for the Proposed Project; and,
- Section 6 presents the FRA report conclusions.

2. BACKGROUND INFORMATION

2.1 INTRODUCTION

This section provides details on the topographical setting of the Site and the Proposed Offsetting lands along with a description of the Proposed Project.

2.2 SITE LOCATION AND TOPOGRAPHY

Proposed Lifetime Extension- the Site
The Site is located 3.5km south of Rockchapel and 10.5km northwest of Newmarket, Co. Cork. The Site is located in the townlands of Taurbeg, Glasheenanargid, Foiladaun, Glennaknockane, Meentinny West, Taurmore. The Site has a total area of ~112hectares (ha).

The Site is located in an upland setting and is situated on the southern foothills of the Mullaghareirk Mountain range. Topography within the Site ranges from ~302 metres above Ordnance Datum (mOD) in the northeast to ~405mOD in the southwest. The lowest elevations are found in the northeast of the Site, at the existing entrance to Taurbeg Wind Farm. Topography rises to the west and there are three local peaks within the Site, one standing at an elevation of ~392mOD in the north, with two local peaks standing at ~405mOD further south.

The Site is drained by several streams which ultimately drain to the River Feale or River Blackwater rivers. The Site comprises of a mixture of renewable energy production, coniferous forestry, blanket peat (bogs) and transitional woodland/scrub, and farmland (grassland). The existing Taurbeg Wind Farm is accessed via the wind farm site entrance off the L5005, in the townland of Taurbeg and is served by a network of existing wind farm access roads.

Taurbeg Wind Farm comprises of 11 no. existing wind turbines, associated hardstands, access roads, grid cabling, on onsite substation and met mast. There are no changes to the existing wind farm infrastructure are proposed as part of the Proposed Lifetime Extension.

Proposed Offsetting Lands
The Proposed Offsetting lands are located in townlands of Coom and Knockatee, Co. Kerry, ~12km west/southwest of the existing Taurbeg Wind Farm. The Proposed Offsetting lands consist of 4 no. parcels of land proposed for hen harrier habitat restoration, 3 in the townland of Coom (Areas 1, 2 and 4) and 1 no. further north in the townland of Knockatee (Area 3). The Proposed Offsetting Measures comprise the permanent removal of c. 105.5 ha of coniferous plantation forestry and the restoration of c.17.7 ha of farmland for the benefit of hen harrier. The total area of the Proposed Offsetting lands is ~123.2ha.

The Proposed Offsetting lands are located on the slopes of Mount Eagle which stands at an elevation of 431mOD. Topography within the Proposed Offsetting lands is steeply sloping and ranges from ~200 to ~380mOD.

Areas 1, 2 and 4 within the Proposed Offsetting lands are located in an area dominated by coniferous forestry plantations. Area 3 is located in an agricultural field whilst the remaining lands (~105.5ha) are located in coniferous forestry plantations (Areas 1, 2 and 4).

A site location map is shown as **Figure A**.

2.3 DEVELOPMENT DETAILS

Planning permission is being sought for the Proposed Lifetime Extension of Taurbeg Wind Farm as permitted by Cork County Council under planning regulation ref N/2002/3608, for a further period of 10 years from the date of expiry (2026) per Condition no. 7 of the original planning consent issued, with decommissioning of the wind farm at the end of the proposed extension period.

The Proposed Project is described in full in Chapter 4 of this EIAR and relates to the extended operation of all elements of the existing wind farm and the management of lands for the purposes of hen harrier.

There are no alterations proposed to the existing wind farm infrastructure, therefore, there are no requirements for construction works or reinstatement works for the Proposed Lifetime Extension.

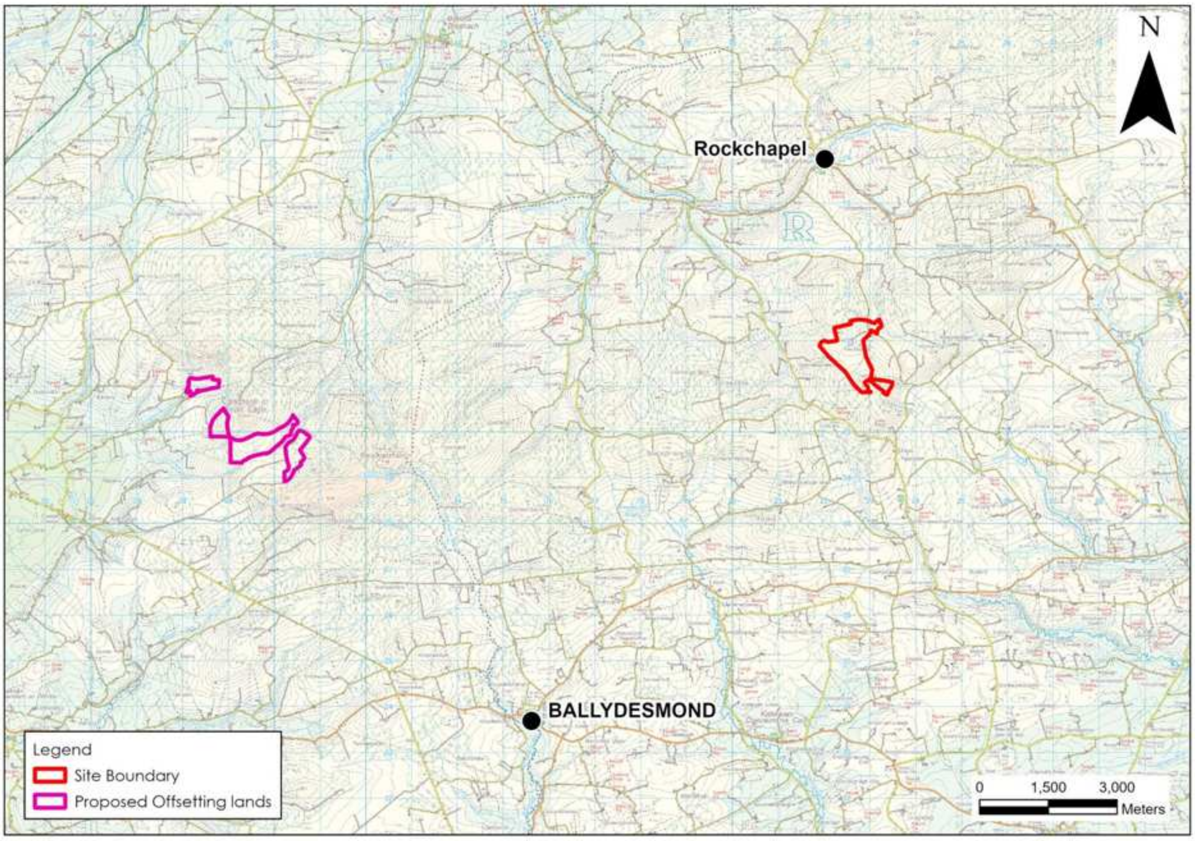

Figure A: Site Location Map

3. EXISTING ENVIRONMENT AND CATCHMENT CHARACTERISTICS

3.1 INTRODUCTION

This section gives an overview of the hydrological and geological characteristics of the region and the Site.

3.2 HYDROLOGY

3.2.1 Regional and Local Hydrology

Proposed Lifetime Extension

Regionally, the Site is located in 2 no. regional surface water catchments. The vast majority of the Site, including 10 of 11 no. existing turbines associated with the Taurbeg Wind Farm are located in the Tralee Bay-Feale surface water catchment within Hydrometric Area No. 23 of the Shannon River Basin District. Meanwhile, the south of the Site, including 1 no. existing turbine, is mapped within the Blackwater (Munster) surface water catchment within Hydrometric Area No. 18 of the South Western River Basin District.

More locally, within the Feale_SC_010 WFD river sub-catchment, the Site is located in 2 no. WFD river sub-basins. 8 no. turbines and the existing substation location are mapped in the Feale_010 WFD river sub-basin whilst 2 no. turbines are mapped in the Glenacarney_010 WFD river sub-basin to the west. Within the Feale_010 WFD river sub-basin, 2 no. 1st order streams emerge from within the Site, referred to by the EPA as the Knockahorrea East and the Glennaknockane streams. These streams flow to the east and merge to the east of a local road on the boundary between the townlands of Taurbeg and Glennaknockane. This watercourse then flows to the north and discharges into the Feale River at Rockchapel, ~3.2km to the north. Meanwhile, within the Glenacarney_010 WFD river sub-basin, the Glasheenanargid stream flows to the west and discharges into the Glenacarney River ~600m west of the Site. The Glenacarney River flows to the north and discharges into the Feale River ~3.8km to the northwest. The Feale River continues to flow to the northwest and discharges into the Feale Estuary to the west of Listowel.

More locally within the Dalua_SC_010 WFD river sub-catchment, the Site is mapped within the Owenkeal_010 and Glenlara_010 WFD river sub-basins. No infrastructure associated with the existing Taurbeg Wind Farm is located in the Owenkeal_010 WFD river sub-basin, while 1 no. turbine (T10) is located in the Glenlara_010 WFD river sub-basin. 2 no. streams drain the Site discharge into the Glenlara River ~2.5km to the southeast. The Glenlara River continues to flow to the southeast and discharges into the Dalua River to the west of Newmarket Town. The Dalua River discharges into the Allow River at Kanturk, ~16km to the southeast.

Proposed Offsetting Measures

The Proposed Offsetting lands are located in 2 no. regional surface water catchments. In the west the Proposed Offsetting lands are located in the Laune-Maine-Dingle Bay regional surface water catchment (Hydrometric Area 22) while the southeast is mapped in the Tralee Bay Feale regional surface water catchment (Hydrometric Area 23).

Within the Tralee Bay Feale regional surface water catchment, the Proposed Offsetting lands are mapped in the Feal_SC_030 WFD river sub-catchment and the Clydagh (Feale)_010 WFD river sub-basin. Within this sub-basin, the Proposed Offsetting lands are drained by the Glengarriff River which in the vicinity of the Proposed Offsetting lands is referred to by the EPA as the Tooreennascarty Stream. This stream flows to the northwest, immediately north of the Area 1 before it veers to the northeast. A tributary stream flows between the Proposed Offsetting lands before it discharges into the Glengarriff River. This river, also referred to by the EPA as the Clydagh River, continues to flow to the northeast, before it discharges into the Feale River near Clydagh Bridge, ~10.5km northeast of the Proposed Offsetting lands.

Within the Laune-Maine-Dingle Bay regional surface water catchment, the Proposed Offsetting lands are mapped in the Maine_SC_010 WFD river sub-catchment and the Shanowen (Maine)_010 WFD river sub-basin. Within this WFD river sub-basin a 2nd order stream, referred to as the Knockatee Stream is mapped to flow to the south along the western border of Area 3 of the Proposed Offsetting lands. Meanwhile, the Croaghane Stream is mapped to flow to the west, ~30m to the south. These 2 no. streams merge to form the Croaghane River. Further to the south, the Proposed Offsetting lands are drained by the Cloone (Shanowen) River. The Cloone and Croaghane rivers flow to the west and merge to form the Shanowen River ~5.3km west of the Proposed Offsetting lands near Fairfield Bridge. The Shanowen River discharges into the Maine River near Castleisland.

A local hydrology map is attached as **Figure B**.

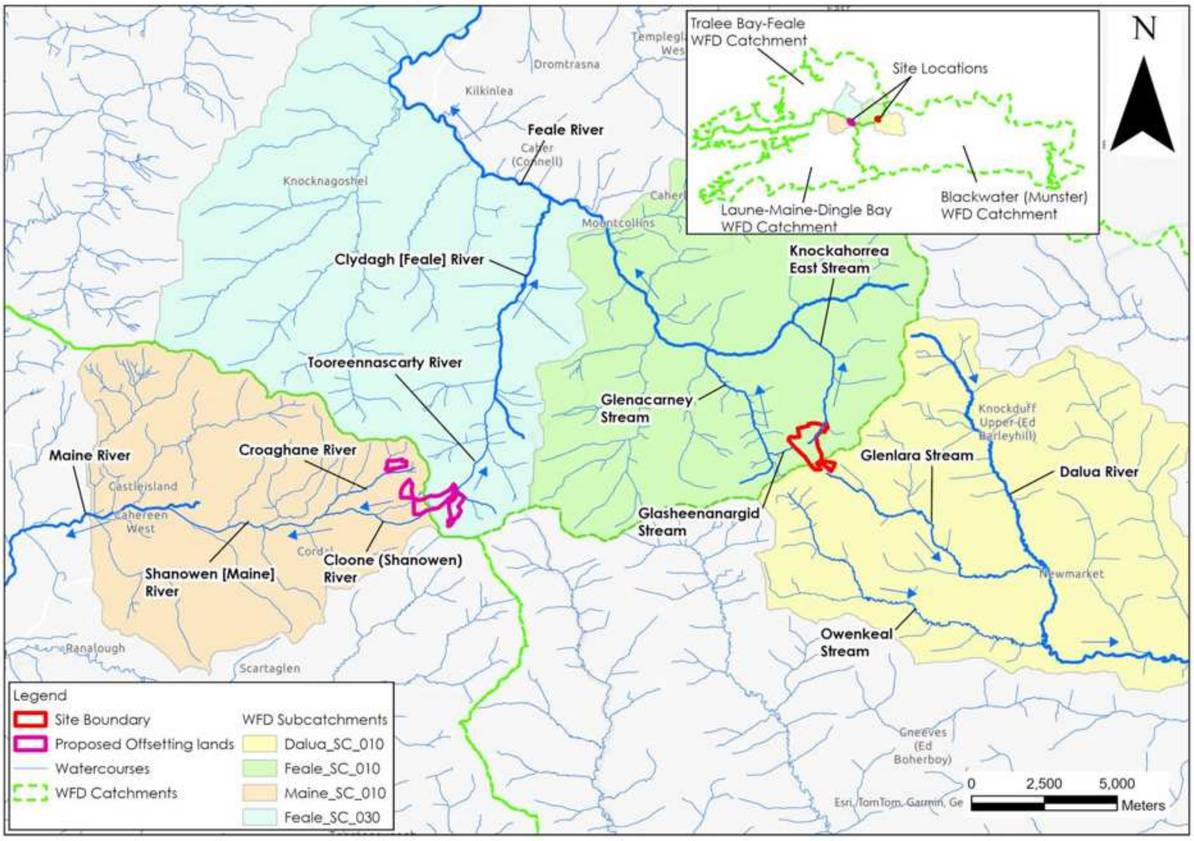

Figure B: Local Hydrology Map

3.2.2 Rainfall and Evaporation

The SAAR (Standard Average Annual Rainfall) recorded at Newmarket Garda Station, located ~7.6km to the southeast of the Site with long term SAAR data of 1,198mm (www.met.ie).

However, the AAR at Newmarket Garda Station may underestimate the actual AAR at the Site due to the elevation difference (the highest elevations at the Site (~405mOD) are ~250m higher than the elevation of Newmarket Garda Station (~157mOD).

Met Éireann also provide a grid of average annual rainfall for the entire country for the period of 1991 to 2020. Based on this more site-specific modelled rainfall values, the average annual rainfall at the Site ranges from 1,698 to 1,744mm/year. The average annual rainfall is

1,721mm/yr (this is considered to be the most accurate estimate of average annual rainfall from the available sources).

The average potential evapotranspiration (PE) at Shannon Airport ~50km northeast of the Site is taken to be 562.6mm/yr (www.met.ie). The actual evapotranspiration (AE) is calculated to be 534mm/yr (95% PE). Using the above figures, the effective rainfall (ER)[1] for the area is calculated to be (ER = SAAR – AE) 1,187mm/yr.

In addition to average rainfall data, extreme value rainfall depths are available from Met Eireann. **Table A** below presents return period rainfall depths for the area of the Site. These data are taken from https://www.met.ie/climate/services/rainfall-return-periods and they provide rainfall depths for various storm durations and sample return periods (1-year, 5-year, 30-year, 100-year).

Table A. Taurbeg Wind Farm – Return Period Rainfall Depths (mm)

	Return Period (Years)			
Duration	**1**	**5**	**30**	**100**
5 mins	3.9	5.9	8.9	11.6
15 mins	6.4	9.6	14.6	19
30 mins	8.7	12.8	19	24.3
1 hours	11.8	17	24.8	31.3
6 hours	25.9	35.4	48.9	59.7
12 hours	35	47	63.6	76.7
24 hours	47.5	62.4	82.7	98.5
2 days	62.5	80.1	103.2	120.8

3.3 GEOLOGY

Proposed Lifetime Extension

The published Teagasc soils map (www.gsi.ie) for the area shows that the Site is predominantly overlain by blanket peat. Some areas of peaty poorly drained, mainly acidic mineral soils (AminPDPT) and acidic poorly drained mineral soils (AminDW) soils are mapped around the periphery of the Site. Meanwhile, shallow, rocky, peaty/non-peaty mineral complexes (AminSPRT) are mapped in the valley of a stream to the south of T7. In terms of the existing Taurbeg Wind Farm infrastructure, 10 no. turbines and the existing onsite substation are mapped in areas of blanket peat whilst T06 is mapped in an area of acidic poorly drained mineral soils.

Similarly, the GSI subsoil mapping (www.gsi.ie) shows that blanket peat is the dominant subsoil type at the Site. Some tills derived from Namurian sandstones and shales are mapped around the periphery of the Site. Meanwhile, an area of bedrock outcrop or subcrop is mapped along a natural watercourse to the south of T7. In terms of the existing Taurbeg Wind Farm infrastructure, 10 no. turbines and the existing onsite substation are mapped in areas underlain by blanket peat. T6 is mapped to be underlain by till derived from Namurian sandstones and shales. There are no alluvium subsoils mapped within the Site. Alluvium is mapped downstream along the Glenacarney, the Feale, the Glenlara and the Owenkeal Rivers.

The soils and subsoils at the Site have been confirmed by the completion of 10 no. gouge cores (HES 2024) and the excavation of trial pits by Whiteford Geoservices (2004).

Based on the GSI bedrock mapping (www.gsi.ie) the Site is underlain by 2 no. bedrock geological formations. The northern section of the Site is underlain by the Glenoween Shale Formation which is comprised of grey silty mudstones. Meanwhile, the south of the Site is underlain by the Cloone Flagstone Formation which is composed of greywackes, siltstones and silty mudstones. In terms of the existing Taurbeg Wind Farm infrastructure, a total of 9 no.

---

[1] *ER – Effective Rainfall is the excess rainfall after evaporation which produces overland flow and recharge to groundwater.*

turbines and the onsite substation are mapped to be underlain by the Glenoween Shale Formation. Meanwhile, T10 and T11 are mapped to be underlain by the Cloone Flagstone Formation.

Proposed Offsetting Measures
The published Teagasc soils map (www.gsi.ie) shows that the Proposed Offsetting lands are predominantly overlain by blanket peat. However, Area 3 of the Proposed Offsetting lands in the townland of Knockatee is mapped to be overlain by acidic deep well drained mineral soils (AminDW), acidic poorly drained mineral soils (AminPD) and acidic shallow well drained mineral soils (AminSW).

The GSI subsoil map (www.gsi.ie) shows that the Proposed Offsetting lands are predominantly underlain by blanket peat. Meanwhile, till derived from Namurian sandstones and shales and bedrock outcrop or subcrop are mapped in Area 3 of the Proposed Offsetting lands in the townland of Knockatee. Some alluvial subsoils are also mapped along the Glengarriff Stream in the vicinity of the Proposed Offsetting lands.

A total of 107 no. peat probes were completed by GDG at the Proposed Offsetting lands with peat depths ranging from 0 to 3.2m, with a median peat depth of 1.6m.

In terms of bedrock, the Proposed Offsetting lands are underlain by the Glenoween Shale Formation and the Cloone Flagstone Formation.

3.4 SITE SURVEY AND DRAINAGE

The topography of the Site is mountainous, with protruding ridges of bedrock outcrop. Ground elevations slope in all directions and range from ~302 to 405mOD. Due to the local topography, the coverage of peat and low permeability of the underlying bedrock aquifer, the hydrology of the Site is characterised by a high density of surface water features.

The Site is drained by several streams which flow downslope before eventually discharging into the Feale River, to the north, and the Dalua River to the southeast.

In places the natural drainage is further facilitated by a network of manmade drains. These manmade drains are concentrated within the areas of coniferous forestry and along sections of the existing wind farm access roads.

Several of the hardstand areas have adopted an “over the edge” drainage approach (where no drains are located in the alongside hardstand areas) in conjunction with sections of roadside drainage swales. Site drainage measures installed during the construction phase (i.e. silt traps settlement and ponds) have since been removed as the Site has naturally revegetated overtime.

The on-site roadways are constructed of permeable crushed stone and are cambered to direct runoff to roadside drains which run along the sides of the roads. This ensures that drainage channels have not formed on the roads, have not eroded the roadways and caused excessive sedimentation downstream. The roadside drains contain check-dams at regular intervals which reduce runoff rates. The roadside drains discharge to several outfall points which are designed in such a way that the natural hydrology of the area remained undisturbed.

3.5 DESIGNATED SITES & HABITATS

Proposed Lifetime Extension
Within the Republic of Ireland designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs).

The Site is mapped within the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA (Site Code: 004161).

Furthermore, the Site has downstream hydrological connections with designated conservation sites in the region as described below:

- The Lower River Shannon SAC (Site Code: 002165) is located downstream of the Site via the Knockaahorrea East Stream. The length of the hydrological pathway between the Site and the SAC is ~1.8km.

- The Blackwater River (Cork/Waterford) SAC (Site Code: 002170) is located downstream of the Site via the Glenlara River. The length of the hydrological pathway between the Site and the SAC is ~6.5km.

Even further downstream and distant from the Site (>40km straight line distance) there are several designated sites situated within or on the banks of the Blackwater River. These include:

- The Blackwater Valley (Killavullen) pNHA (Site Code: 001080);
- The Blackwater Valley (Ballincurrig Wood) pNHA (Site Code: 001793);
- The Blackwater Valley (Killathy Wood) pNHA (Site Code: 001795);
- The Blackwater Valley (Cregg) pNHA (Site Code: 001796);
- The Blackwater Valley (The Beech Wood) pNHA (Site Code: 001797);
- Blackwater River Callows pNHA (Site Code: 000073);
- Blackwater Callows SPA (Site Code: 004094);
- Blackwater River And Estuary pNHA (Site Code: 000072); and,
- Blackwater Estuary SPA (Site Code: 004028).

The Cashen River Estuary pNHA (Site Code: 001340) is also located downstream (>35km straight line distance) of the Site in the Tralee Bay-Feale Catchment.

Other designated sites within 10km of the Site include:

- Mount Eagle Bogs NHA (Site Code: 002449) is situated ~7.5km to the west; and,
- Lough Gay Bog NHA (Site Code: 002454) is located ~9.3km to the north.

Proposed Offsetting Measures

The Proposed Offsetting lands are also mapped within the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA.

The Proposed Offsetting lands are located immediately adjacent to the Mount Eagle Bogs NHA (Site Code: 002449). This NHA consists of four areas of blanket big adjacent to Mount Eagle and includes the summits of Mount Eagle, Knockfeha and Knockanefune. The Proposed Offsetting lands are located topographically downgradient of this NHA.

Within the Tralee Bay-Feale regional surface water catchment, the Proposed Offsetting lands are also located immediately upstream of the Lower River Shannon SAC (Site Code: 002165), the length of the hydrological flowpath between the Proposed Offsetting lands and the SAC is ~2km along the Glengarriff River.

Within the Laune-Maine-Dingle Bay regional surface water catchment, the Proposed Offsetting lands are located ~28km northeast (straight line distance) of the Castlemaine Harbour SAC (Site Code: 000343).

4. SITE SPECIFIC FLOOD RISK ASSESSMENT

4.1 INTRODUCTION

The following flood risk assessment is carried out in accordance with '*The Planning System and Flood Risk Management Guidelines for Planning Authorities*' (DoEHLG, 2009). The basic objectives of these guidelines are to:

- Avoid inappropriate development in areas at risk of flooding;
- Avoid new developments increasing flood risk elsewhere, including that which may arise from surface water run-off;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders; and,
- Ensure that the requirements of EU and national law in relation to the natural environment and nature conservation are complied with at all stages of flood risk management.

4.2 FLOOD RISK ASSESSMENT PROCEDURE

This section of the report details the site-specific flood risk assessment carried out for the Site and surrounding area and Proposed Offsetting Lands. The primary aim of the assessment is to consider all types of flood risks and the potential impact on the development. As per the relevant guidance (DOEHLG, 2009), the stages of a flood risk assessment are:

- *Flood risk identification* – identify whether there are surface water flooding issues at a site;
- *Initial flood risk assessment* - confirm sources of flooding that may affect a development; and,
- *Detailed flood risk assessment – quantitative appraisal of potential risk to a development*.

As per the Guidelines, there are essentially two major causes of flooding:

Coastal flooding which is caused by higher sea levels than normal, largely as a result of storm surges, resulting in the sea overflowing onto the land. Coastal flooding is influenced by the following three factors, which often work in combination:

- High tide level;
- Storm surges caused by low barometric pressure exacerbated by high winds (the highest surges can develop from hurricanes); and,
- Wave action, which is dependent on wind speed and direction, local topography and exposure.

Due to its inland location, coastal flooding is not applicable to the Site or Proposed Offsetting lands.

Inland flooding which is caused by prolonged and/or intense rainfall. Inland flooding can include a number of different types:

- Overland flow occurs when the amount of rainfall exceeds the infiltration capacity of the ground to absorb it. This excess water flows overland, ponding in natural hollows and low-lying areas or behind obstructions. This occurs as a rapid response to intense rainfall and eventually enters a piped or natural drainage system.

- River flooding occurs when the capacity of a watercourse is exceeded or the channel is blocked or restricted, and excess water spills out from the channel onto adjacent low-lying areas (the floodplain). This can occur rapidly in short steep rivers or after some time and some distance from where the rain fell in rivers with a gentler gradient.

- Flooding from artificial drainage systems results when flow entering a system, such as an urban storm water drainage system, exceeds its discharge capacity and the system becomes blocked, and / or cannot discharge due to a high water level in the receiving watercourse. This mostly occurs as a rapid response to intense rainfall. Together with overland flow, it is often known as pluvial flooding. Flooding arising from a lack of capacity in the urban drainage network has become an important source of flood risk, as evidenced during recent summers.

- Groundwater flooding occurs when the level of water stored in the ground rises as a result of prolonged rainfall to meet the ground surface and flows out over it, i.e. when the capacity of this underground reservoir is exceeded. Groundwater flooding tends to be very local and results from interactions of site-specific factors such as tidal variations. While water level may rise slowly, it may be in place for extended periods of time. Hence, such flooding may often result in significant damage to property rather than be a potential risk to life.

- Estuarial flooding may occur due to a combination of tidal and fluvial flows, i.e. interaction between rivers and the sea, with tidal levels being dominant in most cases. A combination of high flow in rivers and a high tide will prevent water flowing out to sea tending to increase water levels inland, which may flood over river banks.

The Flood Risk Management Guidelines provide direction on flood risk and development. The guidelines recommend a precautionary approach when considering flood risk management and the core principle of the guidelines is to adopt a risk based sequential approach to managing flood risk and to avoid development in areas that are at risk. The sequential approach is based on the identification of flood zones for inland and coastal flooding.

Flood zones are geographical areas within which the likelihood of flooding is in a particular range, and they are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning.

There are three types or levels of flood zones defined within the guidelines:

Flood Zone A –	where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);
Flood Zone B –	where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and,
Flood Zone C –	where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

Once a flood zone has been identified for a site, the guidelines set out the different types of development appropriate to each identified zone (pg 25, Table 3.1 of the Guidelines). Exceptions to the restriction of development due to potential flood risks are provided for through the application of a Justification Test, where the planning need and the sustainable management of flood risk to an acceptable level must be demonstrated by the applicant.

The Justification Test has been designed to rigorously assess the appropriateness, or otherwise, of particular developments that, for the reasons outlined above, are being considered in areas of moderate or high flood risk. The test is comprised of two processes.

- The first is the **Plan-making Justification Test** described in Chapter 4 of the Guidelines and used at the plan preparation and adoption stage where it is intended to zone or otherwise designate land which is at moderate or high risk of flooding. Plan making Justification Tests are made at Plan/Policy development stage such as County Development Plans, or Local Area Plans.

- The second is the **Development Management Justification Test** described in Chapter 5 of the Guidelines and used at the planning application stage where it is intended to develop land at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be inappropriate for that land. For example, application of Development Management Justification Test would be required at a site specific level, such as for this FRA assessment, if a Justification Test is required.

4.3 FLOOD RISK IDENTIFICATION

4.3.1 Historical Mapping

To identify those areas as being at risk of flooding, historical mapping (*i.e.* 6" and 25" base maps) were consulted. There was no identifiable map text on local available historical 6" or 25" mapping for the study area that would identify lands that are "liable to flood" within or in the vicinity of the Site or in the Proposed Offsetting lands.

4.3.2 Soils Maps - Fluvial Maps

A review of the soil types in the vicinity of the Site was undertaken as soils can be a good indicator of past flooding in an area. Due to past flooding of rivers, deposits of transported silts/clays referred to as alluvium build up within the flood plain and hence the presence of these soils is a good indicator of potentially flood prone areas.

Based on the EPA/GSI soil mapping for the local area, there are no alluvium subsoils mapped within the Site. Alluvium is mapped downstream along the Glenacarney, the Feale, the Glenlara and the Owenkeal Rivers. The closest mapped alluvial deposits to the existing infrastructure are located along the Glenacarney River ~1km west of T3.

The low permeability blanket peat soils/subsoils that are mapped throughout the Site result in high rates of surface water runoff and low rates of groundwater recharge, so the surface water predominantly flows into the streams that emerge within and near the Site.

With regards to the Proposed Offsetting Measures, some alluvial subsoils are also mapped along the Glengarriff Stream in the vicinity of the southern Proposed Offsetting lands. However, these mapped deposits do not extend any significant distance from the stream and therefore are not indicative of a floodplain.

4.3.3 OPW Past Flood Events Mapping

To identify those areas as being at risk of flooding, OPW's Past Flood Events Map was consulted (www.floodinfo.ie).

No recurring or historic flood incidents are recorded within the Site.

Within the Tralee Bay Feale catchment the closest mapped historic flood event is ~5km downstream of the Site at the confluence of the Knockahorrea East stream and the Feale River at Rockchapel. This event was recorded in August 1986 (Flood ID: 2414).

Within the Blackwater (Munster) catchment, a recurring flood event is mapped ~7km downstream of the Site along the R578 on the Glenlara River, near its confluence with the Dalua River. According to the Area Engineer Notes for Newmarket, the R578 road flooding occurs along a stretch of ~1km, resulting from high flows in River Dalua (Flood ID: 5153).

No areas within the Site are mapped as an OPW Drainage District, i.e. an area where drainage schemes to improve land for agricultural purposes were constructed or as Benefiting Lands, i.e. land identified by the OPW as potentially benefitting from the implementation of Arterial (Major) Drainage Schemes and an indicator of land subject to flooding and poor drainage.

Meanwhile, the OPW Past Flood Events Maps have no records of recurring or historic flood instances in the vicinity of the Proposed Offsetting lands.

Historic and recurring flood events in the vicinity and downstream of the Site and the Proposed Offsetting lands are shown on **Figure C** below.

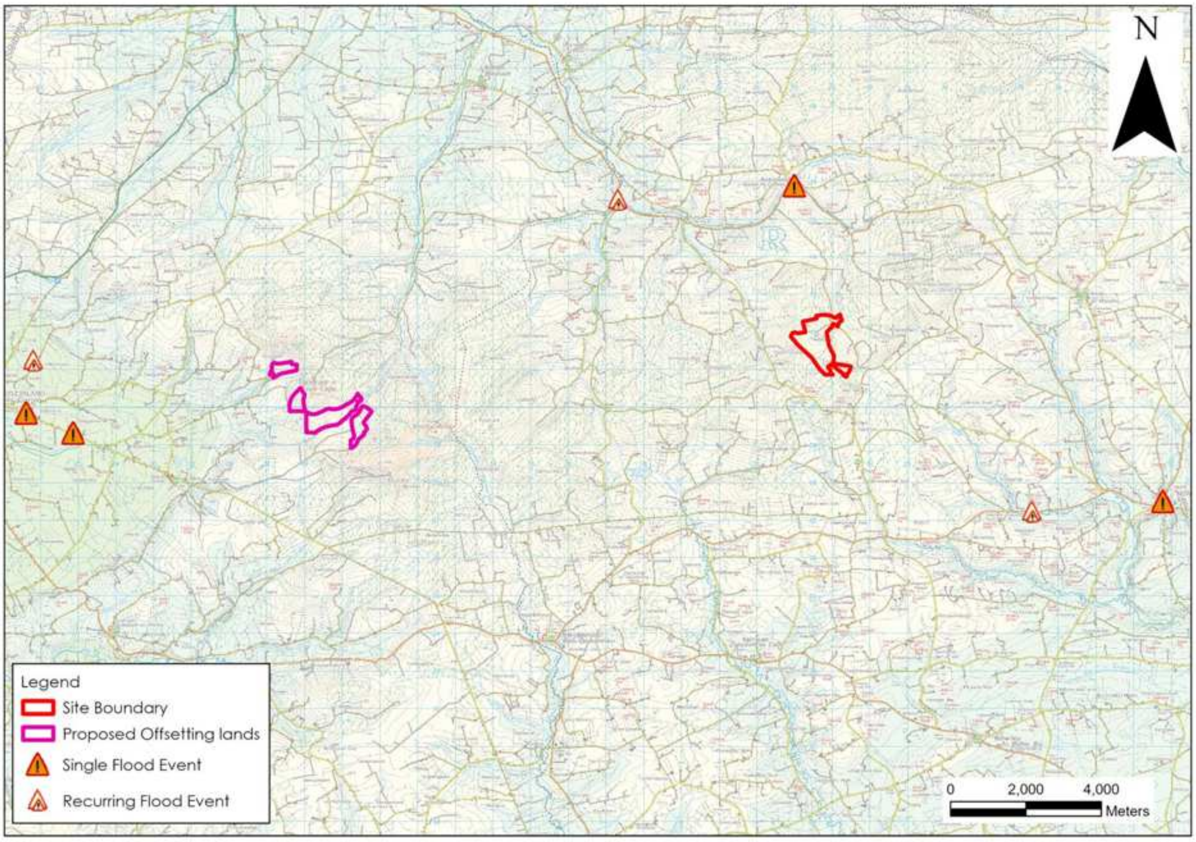

Figure C: OPW Past flood Events Map

4.3.4 GSI Winter (2015/2016) Surface Water Flooding Map

Furthermore, the GSI Winter (2015/2016) Surface Water Flooding Map[2] shows areas of fluvial and pluvial flood extents during the Winter 2015/2016 flood event, which was the largest recorded flood event in many areas.

The flood map for this event does not record any flood zones long the streams and watercourses which drain the Site or the Proposed Offsetting lands.

4.3.5 CFRAM Mapping – Fluvial and Pluvial Flooding

Catchment Flood Risk Assessment and Management (CFRAM)[3] OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the previous PFRA maps.

CFRAM mapping has not been completed for the area of the Site or the Proposed Offsetting lands. The closest CFRAM mapping to the Site has been completed along the Dalua River to the southeast of Newmarket town, ~11km to the southeast. The closest CFRAM mapping to the Proposed Offsetting lands has been completed along the River Maine at Castleisland.

4.3.6 National Indicative Fluvial Flood Mapping

The National Indicative Fluvial Flood Mapping (www.floodinfo.ie) shows probabilistic fluvial flood zones for catchments greater than 5km^2 for which flood maps were not produced under the CFRAM Programme.

The Present Day Scenario has been generated using methodologies based on historic flood data and does not take into account the potential changes due to climate change. The potential effects of climate change on flooding have been separately modelled (see **Section 4.3.9** below.)

The National Indicative Flood Mapping (NIFM) for the Present Day Scenario shows flooding along the Knockahorrea East stream and the Glenacarney River in the Tralee Bay Feale catchment downstream of the Site. Fluvial flood zones are also mapped along the Owenkeal and Glenlara Rivers that drain the south of the Site. The distances to these downstream flood zones are detailed below:

- ~2.2km downstream, along the Knockahorrea East River;
- ~2.4km downstream, along the Glenacarney River;
- ~2.6km downstream, along the Owenkeal River; and,
- ~2.7km downstream, along the Glenlara River.

However, the medium (1% AEP, 1 in 100yr) and low (0.1% AEP, 1 in 1,000yr) probability flood zones do not encroach upon the Site. The steep topography of the area, and the associated high gradients and deeply incised channels of the local streams, preclude any risk of fluvial flooding or out of bank flow.

Therefore, the Site is within the Fluvial Flood Zone C, where the probability of fluvial flooding is low (less than 0.1%). A fluvial map showing the National Indicative Fluvial Flood Mapping for the present day scenario is included as **Figure D** below.

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[2] GSI *Historical flood mapping principally developed using Sentinel-1 Satellite Imagery from the European Space Agency Copernicus Programme as well as any available historic records (from winter 2015/2016 or otherwise)*

[3] *CFRAM is Catchment Flood Risk Assessment and Management. The national CFRAM programme commenced in Ireland in 2011 and is managed by the OPW. The CFRAM Programme is central to the medium to long-term strategy for the reduction and management of flood risk in Ireland.*

No NIFM flood zones are mapped in the immediate vicinity of the Proposed Offsetting lands. The closest mapped flood zones are located along the Glengarriff River (Clydagh River), ~900m downstream of the Proposed Offsetting lands, and along the Croaghane River, ~2.2km west of the Proposed Offsetting lands.

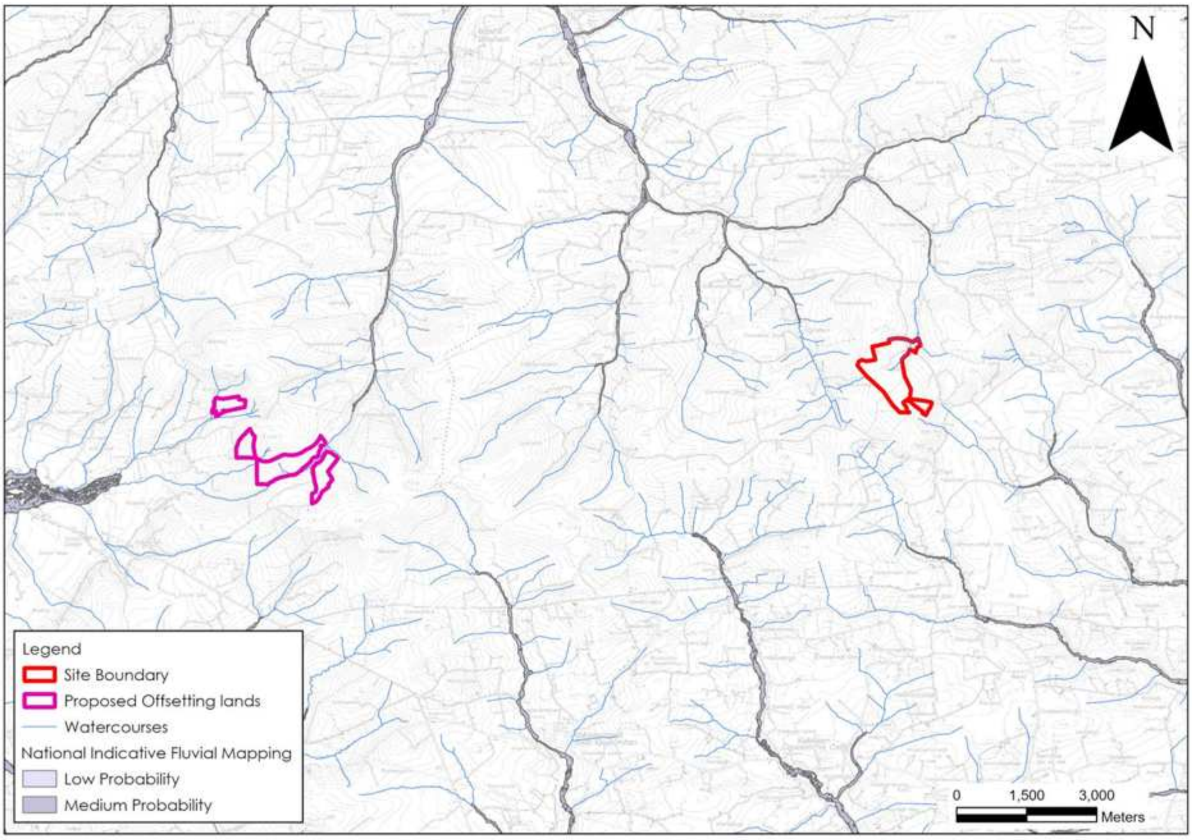

Figure D: OPW National Indicative Flood Mapping

4.3.7 Coastal Flooding

The Site is located ~40km inland and at an elevation of between ~290mOD to 405mOD. Furthermore, the Proposed Offsetting lands are distant from the coast and at elevations in excess of 200mOD.

Therefore, the Site and the Proposed Offsetting lands are not at risk of coastal (tidal) flooding.

4.3.8 Groundwater Flooding

The GSI Historical Groundwater flood map and the modelled groundwater flood extents map (www.floodinfo.ie) do not show the occurrence of any groundwater flooding within the Site or in the Proposed Offsetting lands.

4.3.9 Climate Change

Fluvial flood modelling has also been completed to consider future climate scenarios where the potential effects of climate change can increase rainfall.

The National Indicative Fluvial Flood Mapping Mid-Range Future Scenario models flood extents based on a 20% increase in rainfall. Similarly, the National Indicative Fluvial Flood Mapping High-End Future Scenario models flood extends based on a 30% increase in rainfall.

Both of these modelled flood extents show similar flood zones to the Present Day Scenario discussed above in **Section 4.3.6**. Therefore, flood zones at the Wind Farm Site are unlikely to be significantly impacted by future climate change.

4.3.10 Summary – Flood Risk Identification

Based on the information gained through the flood identification process, it is apparent that the Site and the Proposed Offsetting lands are located in Flood Zone C and are at low risk of flooding.

4.4 INITIAL FLOOD RISK ASSESSMENT

4.4.1 Hydrological Flood Conceptual Model

Potential flooding in the vicinity of the Site and at the Proposed Offsetting lands can be described using the Source – Pathway – Receptor Model ("S-P-R"). The primary potential source of flooding in this area is fluvial, and more likely to occur downstream from the Site along the rivers and streams that drain the Site. The primary potential pathways, in the most likely order of significance, would be overbank flooding of the rivers downstream during significant rainfall events. The potential receptors in the area are infrastructure and land as outlined below.

4.4.2 Summary – Initial Flood Risk Assessment

Based on the information gained through the flood identification process and Initial Flood Risk Assessment process it would appear that flooding is unlikely to be problematic at the Site or downstream of the Site. The potential sources of flood risk for the Site are outlined and assessed in **Table B**.

Based on the information gained through the flood identification process and Initial Flood Risk Assessment process it has been determined that flooding is unlikely to be problematic within the Site.

Based on the information gained through the flood identification process and Initial Flood Risk Assessment process the sources of flood risk for the Site and Proposed Offsetting lands are outlined and assessed in **Table B.**

Table B. S-P-R Assessment of Flood Sources.

Source	Pathway	Receptor	Comment
Fluvial	Overbank flooding of the rivers and streams downstream of the Site	Land & infrastructure	The Site and the Proposed Offsetting lands are located in Fluvial Flood Zone C where there is a low risk of fluvial flooding.
Pluvial	Ponding of rainwater on Site	Land & infrastructure	There is slight risk of pluvial flooding at the Site and at the Proposed Offsetting lands due to the presence of impermeable blanket peat soils. However, the risk is very low as drainage moves relatively freely as a result of the sloping topography and the existing drainage.
Surface water	Surface ponding/ Overflow	Land & infrastructure	Same as above (pluvial).
Groundwater	Rising groundwater levels	Land & infrastructure	Based on local hydrogeological regime and GSI mapping, there is no risk of groundwater flooding at the Site or at the Proposed Offsetting lands.
Coastal/tidal	Overbank flooding	Land, People, property	The Site and the Proposed Offsetting lands are inland and stand at significant elevations above sea level. Therefore, there is no risk of coastal/tidal flooding.

4.5 REQUIREMENT FOR A JUSTIFICATION TEST

The matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test[4] is shown in **Table C** below.

It may be considered that the Site can be categorised as "Highly Vulnerable Development". However, as stated above, all wind farm infrastructure is located in Flood Zone C (Low Risk) and therefore the Site is appropriate from a flood risk perspective.

Table C: Matric of Vulnerability versus Flood Zone

	Flood Zone A	**Flood Zone B**	**Flood Zone C**
Highly vulnerable development (including essential infrastructure)	Justification test	Justification test	**Appropriate**
Less vulnerable development	Justification test	Appropriate	Appropriate
Water Compatible development	Appropriate	Appropriate	Appropriate

Note: *Taken from Table 3.2 (DoEHLG, 2009)*
Bold: *Applies to this project.*

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[4] *A 'Justification Test' is an assessment process designed to rigorously assess the appropriateness, or otherwise, of particular developments that are being considered in areas of moderate or high flood risk, (DoEHLG, 2009).*

5. PLANNING POLICY AND JUSTIFICATION TEST

5.1 PLANNING POLICY AND COUNTY DEVELOPMENT PLAN

The following policies (**Table D**) are defined in Cork County CDP 2022-2028 in respect of flooding, and we have outlined in the column to the right how these policies are provided for within the Site:

Table D: Cork County Council Planning Policy/Objective and Responses

No.	Policy/Objective	Development Design Response
WM 11-13 (a)	Protect the County's floodplains, wetlands and coastal areas subject to flooding as vital green infrastructure which provides space for storage and conveyance of floodwater, enabling flood risk to be more effectively managed and reducing the need to provide flood defences in the future.	No such areas identified in the Site.
WM 11-13 (b)	Ensure that development does not impact on wetland sites within river / stream catchments and seek the restoration of degraded wetlands	No such areas identified in the Site.
WM 11-14 (a)	Support the implementation of • the EU Flood Risk Directive (20010/60/EC) on the assessment and management of flood risks, • the Flood Risk Regulations (SI No 122 of 2010) • the Guidelines on 'The Planning System and Flood Risk Management' (2009) and • the recommendations of the South Western CFRAM study.	As Outlined in this FRA
WM 11-14 (b)	Application of the flood policies of this Plan shall be fully informed by the recommendations contained in the updated Strategic Flood Risk Assessment (June 2022) accompanying the Plan, including the conclusions of Justification Tests contained therein.	As Outlined in this FRA
WM 11-15	To require flood risk assessments to be undertaken for all new developments within the County in accordance with The Planning System and Flood Risk Management – Guidelines for Planning Authorities (2009) and the requirements of DECLG Circular P12/2014 and the EU Floods Directive.	Not applicable as the it is not a new development.
WM 11-16	Take the following approach in order to reduce the risk of new development being affected by possible future flooding: • Avoid development in areas at risk of flooding; and • Apply the sequential approach to flood risk management based on avoidance, substitution, justification and mitigation of risk. • Where development in floodplains cannot be avoided, applications for development must meet the definition of Minor Development or have passed the Justification Test for Development Plans in the updated SFRA and can pass the Justification Test for Development Management to the satisfaction of the planning authority. • • Consider the impacts of climate change on the development. In areas where the Justification Test for Development Plans has not been applied, or has been failed, the sequential approach should be applied as follows: • In areas where there is a high probability of flooding - 'Flood Zone A' - avoid highly and less vulnerable development as described in Section 3 of 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities' issued in November 2009 by DoEHLG. • In areas where there is a moderate probability of flooding -	Not applicable as the it is not a new development.

	'Flood Zone B' - avoid 'highly vulnerable development' described in section 3 of 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities' issued in November 2009 by DoEHLG. • In areas where there is low probability of flooding – 'Flood Zone C' all uses may be considered subject to a full consideration of all flood risks.	
WM 11-17 (1)	The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.	As Outlined in this FRA
WM 11-17 (2)	The proposal has been subject to an appropriate flood risk assessment that demonstrates: a) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk; b) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible; c) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; d) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.	As Outlined in this FRA and Section 4.5

6. REPORT CONCLUSIONS

- A flood risk identification study was undertaken to identify existing potential flood risks associated with the Proposed Lifetime Extension and the Proposed Offsetting Measures. From this study:
    - No instances of historical flooding were identified in historic OS maps within the Site or in the Proposed Offsetting lands;
    - No instances of recurring or historic flooding were identified on OPW maps within the Site or in the Proposed Offsetting lands;
    - No instances of recurring flood incidents were identified on OPW maps immediately in the Site or the Proposed Offsetting lands;
    - Neither the Site or the Proposed Offsetting lands are not identified within the OPW/CFRAM or NIFM Flood Zones; and,
    - The Site and the Proposed Offsetting lands are associated with Flood Zone C.
- During the walkover surveys and flow monitoring at the Site, there was no evidence of out of bank flow from within the various stream/river channels. No widespread or even localized flooding was observed during these Site visits;
- There has been no reported increase in downstream flood risk associated with the operational phase of the existing Taurbeg Wind Farm;
- The Taurbeg Wind Farm can be categorised as “Highly Vulnerable Development”, however, all infrastructure is located outside of areas mapped as Flood Zones and therefore the proposed extension of life of the Taurbeg Wind Farm is appropriate from a flood risk perspective;
- The overall risk of flooding posed at the Site is estimated to be very low. A low risk would typically relate to the probability of being impacted by a 1000-year flood (*i.e.* the entire area of the Site footprint is located in fluvial Flood Zone C). The flooding risk at the Site has an estimated AEP of <0.1%. All infrastructure is located within Flood Zone C; and,
- In addition, the risk of the Proposed Lifetime Extension or the Proposed Offsetting Measures contributing to downstream flooding is also very low. The long-term plan for the Site is to retain and slow down drainage water rates prior to release. Robust drainage measures on the Site will include swales, silt traps, check dams, settlement ponds and buffered outfalls. Please refer to Chapter 9 of the EIAR for further details.

* *

7. REFERENCES

DOEHLG	2009	The Planning System and Flood Risk Management.
Natural Environment Research Council	1975	Flood Studies Report (& maps).
Cunnane & Lynn	1975	Flood Estimated Following the Flood Studies Report
CIRIA	2004	Development and Flood Risk – Guidance for the Construction Industry.
OPW	Not Dated	Construction, Replacement or Alteration of Bridges and Culverts. A Guide to Applying for Consent under Section 50 of the Arterial Act, 1945.
Institute of Hydrology	1994	Flood Estimation in Small Catchments (IH 124).
Fitzgerald & Forrestal	1996	Month and Annual Averages of Rainfall for Ireland 1961 – 1990.
Met Eireann	1996	Monthly and Annual Averages of Rainfall for Ireland 1961-1990.
Cork County Council	2022	County Cork Development Plan 2022-2028

APPENDIX 9-2

Laboratory Reports

ALS Life Sciences Ltd trading as ALS
Carrigeen Business Park, Clonmel, Co. Tipperary
Telephone: +353 (0) 52 617 8100

Report No: HYDR-850260324
Document No: EF0011

CERTIFICATE OF ANALYSIS

Client **Hydro Environmental Services**
22 Lower Main Street
Dungarvan
Co. Waterford

Date Submitted 26/03/2024
Date Reported 10/04/2024
Order Number p1688-0

For the Attention of: Hydro Environmental Services

Sample Reception 4 sample(s) received in good condition.

Comments N/A

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

Conditions:
1. Results in this report relate only to the items tested
2. Reports may not be reproduced except in full without the approval of ALS Life Sciences Ltd
3. All queries regarding this report should be addressed to the Technical Manager at the above address
*4. A * next to a method reference signifies that ALS Life Sciences Ltd is NOT INAB accredited for this method*
5. Results reported as CFU/cm² are calculated based on information supplied by customer regarding area swabbed
6. SUBCON indicates analysis subcontracted to approved subcontractors who do not hold accreditation for this test*
7. SUBCON^ indicates analysis subcontracted to approved subcontractors who hold accreditation for this test
8. Where sampling is undertaken by ALS personnel, sampling activities are outside the scope of INAB accreditation
9. Dil next to a method reference indicates that a dilution of the water sample was undertaken during testing
10. Statement of conformity made against the result does not take into account the uncertainty of measurement associated with the method

Report No: HYDR-850260324

Document No: EF0011

CERTIFICATE OF ANALYSIS

Date Submitted 26/03/2024
Date Reported 10/04/2024
Order Number p1688-0

Sample Type Water
Client ID P1688 - Taurbeg SW 1 13:30 26/03/2024
Date Tested 27/03/2024
ALS ID 6054299

Test	Result	Unit	Method
Suspended Solids	<5	mg / l	P202
Phosphorus	0.1	mg/l P	P207
BOD 5 day Total	2	mg/l O2	P280
Ammonia	0.02	mg/l NH3-N	P281
Chloride	9.2	mg/l Cl	P281
Nitrate	<5.0	mg/l NO3	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Total Oxidised Nitrogen	<0.25	mg/L N	P281
Nitrogen (Total)	<1.0	mg/L N	P285

Sample Type Water
Client ID P1605 - Taurbeg SW 2 14:00 26/03/2024
Date Tested 27/03/2024
ALS ID 6054300

Test	Result	Unit	Method
Suspended Solids	<5	mg / l	P202
Phosphorus	<0.1	mg/l P	P207
BOD 5 day Total	2	mg/l O2	P280
Ammonia	<0.02	mg/l NH3-N	P281
Chloride	5.3	mg/l Cl	P281
Nitrate	5.6	mg/l NO3	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Total Oxidised Nitrogen	1.25	mg/L N	P281
Nitrogen (Total)	<1.0	mg/L N	P285

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

ISO 17025
INAB
ACCREDITED
TESTING
DETAILED IN SCOPE REG NO.166T

Report No: HYDR-850260324
Document No: EF0011

CERTIFICATE OF ANALYSIS

Date Submitted 26/03/2024
Date Reported 10/04/2024
Order Number p1688-0

Sample Type Water
Client ID P1605 - Taurbeg SW 3 14:30 26/03/2024
Date Tested 27/03/2024
ALS ID 6054301

Test	Result	Unit	Method
Suspended Solids	<5	mg / l	P202
Phosphorus	<0.1	mg/l P	P207
BOD 5 day Total	1	mg/l O2	P280
Ammonia	0.02	mg/l NH3-N	P281
Chloride	5.8	mg/l Cl	P281
Nitrate	<5.0	mg/l NO3	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Total Oxidised Nitrogen	<0.25	mg/L N	P281
Nitrogen (Total)	<1.0	mg/L N	P285

Sample Type Water
Client ID P1605 - Taurbeg SW 4 15:00 26/03/2024
Date Tested 27/03/2024
ALS ID 6054302

Test	Result	Unit	Method
Suspended Solids	<5	mg / l	P202
Phosphorus	0.2	mg/l P	P207
BOD 5 day Total	2	mg/l O2	P280
Ammonia	0.02	mg/l NH3-N	P281
Chloride	9.5	mg/l Cl	P281
Nitrate	<5.0	mg/l NO3	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Total Oxidised Nitrogen	<0.25	mg/L N	P281
Nitrogen (Total)	1.2	mg/L N	P285

Report Authorised by: Rosemary Thomas

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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.166T

Report No:	HYDR-821140824
Document No:	EF0011

CERTIFICATE OF ANALYSIS

Client **Hydro Environmental Services**
22 Lower Main Street
Dungarvan
Co. Waterford

Date Submitted	14/08/2024
Date Reported	28/08/2024
Order Number	P1688-0

For the Attention of:	Hydro Environmental Services
Sample Reception	4 sample(s) received in good condition.
Comments	N/A

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

Conditions:
1. Results in this report relate only to the items tested as received
2. Reports may not be reproduced except in full without the approval of ALS Life Sciences Ltd
3. All queries regarding this report should be addressed to the Technical Manager at the above address
*4. A * next to a method reference signifies that ALS Life Sciences Ltd is NOT INAB accredited for this method*
5. Results reported as CFU/cm² are calculated based on information supplied by customer regarding area swabbed
6. SUBCON indicates analysis subcontracted to approved subcontractors who do not hold accreditation for this test*
7. SUBCON^ indicates analysis subcontracted to approved subcontractors who hold accreditation for this test
8. Where sampling is undertaken by ALS personnel, sampling activities are outside the scope of INAB accreditation
9. Dil next to a method reference indicates that a dilution of the water sample was undertaken during testing
10. Statement of conformity made against the result does not take into account the uncertainty of measurement associated with the method

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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.166T

Report No: HYDR-821140824

Document No: EF0011

CERTIFICATE OF ANALYSIS

Date Submitted 14/08/2024
Date Reported 28/08/2024
Order Number P1688-0

Sample Type Effluent
Client ID P1688 Taurbeg SW5 11:30 14/08/2024
Date Tested 15/08/2024
ALS ID 6284290

Test	Result	Unit	Method
Suspended Solids	<6	mg / l	P202
Phosphorus	<0.10	mg/l P	P207
BOD 5 day Total	<1	mg/l O2	P280
Ammonia	0.02	mg/l NH3-N	P281
Chloride	14.7	mg/l Cl	P281
Nitrate	<5.0	mg/l NO3	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Total Oxidised Nitrogen	0.64	mg/L N	P281
Nitrogen (Total)	<1.0	mg/L N	P285

Sample Type Effluent
Client ID P1605 Taurbeg SW2 12:00 14/08/2024
Date Tested 15/08/2024
ALS ID 6284291

Test	Result	Unit	Method
Suspended Solids	<5	mg / l	P202
Phosphorus	0.11	mg/l P	P207
BOD 5 day Total	<1	mg/l O2	P280
Ammonia	0.06	mg/l NH3-N	P281
Chloride	18.4	mg/l Cl	P281
Nitrate	<5.0	mg/l NO3	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	0.04	mg/l P	P281
Total Oxidised Nitrogen	0.40	mg/L N	P281
Nitrogen (Total)	1.1	mg/L N	P285

Report Authorised by: Rosemary Thomas

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ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO.166T

Report No: HYDR-821140824
Document No: EF0011

CERTIFICATE OF ANALYSIS

Date Submitted 14/08/2024
Date Reported 28/08/2024
Order Number P1688-0

Sample Type Effluent
Client ID P1605 Taurbeg SW3 12:30 14/08/2024
Date Tested 15/08/2024
ALS ID 6284292

Test	Result	Unit	Method
Suspended Solids	55	mg / l	P202
Phosphorus	<0.10	mg/l P	P207
BOD 5 day Total	<1	mg/l O2	P280
Ammonia	<0.02	mg/l NH3-N	P281
Chloride	11.5	mg/l Cl	P281
Nitrate	<5.0	mg/l NO3	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Total Oxidised Nitrogen	0.52	mg/L N	P281
Nitrogen (Total)	<1.0	mg/L N	P285

Sample Type Effluent
Client ID P1605 Taurbeg SW4 12:45 14/08/2024
Date Tested 15/08/2024
ALS ID 6284293

Test	Result	Unit	Method
Suspended Solids	17	mg / l	P202
Phosphorus	<0.10	mg/l P	P207
BOD 5 day Total	<1	mg/l O2	P280
Ammonia	0.02	mg/l NH3-N	P281
Chloride	14.0	mg/l Cl	P281
Nitrate	<5.0	mg/l NO3	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Total Oxidised Nitrogen	<0.25	mg/L N	P281
Nitrogen (Total)	<1.0	mg/L N	P285

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

APPENDIX 9-3

Water Framework Directive Compliance Assessment

HYDRO
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TAURBEG WIND FARM
EXTENSION OF OPERATIONAL LIFE

WATER FRAMEWORK DIRECTIVE COMPLIANCE ASSESSMENT

FINAL REPORT

Prepared for:

TAURBEG LTD

Prepared by:

HYDRO-ENVIRONMENTAL SERVICES

DOCUMENT INFORMATION

Document Title:	**WATER FRAMEWORK DIRECTIVE ASSESSMENT PROPOSED EXTENSION OF LIFE, TAURBEG WIND FARM, CO. CORK**
Issue Date:	**13th June 2025**
Project Number:	**P1688-0**
Project Reporting History:	**P1688-0**
Current Revision No:	**P1688-0 _WFD_F0**
Author:	**MICHAEL GILL CONOR MCGETTIGAN NITESH DALAL**
Signed:	Michael Gill **Michael Gill B.A., B.A.I., M.Sc., MIEI Managing Director – Hydro-Environmental Services**

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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) were requested by MKO Ireland (MKO), acting on behalf of Taurbeg Ltd, to complete a Water Framework Directive (WFD) Compliance Assessment for a planning application for the proposed extension of life for Taurbeg Wind Farm, Co. Cork (i.e. the Proposed Project).

The purpose of this WFD assessment is to determine if any specific components or activities associated with the proposed lifetime extension application will compromise WFD objectives or cause a deterioration in the status of any surface water or groundwater body and/or jeopardise the attainment of good surface water or groundwater status. This assessment will determine the water bodies with the potential to be impacted, describe the proposed mitigation measures and determine if the Site is in compliance with the objectives of the WFD.

This WFD Assessment is intended to supplement the Environmental Impact Assessment Report (EIAR) submitted as part of the Proposed Lifetime Extension application.

As detailed in Section 1.1.1 of the EIAR, this FRA uses for the following terminology: 'Proposed Lifetime Extension', 'the Site', the 'Proposed Offsetting Measures', the 'Proposed Offsetting lands' and the 'Proposed Project'.

1.2 STATEMENT OF AUTHORITY

Hydro-Environmental Services (HES) are a specialist hydrological, hydrogeological and environmental practice that delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types including wind farms.

This WFD assessment was prepared by Michael Gill, Conor McGettigan and Nitesh Dalal.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIARs for Slievecallan WF, Cahermurphy (Phase I & II) WF, Carrownagowan WF, and Croagh WF and over 100 other wind farm related projects across the country.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with over 4 years' experience in environmental consultancy in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor has prepared the Land, Soils and Geology and Hydrology and Hydrogeology Chapters for numerous wind farm EIAR projects. Conor routinely completes WFD Assessments for a wide variety of projects including wind farms, quarries and proposed residential developments.

Nitesh Dalal (B.Tech, PG Dip., MSc) is an Environmental Scientist with over 7 years' experience in environmental consultancy and environmental management in India. Nitesh holds a M.Sc. in Environmental Science from University College Dublin (2024), a PG Diploma in Health, Safety and Environment from Annamalai University, India (2021) and B.Tech. in Environmental Engineering (2016) from Guru Gobind Singh Indraprastha University, India (2016).

1.3 WATER FRAMEWORK DIRECTIVE

The EU Water Framework Directive (2000/60/EC), as amended by Directives 2008/105/EC, 2013/39/EU and 2014/101/EU (“**WFD**”), was established to ensure the protection of the water environment. The Directive was transposed in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003).

The WFD requires that all member states protect and improve water quality in all waters, with the aim of achieving good status by 2027 at the latest. Any new development must ensure that this fundamental requirement of the WFD is not compromised.

The WFD is implemented through the River Basin Management Plans (RBMP) which comprises a six-yearly cycle of planning, action and review. RBMPs include identifying river basin districts, water bodies, protected areas and any pressures or risks, monitoring and setting environmental objectives. In Ireland the first RBMP covered the period from 2010 to 2015 with the second cycle plan covering the period from 2018 to 2021, and the third cycle covers the period from 2022 to 2027[1]. The RBMPs are forward looking.

The Water Action Plan 2024 is Ireland’s 3rd River Basin Management Plan (2022 - 2027). The objectives of the Water Action Plan 2024 have been integrated into the design of the Project and include:

- Ensure full compliance with relevant EU legislation;
- Prevent deterioration;
- Meet the water standards and objectives for designated protected areas;
- Protect high-status waters; and,
- Implement targeted action and pilot schemes in focus sub-catchments aimed at (i) targeting water bodies close to meeting their objective and (ii) addressing more complex issues that will build knowledge for future cycles.

Our understanding of these objectives is that water bodies, regardless of whether they have ‘Poor’ or ‘High’ status, should be treated the same in terms of the level of protection and mitigation measures employed.

---

[1] *The WFD RBMP cycles are forward looking plans, so 2009-2015 (1st Cycle), 2016-2021 (2nd Cycle), and 2022-2027 (3rd Cycle) are the plans and they use status from the previous 6 years.*
The EPA updates status every three years, but they also complete an additional assessment mid-RBMP cycle. The mid-cycle status does not get reported to the Commission.
The linkage between the two is that the 2nd Cycle plan uses the 2009-2015 status, the 3rd Cycle plan uses the 2016-2021 status. The 2013-2018 status was not used in the RBMP and the 2019-2024 status will not be used in the next RBMP.

2. WATERBODY IDENTIFICATION AND CLASSIFICATION

2.1 INTRODUCTION

This section identifies those Surface Waterbodies (SWBs) and Groundwater Bodies (GWBs) with potential to be affected by the Proposed Project and reviews any available WFD information.

2.2 SURFACE WATERBODY IDENTIFICATION

Proposed Lifetime Extension

Regionally, the Site is located in 2 no. surface water catchments. The vast majority of the Site, including 10 of 11 no. turbines, is located in the Tralee Bay-Feale surface water catchment within Hydrometric Area No. 23 of the Shannon River Basin District. The very south of the Site, including 1 no. turbine, is mapped within the Blackwater (Munster) surface water catchment within Hydrometric Area No. 18 of the Shannon River Basin District.

Within the Tralee Bay-Feale regional surface water catchment, the Site is located within the Feale_SC_010 sub-catchment and 2 no. WFD river sub-basins. 8 no. turbines and the existing substation location are mapped in the Feale_010 WFD river sub-basin whilst 2 no. turbines are mapped in the Glenacarney_010 WFD river sub-basin to the west. Within the Feale_010 WFD river sub-basin, 2 no. 1st order streams emerge from within the Site. These watercourses are locally unnamed but are referred to by the EPA as the Knockahorrea East and the Glennaknockane streams. These streams form part of the Feale_010 SWB and flow to the east and merge together to the east of a local road. This watercourse then flows to the north and discharges into the Feale River at Rockchapel, ~3.2km to the north. Meanwhile, within the Glenacarney_010 WFD river sub-basin, the EPA map a 1st order stream, referred to as the Glasheenanargid stream, to flow to the west and discharge into the Glenacarney River ~600m west of the Site. These watercourses form part of the Glenacarney_010 SWB. The Glenacarney River flows to the north and discharges into the Feale River (Feale_020 SWB) ~3.8km to the northwest. The Feale River continues to flow to the northwest before the Feala_090 SWB discharges into the Upper Feale Estuary to the west of Listowel. Further downstream this joins to the Cashen River Estuary and the Mouth of the Shannon coastal SWB.

Within the Blackwater (Munster) surface water catchment, the Site lies within the Dalua_SC_010 sub-catchment and 2 no. WFD river sub-basins. No infrastructure associated with the existing Taurbeg Wind Farm is located in the Owenkeal_010 WFD river sub-basin, while 1 no. turbine is located in the Glenlara_010 WFD river sub-basin. 2 no. 1st order streams are mapped by the EPA to flow to the southeast from the Site. These streams merge and discharge into the Glenlara River ~2.5km to the southeast. The Glenlara River continues to flow to the southeast and discharges into the Dalua River (Dalua_020 SWB) to the west of Newmarket Town. The Dalua River (Dalua_040 SWB) discharges into the Allow River (Allow_060 SWB) at Kanturk, ~16km to the southeast. Further downstream the Allow_070 SWB discharges into the Blackwater River (Blackwater (Munster)_090 SWB).

Figure A below is a local hydrology map of the area.

Table A presents the catchment area of each SWB downstream of the Site as far as the Feale Estuary in the Tralee Bay-Feale catchment and the River Blackwater in the Blackwater (Munster) catchment. The catchment area for these SWBs increases progressively downstream as more tributaries discharge into the Feale and Dalua Rivers. Therefore, those waterbodies which are located in close proximity to the Site are more susceptible to water quality impacts as a result of activities associated with the Site. The potential for the Site to impact a waterbody decreases further downstream due to the increasing catchment area to the surface waterbody and resulting increase in flow volumes (Note that the Proposed Project does not in any way rely on dilution or the assimilative capacity of any downstream waterbody for the protection of surface water quality or quantity – the mitigation measures detailed in Section 4.3 are prescribed to ensure that the Proposed Project does not impact any downstream SWB).

Table A: Catchment Area Downstream of the Site

WFD River Sub-Basin	Total Upstream Catchment Area (km^2)
Tralee Bay Feale Catchment	
Glenacarney_010	20
Feale_010	28
Feale_020	60
Feale_030	120
Feale_040	208
Feale_050	318
Feale_060	492
Feale_070	515
Feale_080	661
Feale_090	673
Blackwater (Munster) Catchment	
Owenkeal_010	14
Owenkeal_020	25
Glenlara_010	25
Dalua_020	56
Dalua_030	87
Dalua_040	134
Allow_060	266
Allow_070	311
Blackwater (Munster)_090	>900

Proposed Offsetting Measures

The Proposed Offsetting lands are located in 2 no. regional surface water catchments. In the west, the Proposed Offsetting lands are located in the Laune-Maine-Dingle Bay regional surface water catchment (Hydrometric Area 22) while the southeast is mapped in the Tralee Bay Feale regional surface water catchment (Hydrometric Area 23).

Within the Tralee Bay Feale regional surface water catchment, the Proposed Offsetting lands are mapped in the Feal_SC_030 WFD river sub-catchment and the Clydagh (Feale)_010 WFD river sub-basin. Within this river sub-basin, the Proposed Offsetting lands are drained by the Glengarriff River which forms part of the Clydagh (Feale)_010 SWB. This river flows to the northeast, before the Clydagh (Feale)_020 SWB discharges into the Feale River (Feale_040 SWB) near Clydagh Bridge, ~10.5km northeast of the Proposed Offsetting lands.

Within the Laune-Maine-Dingle Bay regional surface water catchment, the Proposed Offsetting lands are mapped in the Maine_SC_010 WFD river sub-catchment and the Shanowen (Maine)_010 WFD river sub-basin. Within this river sub-basin, the Proposed Offsetting lands are drained by the Knockatee and Croaghane streams and the Cloon (Shanowen) River which form part of the Shanowen (Maine)_010 SWB. The Shanowen River discharges into the Maine River (Maine_020 SWB) near Castleisland. Further downstream, the Maine River discharges into the Castlemaine Harbour transitional waterbody.

The catchment area of the river waterbodies downstream of the Proposed Offsetting lands are detailed in **Table B**.

Table B: Catchment Area Downstream of the Proposed Offsetting lands

WFD River Sub-Basin	**Total Upstream Catchment Area (km²)**
Tralee Bay Feale Catchment	
Clydagh (Feale)_010	23
Clydagh (Feale)_020	41
Feale_040	208
Laune-Maine-Dingle Bay Catchment	
Shanowen (Maine)_010	11
Maine_010	45
Maine_020	92
Maine_030	155
Maine_040	~300

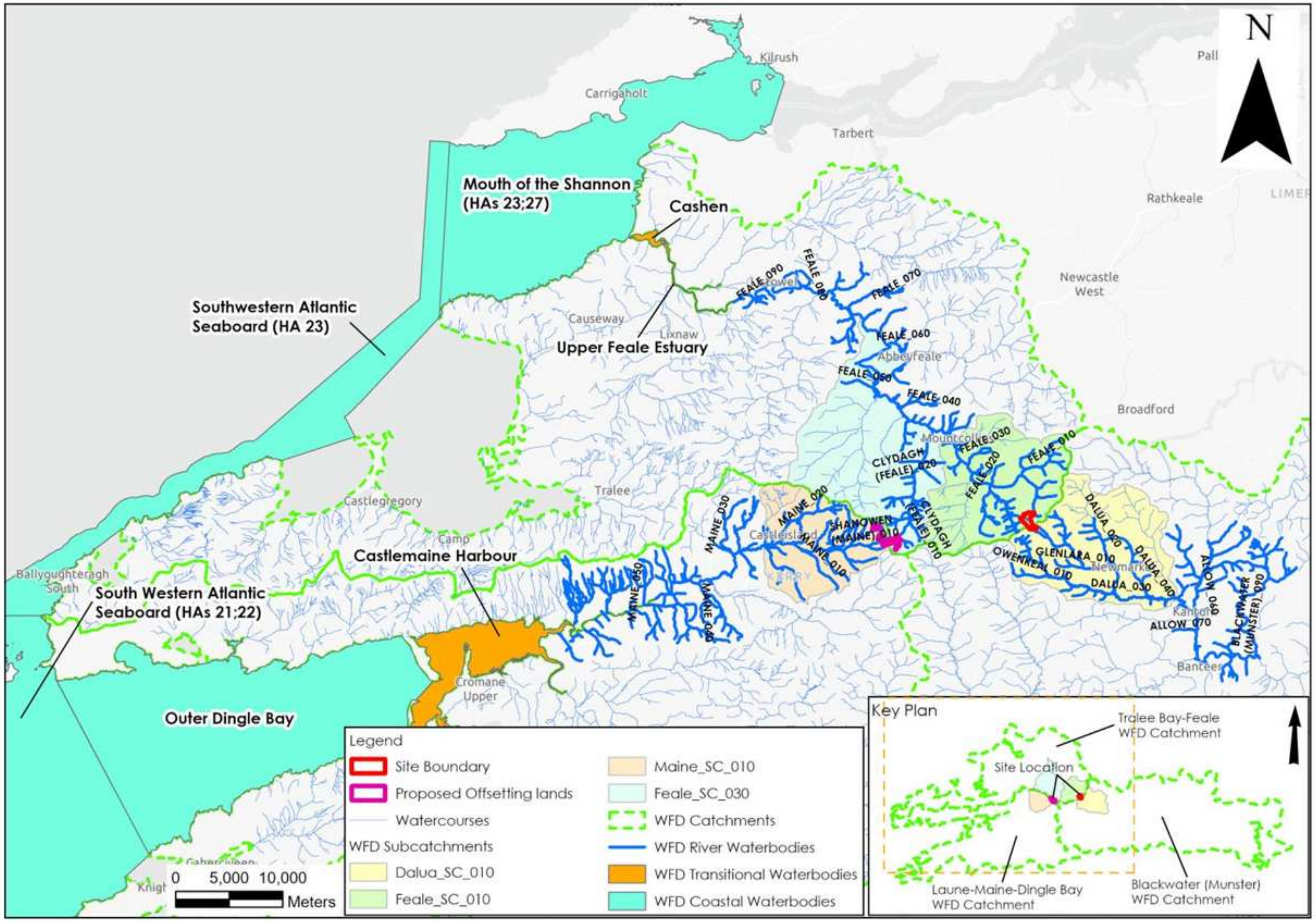

Figure A: Local Hydrology Map

2.3 SURFACE WATER BODY CLASSIFICATION

A summary of the WFD status and risk result for SWBs downstream of the Site and the Proposed Offsetting lands are shown in **Table C**. The overall status is based on the ecological, chemical and quantitative status of each SWB.

Local Surface water Body (SWB) status information is available from (www.catchments.ie).

As described in **Section 2.2** above, the majority of the Site drains to the River Feale. The Feale_010 SWB achieved "High" status in the latest WFD cycle (2016-2021). This was an improvement on the "Good" status which was achieved by this SWB in the previous cycles. Meanwhile, the Glenacarney_010 SWB achieved "Good" status in all 3 no. WFD cycles. Further downstream the WFD status of the River Feale ranges from "Moderate" to "Good". Meanwhile, the Feale_070 SWB achieved "High" status.

In terms of risk status, only the very lower reaches of the River Feale (Feale_090 SWB) have been deemed to be "at risk" of failing to meet its future WFD objectives. All other river SWBs downstream of the Site are classified as being "not at risk". Hydromorphology, urban run-off and agricultural activities have been identified as significant pressures impacting negatively on the Feale_090 SWB.

Within the Blackwater (Munster) catchment, the Owenkeal_010 SWB in the vicinity of the Site achieved "Good" status in the latest WFD cycle. However, as stated previously no infrastructure associated with the existing Wind Farm is located within this WFD river sub-basin. Meanwhile, the Glenara_010 SWB achieved "Moderate" status in all 3 no. WFD cycles. Further downstream, the Dalua_020 and _030 SWBs are of "Good" status whilst the Dalau_040 SWB is of "High" status. The status of the Allow River downstream of the Site ranges from "Moderate" to "Good" status. The status of the Blackwater River downstream of the confluence with the Allow River is "Good" (Blackwater (Munster)_090 SWB).

In terms of risk status, the Glenara_010 SWB has been classified as being "at risk" with hydromorphology and forestry activities listed as significant pressures on the waterbody. Both the Dalua_020 and the Dalua_040 SWBs are "not at risk" whilst the Dalua_030 SWB is "at risk". The Allow_060 SWB is "at risk" with agriculture, hydromorphology, industry, urban wastewater and other activities noted as significant pressures. The Allow_070 SWB is "not at risk". The risk status of the Blackwater (Munster)_090 SWB is "at risk".

In terms of the Proposed Offsetting lands, the Shanowen (Maine)_010 SWB in the vicinity achieved "Good" status in all 3 no. WFD cycles. Further downstream, the Maine_010 SWB achieved 'Moderate' status in the latest WFD cycle (2016-2021). This was a deterioration from the 'Good' status which this SWB achieved previous WFD cycles. The Maine_010 SWB is deemed to be at risk of failing to meet its WFD objectives and is listed as being under significant pressure from hydromorphological impacts. Within the Tralee Bay-Feale regional surface water catchment, the Clydagh (Feale)_010 and _020 SWBs downstream of the Proposed Offsetting lands achieved 'High' status in the latest WFD cycle (2016-2021). This was an improvement in status from the 'Good' status which these SWBs achieved in the 2013-2018 cycle. These SWBs are not at risk of failing to meet their WFD objectives.

With regards the transitional waterbodies, the Feale River downstream of the Site discharges into the Upper Feale Estuary, which in turn leads into the Cashen transitional waterbody. These transitional SWBs achieved "Moderate" and "Poor" status respectively and both are "at risk. Within the Laune-Maine-Dingle Bay Catchment, Castlemaine Harbour transitional SWB achieved "Poor" status and is "at risk" of failing to meet its WFD objectives.

With regards to downstream coastal waterbodies, the Mouth of the Shannon (HAs 23;27) and Southwestern Atlantic Seaboard (HA 23) coastal waterbodies within the Tralee Bay-Feale Catchment achieved "Good" and "High" status respectively and are "not at risk". Within the

Laune-Maine-Dingle Bay Catchment, the Outer Dingle Bay coastal SWB achieved "High" status in the latest WFD cycle.

The SWB status for the 2016-2021 WFD cycle are shown on **Figure B.**

Table C: Summary WFD Information for River Water Bodies

SWB	Overall Status 2010-2015	Overall Status 2013-2018	Overall Status 2016-2021	Risk Status 3rd Cycle	Pressures
	Tralee Bay-Feale Catchment				
Glenacarney_010	Good	Good	Good	Not at risk	None
Feale_010	Good	Good	High	Not at risk	None
Feale_020	Good	Good	Good	Not at risk	None
Feale_030	Good	Good	Good	Not at risk	None
Feale_040	Good	Good	Good	Not at risk	None
Feale_050	Good	Good	Good	Not at risk	None
Feale_060	Good	Moderate	Good	Not at risk	None
Feale_070	Good	Good	High	Not at risk	None
Feale_080	Moderate	Good	Good	Not at risk	None
Feale_090	Moderate	Moderate	Moderate	At risk	Agriculture, hydromorphology & urban run-off
Upper Feale Estuary	Poor	Poor	Moderate	At risk	Agriculture, hydromorphology & urban wastewater
Cashen	Poor	Poor	Poor	At risk	Agriculture & urban wastewater
Mouth of the Shannon (HAs 23;27)	Moderate	Good	Good	Not at risk	None
Southwestern Atlantic Seaboard (HA 23)	Unassigned	High	High	Not at risk	None
Clydagh (Feale)_010	Good	Good	High	Not at risk	None
Clydagh (Feale)_020	Moderate	Good	High	Not at risk	None
	Laune-Maine-Dingle Bay Catchment				
Shanowen (Maine)_010	Good	Good	Good	Not at risk	None
Maine_010	Good	Good	Moderate	At risk	Hydromorphology
Maine_020	Moderate	Moderate	Good	Under review	None
Maine_030	Good	Poor	Good	Not at risk	None
Maine_040	Moderate	Moderate	Good	Not at risk	None

Maine_050	Unassigned	Unassigned	Moderate	Under Review	None
Castlemaine Harbour	Good	Good	Poor	At risk	Agriculture
Outer Dingle Bay	Unassigned	High	High	Under Review	None
	Blackwater (Munster) River Catchment				
Owenkeal_010	High	Good	Good	Not at risk	None
Owenkeal_020	Good	Good	High	Not at risk	None
Glenlara_010	Moderate	Moderate	Moderate	At risk	Forestry & hydromorphology
Dalua_020	Good	Good	Good	Not at risk	None
Dalua_030	Good	Good	Good	At risk	Other
Dalua_040	Good	High	High	Not at risk	None
Allow_060	Poor	Poor	Moderate	At risk	Agriculture, hydromorphology, industry, other & urban wastewater
Allow_070	Good	Good	Good	Not at risk	None
Blackwater (Munster)_090	Good	Good	Good	At risk	Agriculture & hydromorphology

2.4 GROUNDWATER BODY IDENTIFICATION

The bedrock geology underlying the Site is mapped by the GSI as comprising of Namurian shales in the north and Namurian sandstones in the south. The bedrock is classified by the GSI as being a Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones.

The majority of the Site, including 10 no. existing turbines, is underlain by the Abbeyfeale Groundwater Body (GWB) which is characterized by poorly productive bedrock. Meanwhile, the south of the Site is underlain by the Rathmore West GWB which is also characterised by poorly productive bedrock.

The eastern section of the Proposed Offsetting lands is underlain by the Abbeyfeale GWB and the western areas are underlain by the Scartaglin GWB which is also characterised by poorly productive bedrock.

Each of the GWB's are composed primarily of low permeability rocks, although localized zones of enhanced permeability do occur along faults. Groundwater flows along fractures, joints and major faults. Recharge occurs diffusely through the subsoils and via outcrops. Groundwater discharges to the numerous small streams crossing the aquifer, and to the springs and seeps. Local flow directions tend to follow the local topography.

2.5 GROUNDWATER BODY CLASSIFICATION

The GWBs are assigned a status based on the assessment of groundwater chemical and quantitative figures. Summary WFD information for GWBs underlying the Site is presented in **Table D**. The GWB status for the 2016-2021 WFD cycle are shown on **Figure B**.

The Abbeyfeale GWB (IE_SH_G_001) and the Rathmore West GWB (IE_SW_G_070) achieved "Good" status in all 3 no. WFD cycles. These GWBs have been deemed to be 'Not at Risk'. No significant pressures have been identified on these GWBs.

Furthermore, the Scartaglin GWB underlying the western section of the Proposed Offsetting lands achieved "Good" status in all 3 no. WFD cycles. This GWB is also "not at risk" and no significant pressures have been identified.

Table D: Summary WFD Information for Groundwater Bodies

GWB	Overall Status 2010-2015	Overall Status 2013-2018	Overall Status 2016-2021	Risk Status 3rd Cycle	Pressures
Abbeyfeale	Good	Good	Good	Not at risk	None
Rathmore West	Good	Good	Good	Not at risk	None
Scartaglin	Good	Good	Good	Not at risk	None

2.6 ZONE OF INFLUENCE

The potential Zone of Influence (ZOI) for the Site extends to the following SWBs, GBs, and transitional and coastal waterbodies.

- River waterbodies: Glenacarney_010, Feale_010 to Feale_090, Owenkeal_010, Owenkeal_020, Glenlara_010, Dalua_020 to Dalua_040, Allow_060, Allow_070 and Blackwater (Munster)_090 river waterbody.
- Transitional waterbodies: Upper Feale Estuary and Cashen estuaries.

- Coastal waterbodies: Mouth of the Shannon (HAs 23;27) and Southwestern Atlantic Seaboard (HA 23) SWBs.
- GWBs: Abbeyfeale and Rathmore West GWBs.

Furthermore, the ZoI for the Proposed Offsetting Measures extends to the following waterbodies:

- River waterbodies: Clydagh (Feale)_010 to Feale_090 and the Shanowen (Maine)_010 to the Maine_050.
- Transitional waterbodies: Upper Feale Estuary, Cashen Estuary and Casltemaine Harbour.
- Coastal Waterbodies: Outer Dingle Bay and Mouth of the Shannon.
- GWBs: Abbeyfeale and Scartaglin GWBs.

2.7 PROTECTED AREA IDENTIFICATION

The WFD requires that activities are also in compliance with other relevant legislation, as considered below. Nature conservation designations, bathing waters, nutrient Sensitive areas (NSA), shellfish areas and drinking water protected area's (DWPA) are looked at as part of the assessment.

2.7.1 Nature Conservation Designations

Within the Republic of Ireland designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs).

Ramsar sites are wetlands of international importance designated under the Ramsar Convention (adopted in 1971 and came into force in 1975), providing a framework for the conservation and wise use of wetlands and their resources.

The Site is mapped within the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA (Site Code: 004161). The site consists of a variety of upland habitats, though almost half is afforested.

Furthermore, the Site has downstream hydrological connections with designated conservation sites in the region as described below:

- The Lower River Shannon SAC (Site Code: 002165) is located downstream of the Site via the Knockaahorrea East Stream. The length of the hydrological pathway between the Site and the SAC is ~2.2km.

- The Blackwater River (Cork/Waterford) SAC (Site Code: 002170) is located downstream of the Site via the Glenlara River. The length of the hydrological flowpath between the Site and the SAC is ~6.5km.

Several designated sites are located even further downstream and distant from the Site (>40km straight line distance) in the Blackwater (Munster) surface water catchment. These designated sites (listed below for completeness) are located downstream of the Blackwater (Munster)_090 SWB and due to their distant location from the Site have no potential to be impacted by the Proposed Project. These distant designated sites include:

- The Blackwater Valley (Killavullen) pNHA (Site Code: 001080);
- The Blackwater Valley (Ballincurrig Wood) pNHA (Site Code: 001793);
- The Blackwater Valley (Killathy Wood) pNHA (Site Code: 001795);
- The Blackwater Valley (Cregg) pNHA (Site Code: 001796);
- The Blackwater Valley (The Beech Wood) pNHA (Site Code: 001797);

- Blackwater River Callows pNHA (Site Code: 000073);
- Blackwater Callows SPA (Site Code: 004094);
- Blackwater River And Estuary pNHA (Site Code: 000072); and,
- Blackwater Estuary SPA (Site Code: 004028).

The Cashen River Estuary pNHA (Site Code: 001340) is also located downstream (>35km straight line distance) of the Site in the Tralee Bay-Feale Catchment.

Other designated sites within 10km of the Site include:

- Mount Eagle Bogs NHA (Site Code: 002449) is situated ~7.5km to the west; and,
- Lough Gay Bog NHA (Site Code: 002454) is located ~9.3km to the north.

The Proposed Offsetting lands are also mapped within the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA. The Proposed Offsetting lands are also located immediately adjacent to the Mount Eagle Bogs NHA (Site Code: 002449). Within the Tralee Bay-Feale regional surface water catchment, the Proposed Offsetting lands are also located immediately upstream of the Lower River Shannon SAC (Site Code: 002165), the length of the hydrological flowpath between the Proposed Offsetting lands and the SAC is ~2km along the Glengarriff River. Within the Laune-Maine-Dingle Bay regional surface water catchment, the Proposed Offsetting lands are located ~28km northeast (straight line distance) of the Castlemaine Harbour SAC (Site Code: 000343).

2.7.2 Bathing Waters

Bathing waters are those designated under the Bathing Water Directive (76/160/EEC) or the later revised Bathing Water Directive (2006/7/EC).

The closest downstream designated bathing waters are located at Ballybunion (>40km northwest of the Site). Meanwhile, the bathing waters at Inch Strand are downstream of the Proposed Offsetting lands associated with the Outer Dingle Bay coastal waterbody.

2.7.3 Nutrient Sensitive Areas

Nutrient Sensitive Areas (NSA) comprise Nitrate Vulnerable Zones and polluted waters designated under the Nitrates Directive (91/676/EEC) and areas designated as sensitive areas under the Urban Wastewater Treatment Directive (UWWTD)(91/271/EEC).

Within the Tralee Bay-Feale catchment, there is 1 no. NSA downstream of the Site and the Proposed Offsetting lands. This is the Upper Feale Estuary and Cashen Estuary NSA downstream of the Listowel urban wastewater agglomeration.

There are no NSA downstream of the Site are far as the Blackwater (Munster)_090 SWB in the Blackwater (Munster) catchment. Furthermore, there are no NSA downstream of the Proposed Offsetting lands in the Laune-Maine-Dingle Bay catchment.

2.7.4 Shellfish Areas

The Shellfish Waters Directive (2006/113/EC) aims to protect or improve shellfish waters in order to support shellfish life and growth.

There are 2 no. designated shellfish area in the Tralee Bay-Feale catchment. However, the Site is situated inland, and the nearest shellfish waters are ~40km to the west at Tralee Bay (IEPA2_0020).

Cromane designated shellfish waters are located downstream of the Proposed Offsetting lands in the Laune-Maine-Dingle Bay catchment and are associated with the Castlemaine Harbour transitional waterbody.

2.7.5 Salmonid Waters

The Salmonid Regulations (S.I. 293 / 1988) identifies the protected river that are designated as Designated Salmonid Waters under S.I. No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations 1988, 14th August 1988. The Council Directive 78/659/EEC of 18th July 1978 on the quality of fresh waters needing protection or improvement in order to support fish life and the Council Directive 92/42/EEC of 21st May 1992 on the conservation of natural habitats and of wild fauna and flora was transposed into Irish law under the Fish Directive S.I. 293/1988 and Habitats Directive S.I. 477/2011.

The Feale River (Feale_020 to Feale_090) are identified as designated Salmonid Waters and are located downstream of the Site and the Proposed Offsetting lands in the Tralee Bay-Feale catchment.

Within the Blackwater (Munster) catchment, the Blackwater River (including the Blackwater (Munster)_090 SWB) downstream of the Allow River is also designated as a salmonid protected watercourse.

Meanwhile, the Maine_040 downstream of the Proposed Offsetting lands in the Laune-Maine-Dingle Bay catchment forms part of the Brown Flesk salmonid protected waters.

2.7.6 Drinking Water Protected Areas

Closest designated surface water Drinking Water Protected Area (DWPA) downstream of the Site is the Feale_050 DWPA, located ~16km (straight line distance) to the northwest. This Uisce Éireann abstraction is for the Abbeyfeale Public Water Supply with the estimated maximum abstraction volume being 3,010m^3/day.

Further downstream the Feale_090 SWB is also listed as a DWPA and is the source for the Listowel Regional Public Water Supply (1300PUB1204). The Feale_090 DWPA did not meet its DWPA objective in 2019 as it had MCPA and Glyphosate pesticide exceedances.

Within the Blackwater (Munster) Catchment there are no DWPAs identified downstream of the Site as far as the Blackwater (Munster)_090 SWB. The closest downstream DWPA is the Blackwater (Munster)_150 SWB located ~35km to the southeast and this has no potential to be impacted due to its distant location.

There are no surface water DWPAs downstream of the Proposed Offsetting lands in the Laune-Maine-Dingle Bay catchment.

Meanwhile, all GWBs within the catchment are listed as DWPAs.

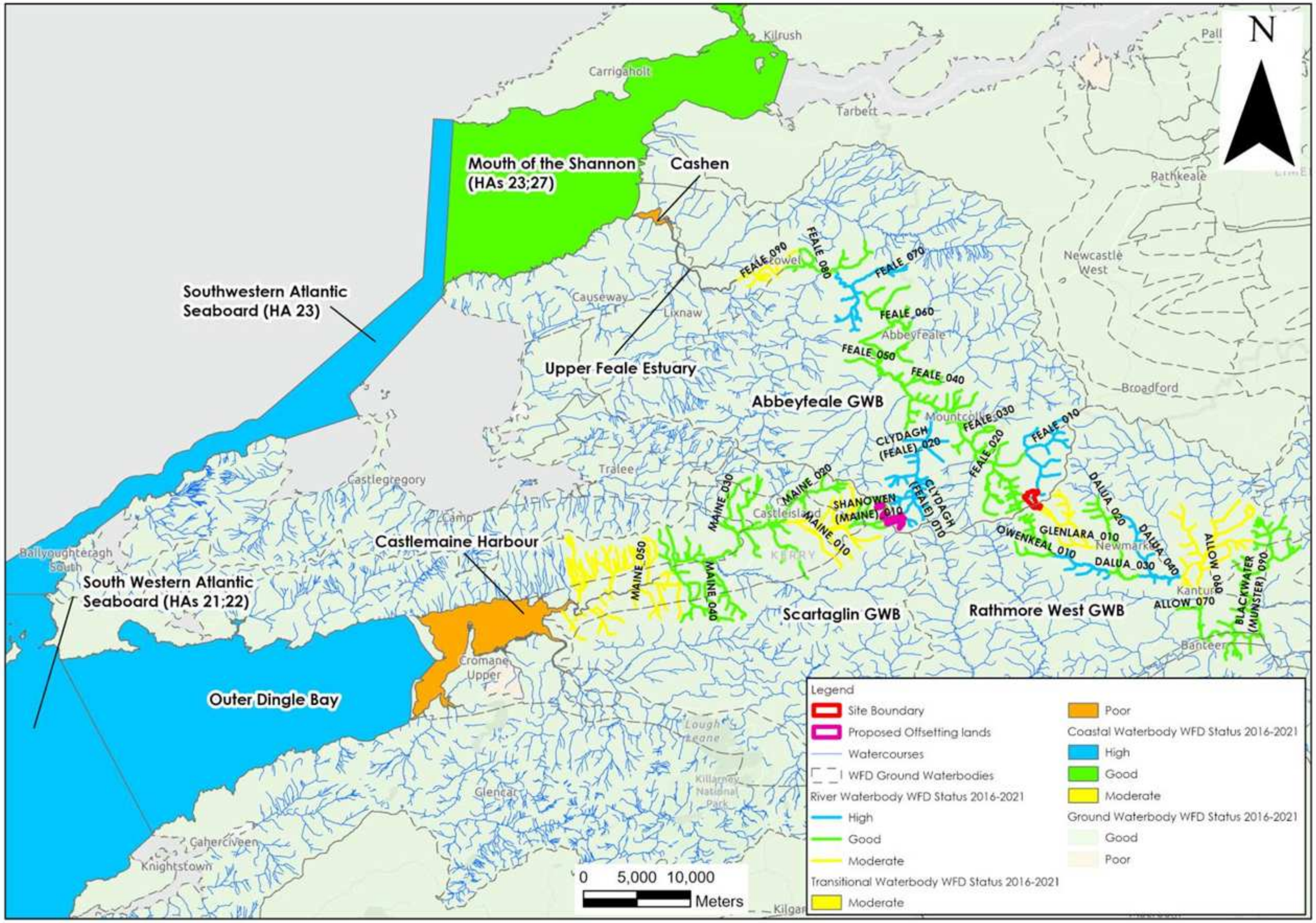

Figure B: WFD Groundwater and Surface Waterbody Status (2016-2021)

3. WFD SCREENING

3.1 SURFACE WATER BODIES

The river waterbodies in the immediate vicinity and downstream of the Site and the Proposed Offsetting lands are shown in **Figure A** and described in **Section 2.2** above.

With consideration for the Proposed Lifetime Extension and the Tralee-Bay Feale Catchment, it is considered that the upper reaches of the Feale River (Feale_010, Feale_020 and Feale_030 SWBs) and the Glenacarney River (Glenacarney_010 SWB) in the vicinity and downstream of the Site are carried through into the WFD Compliance Assessment. These SWBs have been included for further assessment due to their proximal location to the Site. The Feale_040 SWB is also included for the purposes of a conservative assessment. The Proposed Lifetime Extension must not in any way result in a deterioration in the status of these river waterbodies and/or prevent them from meeting the biological and chemical characteristics for good status in the future.

Within the Blackwater (Munster) catchment, the Glenlara_010 SWB has been screened in due to the presence of existing wind farm infrastructure within this WFD river sub-basin. The Dalua River (Dalua_020 and Dalua_030 SWB) in the vicinity and downstream of the Site has also been carried through into the WFD Compliance Assessment. The Site works must not in any way result in a deterioration in the status of these river waterbodies and/or prevent them from meeting the biological and chemical characteristics for good status in the future.

Further downstream, the River Feale (Feale_050 to Feale_090 SWBs) have been screened out due their distant location (hydrological flow path of ~19.5km) from the Site. Furthermore, and as outlined in **Table A** the catchment area for the River Feale increases dramatically downstream and thus the potential for the Site to impact the status of these SWBs decreases further downstream due to the increasing catchment area to the surface waterbody and resulting increase in flow volumes.

Within the Blackwater (Munster) catchment, the Allow and Blackwater rivers have been screened out due to their distant location from the Site. As outlined in **Table A** the catchment area for the Allow_060 SWB downstream of the Dalua_040 increases dramatically. The potential for the Site to impact a waterbody decreases further downstream due to the increasing catchment area to the surface waterbody and resulting increase in flow volumes. Furthermore, the Owenkeal_010 SWB has been screened out due to the lack of any existing wind farm infrastructure within this river sub-basin.

With respect to the Proposed Offsetting Measures, the Clydagh (Feale) _010 and _020 SWBs in the Tralee-Bay Feale catchment and the Shanowen (Maine)_010 and Maine_010 SWBs in the Laune-Maine-Dingle Bay catchment are included in the impact assessment. All other downstream SWBs are screened out of the impact assessment.

The Upper Feale Estuary, the Cashen estuary and the Castlemaine Harbour transitional waterbodies have been screened out due to the large volumes of water within these transitional waterbodies and the saline nature of these waters. The Proposed Lifetime Extension and the Proposed Offsetting Measures have no potential to cause a deterioration in status of these transitional SWBs and/or jeopardise the attainment of good surface water status in the future.

The Mouth of the Shannon (HAs 23;27), the Southwestern Atlantic Seaboard (HA 23) and the Outer Dingle Bay coastal SWBs have also been screened out due to the large volumes of water within these coastal waterbodies and the saline nature of these waters. The Proposed Lifetime Extension and the Proposed Offsetting Measures have no potential to cause a deterioration in status of these coastal waterbodies and/or jeopardise the attainment of good surface water status in the future.

3.2 GROUNDWATER BODIES

With respect to GWBs, the Abbeyfeale, Rathmore West and Scartaglin GWBs are carried through to the WFD Compliance Assessment due to their location directly underlying the Site and/or the Proposed Offsetting lands.

3.3 PROTECTED AREAS

The Site and the Proposed Offsetting lands are mapped within the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA. This SPA will therefore be included in the WFD Compliance Assessment.

The Lower River Shannon SAC and the Blackwater River (Cork/Waterford) SAC are hydrologically connected with the Site. The surface water connections from the Site could transfer poor quality surface water that may affect the conservation objectives of these designated sites. Both SAC's will be included in the Compliance Assessment given the hydrological pathways between them and the Site. The Lower River Shannon SEAC is also hydrologically connected with the Proposed Offsetting lands.

The Mount Eagle Bogs NHA is located immediately adjacent to the Proposed Offsetting lands. Therefore, this NHA will be included in the WFD Compliance Assessment.

The Lough Gay Bog NHA has been screened out of the WFD Compliance Assessment due to its distant location from the Site and lack of hydrological connectivity. Hydrogeologically, groundwater flow paths are expected to be short due to the low storage in the bedrock aquifer. This results in groundwater discharging to streams and springs in the area, and therefore there is no hydrogeological connectivity between the Site and the NHA.

All other downstream designated sites have been screened out of the WFD Compliance Assessment due to their distant location from the Site and the increasing volumes of water within these downstream waterbodies which will dilute any potential effects associated with the Site.

The downstream designated bathing waters has been screened out due to their distant location from the Site and the large volumes of water within the associated SWBs. The Proposed Project has no potential to cause a deterioration in the status of any downstream designated bathing areas.

The NSA's downstream of the Site have been screened out of the WFD Compliance Assessment due to their locations within the Blackwater River and transitional waterbodies downstream of the Site. The NSA's distant locations from the Site and the large volumes of water within these rivers and estuaries means that the Site has no potential to cause a deterioration in the status of these NSA's.

The Tralee Bay shellfish area and the Cromane shellfish area has been screened out due to their distant location from the Site and Proposed Offsetting lands. The Site has no potential to cause a deterioration in the status of these shellfish protected areas.

The Feale Salmonid Waters have also been screened into the WFD Compliance Assessment as they include the feale_030 to Feale_040 SWBs which have been screened in.

The designated salmonid water of the Blackwater River however will be screened out due to their distant location from the Site.

The surface water DWPA's downstream of the Site have been screened out of the WFD Compliance Assessment due to their distant downstream locations and the large volumes of water within these rivers. This means that the Proposed Project has no potential to cause a deterioration in the status of these DWPA's.

3.4 WFD SCREENING SUMMARY

A summary of WFD Screening for SWBs and GWBs discussed above is shown in **Table E** below.

Table E: Screening of WFD water bodies located within the study area

Type	WFD Classification	Waterbody Name/ID	Inclusion in Assessment	Justification
Surface Water Body	Tralee Bay-Feale Catchment			
	River	Glenacarney_010	**Yes**	The northwestern section of the Site, including 2 no. turbines are mapped within the Glenacarney_010 WFD river sub-basin. An assessment is required to consider the potential impacts of the Proposed Lifetime Extension on this SWB.
	River	Feale_010	**Yes**	The northeastern section of the Site, including 8 no. turbines are mapped within the Feale_010 WFD river sub-basin. An assessment is required to consider the potential impacts of the Proposed Lifetime Extension on this SWB.
	River	Feale_020	**Yes**	The Feale_020 is located directly downstream of the Feale_010 and in close proximity to the Site. An assessment is required to consider the potential impacts of the Proposed Lifetime Extension on this SWB.
	River	Feale_030	**Yes**	The Feale_030 is located proximally to the Site and directly downstream of the Feale_020 SWB. An assessment is required to consider the potential impacts of the Site on this SWB.
	River	Clydagh (Feale)_010	**Yes**	The Proposed Offsetting lands are located in this river sub-basin. Therefore, an assessment is required to consider the potential impacts of the Proposed Offsetting Measures on this SWB.
	River	Clydagh (Feale)_020	**Yes**	The Clydagh (Feale)_020 is located directly downstream of the Clydagh (Feale)_010 SWB and in close proximity to the Proposed Offsetting lands. An assessment is required to consider the potential impacts of the Proposed Offsetting Measures on this SWB.
	River	Feale_040	**Yes**	The Feale_040 SWB has been included in the impact assessment due to its location downstream of the Clydagh (Feale) River. An assessment is required to consider the potential impacts of the Proposed Project on this SWB.
	River	Feale_050	No	The Feale_050 SWB has been screened out due to its distant location from the Site (~19.5km) and the Proposed Offsetting lands and the increasing volumes of water within the Feale River. Therefore, the Proposed Project has no potential to affect the status of this SWB.
	River	Feale_060	No	The Feale_060 SWB has been screened out due to its distant location from the Site (>20km) and Proposed Offsetting lands and the increasing volumes of water within the Feale River. Therefore, the Proposed Project has no potential to affect the status of this SWB.
	River	Feale_070	No	The Feale_070 SWB has been screened out due to its distant location from the Site and the Proposed Offsetting lands and increasing volumes of water within the Feale River. Therefore, the Proposed Project has no potential to affect the status of this SWB.
	River	Feale_080	No	The Feale_080 SWB has been screened out due to its distant location from the Site and the Proposed Offsetting lands and the increasing volumes of water within the Feale River. Therefore, the Proposed Project has no potential to affect the status of this SWB.
	River	Feale_090	No	The Feale_090 SWB has been screened out due to its distant location from the Site and the Proposed Offsetting lands and the increasing volumes of water within the Feale River. Therefore, the Proposed Project has no potential to affect the status of this SWB.
	Transitional	Upper Feale	No	The Upper Feale Estuary SWB has been screened out due to the saline nature of its waters and

		Estuary		the large volumes of water within the estuary. The Proposed Project has no potential to impact the status of this SWB.
	Transitional	Cashen	No	The Cashen SWB has been screened out due to the saline nature of its waters and the large volumes of water within the estuary. The Proposed Project has no potential to impact the status of this SWB.
	Coastal	Mouth of the Shannon (HAs 23;27)	No	The Mouth of the Shannon (HAs 23;27) has been screened out due to the saline nature of its waters and the large volumes of water within the SWB. The Proposed Project has no potential to impact the status of this SWB.
	Coastal	Southwestern Atlantic Seaboard (HA 23)	No	The Southwestern Atlantic Seaboard (HA 23) has been screened out due to the saline nature of its waters and the large volumes of water within the SWB. The Proposed Project has no potential to impact the status of this SWB.
	Blackwater (Munster) Catchment			
	River	Owenkeal_010	**Yes**	The southwestern section of the Site is mapped within the Owenkeal_010 river sub-basin. However, no infrastructure associated with the existing Wind Farm is located within this river sub-basin. The Proposed Project has no potential to impact the status of this SWB.
	River	Owenkeal_020	No	The Owenkeal_020 is located downstream of the Owenkeal_010 SWB. However, given the lack of infrastructure within the Owenkeale_010 river sub-basin, the Site has no potential to effect this SWB. The Owenkeale_020 SWB has been screened out.
	River	Glenlara_010	**Yes**	The southeastern section of the Site, including 1 no. turbine is mapped within the Glenlara_010 river sub-basin. An assessment is required to consider the potential impacts of the Proposed Lifetime Extension on this SWB.
	River	Dalua_020	**Yes**	The Dalua_020 SWB is located in close proximity to the Site and directly downstream of the Glenlara_010 SWB. An assessment is required to consider the potential impacts of the Proposed Lifetime Extension on this SWB.
	River	Dalua_030	**Yes**	The Dalua_030 SWB is located in close proximity to the Site and directly downstream of the Dalua_020 SWB. An assessment is required to consider the potential impacts of the Proposed Lifetime Extension on this SWB.
	River	Dalua_040	No	The Dalua_040 SWB has been screened out due to its distant location from the Site and the increasing flow volumes within the river. Therefore, the Proposed Lifetime Extension has no potential to affect the status of this SWB.
	River	Allow_060	No	The Allow_060 SWB has been screened out due to its distant location from the Site and the large flow volumes of water within the Allow River. Therefore, the Proposed Lifetime Extension has no potential to affect the status of this SWB.
	River	Allow_070	No	The Allow_070 SWB has been screened out due to its distant location from the Site and the large flow volumes of water within the Allow River. Therefore, the Proposed Lifetime Extension has no potential to affect the status of this SWB.
	River	Blackwater (Munster)_090	No	The Blackwater (Munster)_090 SWB has been screened out due to its distant location from the Site and the large flow volumes of water within the Blackwater River. Therefore, the Proposed Lifetime Extension has no potential to affect the status of this SWB.

	Laune-Maine-Dingle Bay Catchment			
	River	Shanowen (Maine)_010	**Yes**	The Proposed Offsetting lands are located in this river sub-basin. Therefore, an assessment is required to consider the potential impacts of the Proposed Offsetting Measures on this SWB.
	River	Maine_010	**Yes**	The Maine_010 SWB is located directly downstream of the Shanowen (Maine)_010 SWB and in close proximity to the Proposed Offsetting lands. An assessment is required to consider the potential impacts of the Proposed Offsetting Measures on this SWB.
	River	Maine_020	No	The Maine_020 SWB has been screened out due to its distant location from the Proposed Offsetting lands and the increasing volumes of water within the Maine River. Therefore, the Proposed Offsetting Measures have no potential to affect the status of this SWB.
	River	Maine_030	No	The Maine_030 SWB has been screened out due to its distant location from the Proposed Offsetting lands and the increasing volumes of water within the Maine River. Therefore, the Proposed Offsetting Measures have no potential to affect the status of this SWB.
	River	Maine_040	No	The Maine_030 SWB has been screened out due to its distant location from the Proposed Offsetting lands and the increasing volumes of water within the Maine River. Therefore, the Proposed Offsetting Measures have no potential to affect the status of this SWB.
	River	Maine_050	No	The Maine_040 SWB has been screened out due to its distant location from the Proposed Offsetting lands and the increasing volumes of water within the Maine River. Therefore, the Proposed Offsetting Measures have no potential to affect the status of this SWB.
	Transitional	Castlemaine Harbour	No	The Castlemaine Harbour SWB has been screened out due to the saline nature of its waters and the large volumes of water within the estuary. The Proposed Offsetting Measures have no potential to impact the status of this SWB.
	Coastal	Outer Dingle Bay	No	The Outer Dingle Bay SWB has been screened out due to the saline nature of its waters and the large volumes of water within the SWB. The Proposed Offsetting Measures have no potential to impact the status of this SWB.
Groundwater Bodies				
Groundwater Body	Groundwater	Abbeyfeale	**Yes**	The Site, including 10 no. turbines, and the Proposed Offsetting lands are mapped to overlie the Abbeyfeale GWB. An assessment is required to consider the potential impacts of the Proposed Project on this GWB.
	Groundwater	Rathmore West	**Yes**	The Site, including 1 no. turbine, is mapped to overlie the Rathmore West GWB. An assessment is required to consider the potential impacts of the Proposed Lifetime Extension on this GWB.
	Groundwater	Scartaglin	**Yes**	The Proposed Offsetting lands are mapped to overlie the Scartaglin GWB. An assessment is required to consider the potential impacts of the Proposed Offsetting Measures on this GWB.
Protected Areas				
Protected Areas	Nature Conservation Designations	Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA	**Yes**	The Site and the Proposed Offsetting lands are mapped within the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA. The SPA will therefore be included in the assessment.
		Lower River Shannon SAC	**Yes**	The Lower River Shannon SAC is located ~2.2km downstream of the Site and ~2km downstream of the Proposed Offsetting Measures. The SAC is hydrologically linked to the Site and the Proposed Offsetting lands. An assessment is required to consider the potential impacts of the

				Proposed Project on this protected area.
		Blackwater River (Cork/Waterford) SAC	**Yes**	The Blackwater River (Cork/Waterford) SAC is located ~6.5km downstream of the Site and hydrologically linked to the Site chiefly via the Glenlara_010 SWB. An assessment is required to consider the potential impacts of the Proposed Lifetime Extension on this protected area.
		Castlemaine Harbour SAC	No	The Proposed Offsetting lands are distant from the SAC (~28km). The Proposed Offsetting Measures have no potential to impact the status of this SAC.
		Mount Eagle Bogs NHA	**Yes**	The Mount Eagle Bogs NHA is located immediately adjacent to the Proposed Offsetting lands. An assessment is required to consider the potential impacts of the Proposed Offsetting Measures on this NHA.
		Lough Gay Bog NHA	No	The Lough Gay Bog NHA has been screened out due to its distant location (~9.3km) from the Site and lack of hydrological connectivity. Hydrogeologically, groundwater flow paths are expected to be short due to the low storage in the bedrock aquifer. This results in groundwater discharging to streams and springs in the area, and therefore there is no hydrogeological connectivity between the Site and the NHA.
	Nutrient Sensitive Areas	Upper Feale Estuary & Cashen Estuary NSA	No	The Upper Feale Estuary & Cashen Estuary NSA has been screened out due to its distant location from the Site and the Proposed Offsetting lands. The Proposed Project has no potential to impact the status of this NSA.
	Shellfish Area	Tralee Bay	No	Tralee Bay Shellfish area has been screened out due to its distant location from the Site and the Proposed Offsetting lands. Therefore, the Proposed Project has no potential to impact on this protected area.
		Cromane	No	The Cromane designated shellfish area has been screened out due to its distant location from the Proposed Offsetting lands. Therefore, the Proposed Project has no potential to impact these designated shellfish waters.
	Salmonid Waters	Feale	**Yes**	The Feale designated salmonid waters are located downstream and in close proximity to the Site. An assessment is required to consider the potential impacts of the Proposed Project on these Salmonid Waters.
	Drinking Water Protected Areas	Feale_050	No	The Feale_050 DWPA has been screened out due to its distant location from the Site (~19.5km) and the increasing volumes of water within the Feale River. Therefore, the Proposed Project has not potential to affect the status of this DWPA.
		Feale_090	No	The Feale_090 DWPA has been screened out due to its distant location from the Site and the increasing volumes of water within the Feale River. The Proposed Project has no potential to impact the status of this DWPA.

4. WFD COMPLIANCE ASSESSMENT

4.1 DEVELOPMENT PROPOSALS

Planning permission is being sought for the Proposed Lifetime Extension of Taurbeg Wind Farm as permitted by Cork County Council under planning regulation ref N/2002/3608, for a further period of 10 years from the date of expiry (2026) per Condition no. 7 of the original planning consent issued, with decommissioning of the wind farm at the end of the proposed extension period.

The Proposed Project is described in full in Chapter 4 of the EIAR and related to the extended operation of all elements of the existing wind farm and the enhancement and management of lands for the purposes of hen harrier mitigation.

There are no alterations proposed to the existing wind farm infrastructure, therefore, there are no requirements for construction works or reinstatement works for the Proposed Lifetime Extension.

Typically, daily operational phase maintenance traffic will consist of four-wheel drive vehicles or vans with no off-road requirements.

During the Proposed Lifetime Extension, occasionally vehicles or plant may be necessary for maintenance of access roads, drainage networks and hardstands along with some minor landscaping works.

Small amounts of granular material may be imported to maintain access tracks and hardstands during the Proposed Lifetime Extension which will place intermittent minor demand on local quarries.

Meanwhile, as part of the Proposed Offsetting Measures, it is proposed to permanently remove c. 105.5 hectares of plantation forestry which will create more biodiverse upland habitats suitable for foraging hen harrier. Approximately 10ha of this land will be permanently removed offsite, with the remaining 95.5 ha of felled material being stacked into windrows on site. Regarding the farmland area (c.17.7 ha), this land will be permanently restored for the benefit of hen harrier through restoration measures such as planting and restoring of hedgerow, implementation of a rotational grazing scheme, linear wildlife crop sowing, cease on fertiliser application and predator fencing. Full details of the Proposed Offsetting Measures are also outlined in Chapter 4.

4.2 POTENTIAL EFFECTS

4.2.1 Proposed Offsetting Measures

There are no proposed construction works associated with the Proposed Lifetime Extension.

The only works associated with the Proposed Project relate to the Proposed Offsetting Measures and are discussed below:

4.2.1.1 Potential Surface Water Quality/Quantity Effects

Deforestation is a component of the Proposed Offsetting Measures with ~105.5ha of coniferous forestry proposed for deforestation. Potential effects during deforestation occur mainly from:

- Exposure of soil and subsoils due to vehicle tracking, compaction and skidding or forwarding extraction methods resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface watercourses;

- Entrainment of suspended sediment in watercourses due to vehicle tracking through watercourses;
- Damage to forest roads resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface watercourses;
- Release of sediment attached to timber in stacking areas; and,
- Nutrient release.

These effects from deforestation have the potential to affect the water quality downstream SWBs.

Hydrocarbons will be used during the Proposed Offsetting Measures and any accidental spillage during refuelling of construction plant with petroleum hydrocarbons can cause significant pollution risk to surface water and associated aquatic ecosystems.

There is also a requirement for temporary crossing over a stream between Proposed Offsetting lands Areas 1 and 4. Construction of structures over water courses has the potential to significantly interfere with water quality and flows during the works phase.

A summary of potential status change to SWBs arising from surface water quality effects within the project site during the Proposed Offsetting Measures works phase of the Proposed Project in the unmitigated scenario are outlined in **Table F**.

Table F: Potential Surface Water Quantity Effects Downstream During the Proposed Offsetting Measures (Unmitigated)

SWB	**WFD Code**	**Current Status**	**Assessed Potential Status Change**
Shanowen (Maine)_010	IE_SW_22S010020	Good	Moderate
Maine_010	IE_SW_22M010300	Moderate	Moderate
Clydagh (Feale)_010	IE_SH_23C030200	High	Good
Clydagh (Feale)_020	IE_SH_23C030500	High	High

4.2.1.2 Potential Groundwater Quality/Quantity Effects

The accidental spillage of hydrocarbons and the release of effluent from wastewater treatment systems have the potential to negatively impact on groundwater water quality at the Proposed Offsetting lands.

However, due to the low permeability of the bedrock aquifer and the shallow nature of the proposed works, there is limited potential for the Proposed Offsetting Measures to alter the overall status of the underlying GWBs. The potential to affect the status of the overall GWB is further limited given the scale of the Proposed Offsetting lands in comparison to the overall size of the Abbeyfeale GWB (949km^2) and the Scartaglin GWB (472km^2).

A summary of potential status change to GWBs at arising from works at the Proposed Offsetting lands in the unmitigated scenario are outlined in **Table G**.

Table G: Potential Deterioration of Groundwater Bodies During the Proposed Offsetting Measures (Unmitigated)

GWB	WFD Code	Current Status	Assessed Potential Status Change
Abbeyfeale	IE_SH_G_001	Good	Good
Scartaglin	IE_SW_G_073	Good	Good

4.2.1.3 Potential Effects on Designated Sites

Any deterioration in water quality during the Proposed Offsetting Measures works could impact the overall environmental of the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA and water quality in the downstream designated sites including the Lower River Shannon SAC.

The Mount Eagle Bogs NHA is located upgradient of the Proposed Offsetting lands. Therefore, there are no surface water connections. Given the close proximity to the works areas, any disturbance of the bog hydrological/hydrogeological regime could impact the NHA. However, there are no deep excavations or earthworks proposed and there is no potential to change the hydrological regime in the adjacent lands.

4.2.2 Extended Operational Phase (Unmitigated)

Potential effects associated with the Extended Operational Phase will be much reduced in comparison to the construction of a wind farm development. Any effects at the Site and will be associated with minor maintenance works.

4.2.2.1 Potential Surface Water Quality/Quantity Effects Downstream of the Site

Impermeable surfaces such as site access roads and turbine hardstands can potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network in comparison to the pre-development condition. This could potentially increase runoff from the Site and increase flood risk downstream of the development. However, in reality the existing access roads and hardstand areas have a higher permeability than the underlying peat. No signs of erosion were identified at the Site.

During the Proposed Lifetime Extension, some minor maintenance works may be completed, such as maintenance of site entrance, internal roads and hardstand areas. These works would be of a very minor scale and would be very infrequent. These minor activities could, however, result in a brief release of suspended solids to surface water and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. Potential effects are not likely to be significant even if not mitigated against.

Accidental spillage during refuelling of plant and equipment with petroleum hydrocarbons is a significant pollution risk. However, due to the small volumes of oils and fuels that will be present on-site during the proposed extended operational phase, no significant effects will occur.

A summary of potential status change to SWBs during the Extended Operational Phase in the unmitigated scenario are outlined in **Table H**.

Table H: Potential Surface Water Quantity Effects Downstream of the Site During the Extended Operational Phase (Unmitigated)

SWB	WFD Code	Current Status	Assessed Potential Status Change
Glenacarney_010	IE_SH_23G060300	Good	Good
Feale_010	IE_SH_23F010020	High	High
Feale_020	IE_SH_23F010040	Good	Good
Feale_030	IE_SH_23F010120	Good	Good
Glenlara_010	IE_SW_18G080500	Moderate	Moderate
Dalua_020	IE_SW_18D010200	Good	Good
Dalua_030	IE_SW_18D010300	Good	Good

4.2.2.2 Potential Groundwater Quality/Quantity Effects

There is very limited potential for effects on the status of the underlying GWBs. Any accidental spillage of hydrocarbons during maintenance works could result in a local deterioration in groundwater quality. However, given the scale of the underlying GWBs this would not result in a change in the overall status of the GWBs.

A summary of potential status change to SWBs arising from surface water quality impacts during the operation phase of the Proposed Project in the unmitigated scenario are outlined in **Table I**.

Table I: Potential Surface Water Quality Effects Downstream of Site during the Proposed Extended Operational Phase (Unmitigated)

SWB	WFD Code	Current Status	Assessed Potential Status Change
Abbeyfeale	IE_SH_G_001	Good	Good
Rathmore West	IE_SW_G_070	Good	Good

4.2.2.3 Potential Effects on Protected Areas

The Site is located within the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA. This designated site does not contain any water-dependent qualifying interests or water related conservation objectives.

The Site is also hydrologically connected to the Lower River Shannon SAC and the Blackwater River (Cork/Waterford) SAC.

Due to physical, hydrological and hydrogeological separation all other designated sites have no potential to be affected by the Site.

Due to the lack of any proposed construction works the potential for effects on these designated sites is very limited. However, during minor and infrequent maintenance works there is the potential for the release of suspended solids and hydrocarbons to the surface water environment. These effects could have the potential to impact downstream designated sites.

4.3 MITIGATION MEASURES

4.3.1 Proposed Offsetting Measures

4.3.1.1 Mitigation Measures to Protect Surface Water Quality During Deforestation

Forestry operations will conform to current best practice Forest Service regulations, policies and strategic guidance documents as well as Coillte and DAFM guidance documents, including the specific guidelines listed below, to ensure that deforestation and other forestry operations result in minimal potential negative effects to the receiving environment. These mitigation measures are tried and tested, best practice mitigation measures which are implemented at forestry sites across the country. The guidance documents are listed in Section 9.5.2.1 of the EIAR.

Mitigation by Avoidance:
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. Based on the Forest Service guidance, with moderate slopes existing across much of the project site, a minimum 10m setback would be required, however out of an abundance of caution 30m to 40m setbacks will be established along all aquatic zones. Furthermore, a 5m setback will be established along all relevant watercourses and water hotspots. Buffer zone widths will be increased at vulnerable hotspots, where deemed necessary. This will ensure water quality is protected during the deforestation operations.

The setback distance from sensitive hydrological features means that adequate room is maintained for the proposed mitigation measures (discussed below) to be properly installed and operate effectively. The buffer/setback zone will:

- Avoid physical damage (river/stream banks and river/stream beds) to watercourses and the associated release of sediment;
- Avoid peat/soil disturbance and compaction within close proximity to surface watercourses;
- Avoid the entry of suspended sediment from works into watercourses; and,
- Avoid the entry of suspended sediment from the 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.

Mitigation by Design:
Mitigation measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods which are set out as follows:

- Machine combinations will be chosen which are most suitable for ground conditions at the time of deforestation, and which will minimise soils disturbance. The harvester and the forwarder are designed specifically for the forest environment and are low ground pressure machines;
- All machinery will be operated by suitably qualified personnel;
- Checking and maintenance of forest roads and culverts will be on-going through any deforestation operations. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points. Where possible, existing drains will not be disturbed during deforestation works;
- These machines will traverse the site along specified off-road routes (referred to as racks);
- The location of racks will be chosen to avoid wet and potentially sensitive areas;

- Brash mats will be placed on the racks to support the vehicles on soft ground, reducing peat and mineral soil disturbance and erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal should take place when they become heavily used and worn. Provision should 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;
- Silt fences will be installed at the outfalls of existing drains downstream of deforestation areas. No direct discharge of such drains to watercourses will occur. Sediment traps and silt fences will be installed in advance of any deforestation works and will provide surface water settlement for runoff from work areas and will prevent sediment from entering downstream watercourses. Accumulated sediment will be carefully disposed of at pre-selected peat disposal areas. Where possible, all new silt traps will be constructed on even ground and not on sloping ground;
- In areas particularly sensitive to erosion it will be necessary to install double or triple sediment traps and increase buffer zone width. These measures will be reviewed on site during construction;
- Double silt fencing will also be put down slope of deforestation areas which are located in close proximity to streams and/or relevant watercourses;
- Drains and silt traps will be maintained throughout all deforestation works, ensuring that they are clear of sediment build-up and are not severely eroded;
- Timber will be stacked in dry areas, and outside watercourse buffer zones. Straw bales and check dams to be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water runoff;
- Refuelling or maintenance of machinery will not occur within 50m of an aquatic zone or within 20m of any other hydrological feature. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required; and,
- 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, but care will be taken to avoid removing natural debris deflectors.

Silt Traps:
Silt traps will be strategically placed down-gradient of deforestation areas within forestry drains near streams. The main purpose of the silt traps and drain blocking is to slow water flow, increase residence time, and allow settling of silt in a controlled manner.

Pre-emptive Site Drainage Management:
The works programme for the deforestation operations will also take account of weather forecasts and predicted rainfall in particular. Operations 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.

Timing of Deforestation Works:
Deforestation will only be carried out during periods of low rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses.

Drain Inspection and Maintenance:
The following items shall be carried out during inspection pre-deforestation and after:

- Communication with deforestation operatives in advance to determine whether any areas have been reported where there is unusual water logging or bogging of machines;
- Inspection of all areas reported as having unusual ground conditions;

- Inspection of main drainage ditches and outfalls. During pre-deforestation inspections, the main drainage ditches shall be identified. Ideally the pre-deforestation inspection shall be carried out during rainfall;
- Following tree deforestation all main drains shall be inspected to ensure that they are functioning;
- Extraction tracks near drains need to be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground;
- Culverts on drains exiting the site will be unblocked; and,
- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

4.3.1.2 Mitigation Measures to Protect Against the Release of Hydrocarbons

There will be no fuels or herbicides stored within 50m of an aquatic zone or within 20m of all other water features.

- All road-going vehicles will be refuelled off-site;
- On-site re-fuelling will be required for forestry and excavator machinery which will be based continuously at the project site;
- The on-site refuelling will be undertaken using a mobile double skinned bowser with spill kits kept on site for accidental leakages or spillages;
- The bowser will be refilled off-site and will be towed around the site by a 4x4 jeep;
- The 4x4 jeep will carry absorbent materials and pads in the event of accidental spillages;
- The fuel bowser will be parked on a level area on the construction compound when not in use;
- Only designated trained operatives will be authorised to refuel plant on-site;
- Taps, nozzles or valves associated with refuelling equipment will be fitted with a lock system;
- Fuels stored on-site will be minimised. All storage areas will be bunded appropriately for the duration of the construction phase. All bunded areas will be fitted with a storm drainage system and an appropriate oil interceptor. Ancillary equipment such as hoses, pipes will be contained within the bunded area;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose; and,
- An emergency response plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan.

4.3.2 Extended Operational Phase

4.3.2.1 Increased Site Runoff and Hydromorphology Effects

The footprint of the wind farm development (3.37ha) represents only ~3% of the Site area of 112ha. As detailed in Section 9.5.3.1 of the EIAR, when compared to greenfield pre-development conditions, and assuming that the hardstands and access roads are 100% impermeable, the development footprint results in an increase of approximately 0.1% in the average daily/monthly volume of runoff from the Site.

Therefore, any increase in runoff from the Site is therefore imperceptible and therefore no additional drainage mitigation is proposed above what is already present at the Site.

4.3.2.2 Mitigation Measures to Protect Surface Water Quality

The existing drainage measures have been effective in removing any silt generated during routine maintenance works. This has been reflected in any of the surface water sampling conducted at the site. In addition to the above, temporary check dams and silt fencing arrangements will be placed along sections of access roads where maintenance works are being undertaken. Check dams will be constructed from a 4/40mm non-friable crushed rock. Temporary blocking of drains downstream of works area can also be undertaken if roadside swales are absent.

Any plant and equipment used during the operational phase will require refuelling during the works. Appropriate management of fuels will be required to ensure that incidents relating to refuelling are avoided. The following mitigation measures are proposed to avoid release of hydrocarbons at the site:

- Road-going vehicles will be refuelled off site wherever possible;
- On-site refuelling will be carried out at designated refuelling areas at various locations throughout the Site. Machinery will be refuelled directly by a fuel truck that will come to site as required;
- Only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- Fuel volumes stored on site will be minimised. Any fuel storage areas will be bunded appropriately for the fuel storage volume;
- The plant used will be regularly inspected for leaks and fitness for purpose;
- An emergency plan for the operational phase to deal with accidental spillages will be developed Spill kits will be available to deal with and accidental spillage in and outside the refuelling area;
- A programme for the regular inspection of plant and equipment for leaks and fitness for purpose will be developed at the outset of the operational phase; and,
- Adherence to Operational and Environmental Management Plan.

4.3.2.3 Mitigation Measures to Protect Groundwater Quality

It is proposed to continue to manage wastewater from the staff welfare facilities in the control buildings by means of a sealed storage tank, with all wastewater being tankered off site by permitted waste collector to wastewater treatment plants.

Mitigation measures for hydrocarbons are described above in **Section 4.3.2.2**.

4.3.2.4 Mitigation Measures for Protected Areas

The mitigation measures to protect against poor quality runoff and hydrocarbons during the operational phase of the Site are the same as those outlined **Section 4.3.1.2** above.

It can be concluded that with best practice methods adhered to during the operation phase of the Site, the potential for the project to impact upon the qualifying interests of the local designated sites is not significant.

4.3.3 Decommissioning Phase

The potential impacts associated with decommissioning of the Site will be similar to those associated with construction but of a much-reduced magnitude, due to the reduced scale of the proposed decommissioning works in comparison to construction phase works.

During decommissioning, it will be possible to reverse or at least reduce some of the potential effects caused during construction, and to a lesser extent operation, by rehabilitating constructed areas such as turbine bases and hard standing areas. This will be done by covering with vegetation to encourage vegetation growth and reduce run-off and sedimentation.

The Site roadways will be kept and maintained following decommissioning of the wind farm infrastructure, as these will be utilised by ongoing forestry works and by other participating landowners.

The electrical cabling connecting the site infrastructure to the on-site substation will be removed, while the ducting itself will remain in-situ rather than excavating and removing it, as this is considered to have less of a potential environmental impact, in terms of soil exposure, and thus on the possibility of the generation of suspended sediment which could enter nearby watercourses.

The turbines will be removed by disassembling them in a reverse order to their erection. This will be completed using the same model cranes as used in their construction. They will then be transported off-site along their original delivery route. The turbine concrete bases will remain in the ground and backfilled.

The disassembly and removal of the turbines will not have an impact on the hydrological/hydrogeological environment at the wind farm site.

Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude than the construction phase because of the smaller scale of the works and reduced volumes on-site.

As noted in the Scottish Natural Heritage report (SNH) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made ~30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH guidance, it is, therefore:

"*Best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm*".

Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the operational phase mitigation measures.

No significant effects on the hydrological and hydrogeological environment will occur during the decommissioning phase of the Site.

4.3.4 Potential Effects with the Implementation of Mitigation

In all instances, the mitigation measures described in **Section 4.3** are sufficient to meet the WFD Objectives. The assessment of WFD elements for the WFD waterbodies is summarised in **Table J** below.

Table J: Summary of WFD Status for Unmitigated and Mitigated Scenarios

SWB	WFD Code	Current Status	Assessed Status - Unmitigated	Assessed Status with Mitigation Measures
Tralee Bay Feale Catchment				
Glenacarney_010	IE_SH_23G060300	Good	Good	Good
Feale_010	IE_SH_23F010020	High	High	High
Feale_020	IE_SH_23F010040	Good	Good	Good
Feale_030	IE_SH_23F010120	Good	Good	Good
Blackwater (Munster) Catchment				
Owenkeal_010	IE_SW_18O060500	Good	Good	Good
Glenlara_010	IE_SW_18G080500	Moderate	Moderate	Moderate
Dalua_020	IE_SW_18D010200	Good	Good	Good
Dalua_030	IE_SW_18D010300	Good	Good	Good
Groundwater Bodies				
Abbeyfeale	IE_SH_G_001	Good	Good	Good
Rathmore West	IE_SW_G_070	Good	Good	Good

4.4 CUMULATIVE ASSESSMENT

This section presents an assessment of the potential cumulative effects associated with the Proposed Project and other developments (existing and/or proposed) on the WFD status of downstream SWBs.

The primary potential for cumulative effects associated with a wind farm development would generally occur during the construction phase. However, no construction works are proposed and there will be no excavations or earthworks at the Site. The potential for cumulative effects during the proposed extended operational phase will be significantly reduced in comparison to a construction phase as there will be no exposed excavations, there will be no sources of sediment to reach watercourses, there will be no use of cementitious materials and fuels/oil will be kept to a minimum at the site. During the decommissioning phase, the potential cumulative effects are similar to the construction phase, but to a lesser degree with less ground disturbance.

Separate hydrological cumulative study areas have been delineated for the Site and for the Proposed Offsetting lands. These cumulative study areas are shown in Figure 9-10**.** There will be no potential for cumulative effects beyond these cumulative study areas due to increases in flow volumes (as the catchment area increases) and increasing distance from the Site and the Proposed Offsetting lands.

The cumulative hydrological study area for the Site has a total area of 234km^2 and has been delineated as follows:

- The north of the Site is located in the Tralee Bay Feale Catchment. A quantitative analysis using flow volumes derived from the EPA Hydrotool database shows that there is no potential for effects on the Feale River downstream of EPA Hydrotool Node: 23_1771 (Total Upstream Catchment Area of ~95km^2); and,
- The south of the Site is located in the Blackwater (Munster) Catchment. A quantitative analysis using flow volumes derived from the EPA Hydrotool database shows that there is no potential for effects downstream of EPA Hydrotool Node: 18_2469 on the Glenlara River. This Node is located ~2km upstream of the confluence of the Glenlara and Allow Rivers. In order to be conservative and for completeness, the cumulative study area extends downstream as far as Node 18_1756 which includes the entire catchment of the Glenlara River (Total Upstream Catchment Area of ~139km^2).

Given, the nature of the Proposed Lifetime Extension (i.e. extension of life of an existing wind farm) and the lack of any significant groundworks, the delineated cumulative hydrological study area associated with the Site is considered to be very conservative.

The cumulative hydrological study area for the Proposed Offsetting lands has a total area of 74km2 and has been delineated as follows:

- The Shanowen (Maine)_010 and Clydagh (Feale)_010 WFD river sub-basins are also included in the cumulative study area as these are the river sub-basin within which the Proposed Offsetting lands are located. For the purposes of a conservative assessment, the Maine_010 and Clydagh (Feale)_020 WFD river sub-basins are also included in the cumulative study area.

4.4.1 Cumulative Effects with Commercial Forestry

Taurbeg Wind Farm

The Site is situated in an upland area which contains peat bogs and forested areas.

The most common water quality problems arising from forestry relate to the release of sediment and nutrients to the aquatic environment, and impacts from acidification. Forestry may also give rise to modified stream flow regimes caused by associated land drainage.

Due to the close proximity of several forested areas to the Site and given that they drain to the same watercourses, the potential cumulative effects on downstream water quality and quantity need to be assessed.

However, given the nature of the Proposed Lifetime Extension, the lack of any significant groundworks and the prescribed mitigation measures for the proposed extended operational phase, there will be no effects on downstream surface water quality.

For these reasons we consider that there will not be a significant cumulative effect associated with commercial forestry activities.

Proposed Offsetting Measures
Forestry activities will continue in the lands adjacent to the Proposed Offsetting lands. Typical downstream water quality issues arising from forestry activities include elevated concentrations of suspended solids and nutrient enrichment. However, the Proposed Offsetting Measures involves the deforestation of ~105.5ha of coniferous forestry which will result in improved surface water quality and attenuation. This will improve local surface water quality in the vicinity of the Proposed Offsetting lands in comparison to the existing baseline condition where forestry operations are ongoing.

4.4.2 Cumulative Effects with Agriculture

Taurbeg Wind Farm
The cumulative study area associated with the Site includes agricultural areas surrounding Newmarket and Rockchapel.

Agriculture is the largest pressure on water quality in Ireland. Agricultural practices such as the movement of soil and the addition of fertilizers and pesticides can lead to nutrient losses and the entrainment of suspended solids in local surface watercourses. This can have a negative effect on local and downstream surface water quality.

Due to the close proximity of several forested areas to the Site and given that they drain to the same watercourses, the potential cumulative effects on downstream water quality and quantity need to be assessed.

However, given the nature of the Proposed Project, the lack of any significant groundworks and the prescribed mitigation measures for the Proposed Project, there will be no effects on downstream surface water quality.

For these reasons it is considered that there will not be a significant cumulative effect associated with agricultural activities.

Proposed Offsetting Measures
The cumulative study area associated with the Proposed Offsetting lands includes agricultural areas to the east of Castleisland. Agricultural practices can have negative effects on water quality associated with nutrient losses and the entrainment of suspended solids in surface waters.

However, the Proposed Offsetting Measures involves the deforestation of ~105.5ha of coniferous forestry which will result in improved surface water quality. This will improve local surface water quality in the vicinity of the Proposed Offsetting lands in comparison to the existing baseline condition where forestry operations are ongoing.

4.4.3 Cumulative Effects with Other Housing Developments

A detailed cumulative assessment has been carried out for all planning applications (granted and awaiting decisions) within the cumulative assessment areas described above for both Taurbeg Wind Farm and the Proposed Offsetting lands.

These applications are generally for new dwellings or renovations of existing dwellings, as well as for the erection of farm buildings. There is also a planning permission for the construction of 67 no. dwellings at Cahereen West, Killarney Road, Castleisland (Planning Ref Number: 201198). These developments are typically small scale and localised in nature and impacts on water quality or flows (surface water or groundwater) are not expected. Therefore, hydrological cumulative impacts with respect to the Proposed Project will not occur.

4.4.4 Cumulative Effects with Other Wind Farms

Taurbeg Wind Farm
A total of 3 no. existing wind farms have been identified within the hydrological cumulative study area for the wind farm. These include the Coolegrean, Glentane and Knockacummer Wind Farms. There is also a single existing wind turbine at Newmarket which also lies within the hydrological cumulative study area.

These existing wind farms identified within the cumulative study area have already been constructed and are currently in the operational phase of development and are generating electricity. Given that the wind farms have already been constructed, the potential for cumulative hydrological effects to occur is very limited.

The EIARs for the above wind farm developments detail potential hydrological and hydrogeological issues relating to the operation and decommissioning phases of these developments and propose a suite of best practice mitigation measures designed to ensure that the developments do not in any way have a negative effect on downstream surface water quality and quantity. Similarly, the mitigation and best practice measures proposed in this EIAR chapter will ensure that the Proposed Project does not have the potential to result in significant effects on the hydrological/hydrogeological environment.

The proposed Gooseberry Hill Wind Farm in Co. Cork is also located in the hydrological cumulative study area. This wind farm is currently in the design phase, with 18 no. turbines currently proposed. If this wind farm was to be granted planning permission, it would be accompanied by an EIAR which would prescribe strict mitigation measures for the protection of surface water quality and quantity during the construction, operation and decommissioning phases of this wind farm development.

Therefore, there will be no cumulative effects associated with the extended operational or decommissioning phases of the Proposed Project and other wind farms within the cumulative study area.

Proposed Offsetting Measures
The existing Mount Eagle Wind Farm, Coolegrean Wind Farm and Cordal Wind Farm are located within the cumulative study area associated with the Proposed Offsetting Measures. Mount Eagle Wind Farm is currently in operation. The EIARs for this wind farm development details potential hydrological and hydrogeological issues relating to the operation and decommissioning phases and propose a suite of best practice mitigation measures designed to ensure that the developments do not in any way have a negative effect on downstream surface water quality and quantity. Similarly, the mitigation and best practice measures proposed in this EIAR chapter will ensure that the Proposed Offsetting Measures do not have the potential to result in significant effects on the hydrological/hydrogeological environment.

Therefore, there will be no cumulative effects associated with the Proposed Offsetting Measures and other wind farms within the cumulative study area.

4.4.5 Cumulative Effects with Wastewater Treatment Plants

Taurbeg Wind Farm

A total of 3 no. urban Wastewater Treatment Plants (WwTPs) are located within the hydrological cumulative study area. These include the Meelin, Newmarket and Rockchapel urban WwTPs. In addition, the WwTP associated with Newmarket Co-operative Creameries Ltd (P0793) is located within the hydrological cumulative study area. The discharge of wastewater to local watercourses and could potentially result in cumulative effects with the Proposed Project. However, these WwTPs discharge treated wastewater and discharge limits have been assigned to the effluent to ensure that the treated wastewater does not have any significant effects on the receiving surface water quality. The available Annual Environmental Reports (AERs) have been reviewed and the WwTPs are largely compliant with respect to the discharge limits.

The mitigation and best practice measures proposed in this EIAR chapter will ensure that the Proposed Project does not have the potential to result in significant effects on the hydrological/hydrogeological environment.

Therefore, there will be no cumulative effects associated with the extended operational or decommissioning phases of the Proposed Project and the WwTPs within the cumulative study area.

Proposed Offsetting Measures

The Brosna WwTP is located in the cumulative study area with wastewater being discharged into the Clydagh River. This WwTP discharges treated wastewater and discharge limits have been assigned to the effluent to ensure that the treated wastewater does not have any significant effects on the receiving surface water quality. There is no potential for cumulative effects.

5. SUMMARY AND CONCLUSION

WFD status for SWBs (Surface Water Bodies) and GWBs (Groundwater Bodies) hydraulically linked to the Site and the Proposed Offsetting lands are defined in **Section 2** above.

The Proposed Lifetime Extension does not involve any abstraction of groundwater or alteration of exiting surface water drainage patterns. Therefore, the quantitative status (i.e., the available quantity (volume) of groundwater and surface water locally) to the receiving waters will remain unaltered during the Extended Operational Phase of the Proposed Project.

There is no direct discharge from the Site to downstream receiving waters. Mitigation for the protection of surface water during the Extended Operational Phase and the Decommissioning Phase will ensure the qualitative status of the receiving waters will not be altered by the Site.

There is also mitigation proposed to protect surface and groundwater quality within the Site and at the Proposed Offsetting lands during all phases of the Proposed Project. These mitigation measures will ensure the qualitative status of the underlying GWB will not be altered by the Site.

The operation of the Taurbeg Wind Farm to date has not resulted in the deterioration of the status of any SWB or GWB. Indeed, the status of the Feale_010 SWB which drains the majority of the Site has improved in status during the lifetime of the Taurbeg Wind Farm. Therefore, the existing drainage controls and mitigation measures being implemented are effective. These will continue to be implemented during the proposed extended operational phase.

There will be no change in GWB or SWB status in the underlying GWB or downstream SWBs resulting from the Proposed Project. There will be no change in quantitative (volume) or qualitative (chemical) status, and the underlying GWB and downstream SWBs are protected from any potential deterioration.

As such, the Proposed Project:

- will not cause a deterioration in the status of all surface and groundwater bodies assessed;
- will not jeopardise the objectives to achieve ‘Good’ surface water/groundwater status;
- does not jeopardise the attainment of 'Good’ surface water/groundwater chemical status;
- does not jeopardise the attainment of ‘Good’ surface water/groundwater quantity status;
- does not permanently exclude or compromise the achievement of the objectives of the WFD in other waterbodies within the same river basin district;
- is compliant with the requirements of the Water Framework Directive (2000/60/EC); and,
- is consistent with other Community Environmental Legislation including the EIA Directive (2014/52/EU), the Habitats Directive (92/43/EEC) and the Birds Directive (2009/147/EC) (Note that a full list of legislation complied with in relation to hydrology and hydrogeology is included in Section 9.1.4 of EIAR Chapter 9).

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APPENDIX 11-1

Climate Legislation and Policy

1. CLIMATE LEGISLATION POLICY AND GUIDANCE – INTERNATIONAL AND NATIONAL

Although variation in climate is thought to be a natural process, the rate at which the climate is changing has been accelerated rapidly by human activities. Climate change is one of the most challenging global issues facing the world today and is primarily the result of increased levels of greenhouse gases in the atmosphere. Increasing human emissions of carbon dioxide and other greenhouse gases cause a positive radiative imbalance at the top of the atmosphere, meaning energy is being trapped within the climate system. The imbalance leads to an accumulation of energy in the Earth system in the form of heat that is driving global warming.[1,2] Greenhouse gases come primarily from the combustion of fossil fuels in energy use.

In March 2023 the European Environment Agency (EEA) published the European Climate Risk Assessment.[3] This assessment states that Europe is the fastest warming continent on the planet and is warming at about the twice the global rate. The average global temperature in the 12-month period between February 2023 and January 2024 exceeding pre-industrial levels by 1.5˚C. 2023 was the warmest year on record over more than 100,000 years globally, at 1.48˚C above pre-industrial levels, with the world's ocean temperature also reaching new heights.

The Intergovernmental Panel on Climate Change (IPCC), in their AR6 Synthesis Report: Climate Change 2023[4], state that widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred. This has led to widespread adverse impacts and related losses and damages to people and nature due to the pressures of climate change and the inability to adapt to a rapidly changing environment. Moving away from our reliance on coal, oil and other fossil fuel-driven power plants is essential to reduce emissions of greenhouse gases and mitigate the human activity catalysing climate change.

1.1.1 International Greenhouse Gas Emission and Climate Targets

Globally, governance relating to climate change has changed significantly since 1994 when the United Nations Framework Convention on Climate Change (UNFCCC) entered into force. Greenhouse gas emissions have been a primary focus of climate related international agreements for almost two decades.

International greenhouse gas emission and climate targets play an important role in stimulating and enabling action for developed and developing nations. The following sections provide an overview of the international agreements that have played key roles in establishing climate governance.

1.1.1.1 Kyoto Protocol

The Kyoto Protocol was adopted on 11 December 1997; this Protocol operationalised the UNFCCC and was the first international agreement that committed countries to reduce their greenhouse gas

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[1] *Hansen, J.; Sato, M.; Kharecha, P. et al. Earth's Energy Imbalance and Implications. Atmospheric Chemistry and Physics 2011, 11 (24), 13421–13449.* https://doi.org/10.5194/acp-11-13421-2011

[2] *von Schuckmann, K.; Palmer, M. D.; Trenberth, K. E. et al. An Imperative to Monitor Earth's Energy Imbalance. Nature Clim Change 2016, 6 (2), 138–144.* https://doi.org/10.1038/nclimate2876.

[3] *European Environment Agency (2023) European Climate Risk Assessment* <https://climate-adapt.eea.europa.eu/en/eu-adaptation-policy/key-eu-actions/climate_risk_assessment/index_html/>

[4] *IPCC AR6 Synthesis Report: Climate Change 2023.* https://www.ipcc.ch/report/sixth-assessment-report-cycle/

emissions. It set limitations and reduction targets for greenhouse gases for developed countries (Annex I countries) and set a special obligation for certain countries to provide financial resources and facilitate technology transfer to developing countries (Annex II countries). The EU, and therefore Ireland, was both an Annex I and Annex II country.

The Kyoto Protocol came into effect in 2005, as a result of which, emission reduction targets agreed by developed countries, including Ireland, became binding for the first time.

Under the Kyoto Protocol, the EU agreed to achieve a significant reduction in total greenhouse gas emissions in the period 2008 to 2012. These EU emission targets are legally binding in Ireland. Ireland's contribution to the EU commitment for the period 2008 – 2012 (the first commitment period) was to limit its greenhouse gas emissions to no more than 13% above 1990 levels. Ireland achieved its Kyoto Protocol targets under the EU burden-sharing agreement.

1.1.1.1.1 *Doha Amendment to the Kyoto Protocol*

In Doha, Qatar, on 8th December 2012, the "Doha Amendment to the Kyoto Protocol" was adopted. The amendment includes:

- New commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period from 1 January 2013 to 31 December 2020;
  - The amendment entered into force on 31 December 2020
- A revised list of greenhouse gases to be reported on by Parties in the second commitment period; and
- Amendments to several articles of the Kyoto Protocol which specifically referenced issues pertaining to the first commitment period and which needed to be updated for the second commitment period.

During the first commitment period, 37 industrialised countries and the European Community committed to reduce greenhouse gases emissions to an average of 5% below 1990 levels. During the second commitment period, Parties committed to reduce greenhouse gases emissions by at least 18% below 1990 levels in the eight-year period from 2013 to 2020. The composition of Parties in the second commitment period is different from the first; however, Ireland and the EU signed up to both the first and second commitment periods. Under the protocol, countries must meet their targets primarily through national measures, although market-based mechanisms (such as international emissions trading) can also be utilised.

Although the 1997 Kyoto Protocol and 2012 Doha Amendment were in force in 2020, the 2015 Paris Agreement superseded the Kyoto Protocol as the principle regulatory instrument governing the global response to climate change.

1.1.1.2 Conference of the Parties

Every year since 1995, the Conference of the Parties (COP) has gathered the 196 Parties (195 countries and the European Union) that have ratified the Convention in a different country, to evaluate its implementation and negotiate new commitments, and is the supreme decision-making body of the UNFCCC.

The following details the most significant COPs in terms of impact on climate action as well as a summary of the most recent COP, COP28, which took place in Dubai.

1.1.1.2.1 COP21 Paris Agreement

COP21 was the 21st session of the COP to the UNFCCC. COP21 was organised by the United Nations in Paris and held from 30th November to 12th December 2015.

COP21 closed on 12th December 2015 with the adoption of the first international climate agreement (concluded by 195 countries and applicable to all). The twelve-page text, made up of a preamble and 29 articles, provides for a limitation of the temperature rise to below 2°C above pre-industrial levels and even to tend towards 1.5°C. It is flexible and takes into account the needs and capacities of each country. It is balanced as regards adaptation and mitigation, and durable, with a periodical ratcheting-up of ambitions.

1.1.1.2.2 COP25 Climate Change Conference- Madrid

The 25th United Nations Climate Change conference COP25 was held in Madrid and ran from December 2nd to December 13th, 2019. While largely regarded as an unsuccessful conference, the European Union launched its most ambitious plan, 'The European Green New Deal' which aims to lower CO_2 emissions to zero by 2050. The deal includes proposals to reduce emissions from the transport, agriculture and energy sectors and will affect the technology, chemicals, textiles, cement, and steel industries. Measures such as fines and pay-outs by member states who rely on coal power will be in place to encourage the switch to renewable clean energies such as wind. On the 4th of March 2020, the European Commission put forward the proposal for a European climate law. This aims to establish the framework for achieving EU climate neutrality. It aims to provide a direction by setting a pathway to climate neutrality and to this end, aims to set in legislation the EU's 2050 climate-neutrality objective.

1.1.1.2.3 COP28 Climate Change Conference – Dubai

The 28th COP for the UNFCCC (COP28) took place in Dubai from the 30th of November 2023 to the 13th of December 2023.

COP28 resulted in a landmark deal to 'transition away' from fossil fuels, the UAE Consensus. The agreement calls for 'transitioning away from fossil fuels in energy systems, in a just, orderly, and equitable manner.' This is the first time in 28 years that fossil fuels have been mentioned in a COP outcome. However, it is noted that the text of 'phase out as soon as possible inefficient fossil fuel subsidies' does not address energy poverty or the just transition. The UAE Consensus also calls for more explicit near-term goals in the lead up to 2050, calling for the world to cut greenhouse gas emissions by 43% by 2030 as compared to 2019 levels. However, many island states have criticised that despite the text being an improvement over previous agreements, there is a litany of loopholes that will enable destructive environmental practices to continue and do not assuage their concerns over rising sea levels and other climate change impacts.

COP28 concluded the first ever Global Stocktake under the Paris Agreement. The Global Stocktake recognises that the world is not on track to meet 1.5°C and will require Parties to align their national targets and measures with the Paris Agreement. Parties have two years to submit their Nationally Determined Contributions for 2035, these need to be aligned with the best available science and the outcomes of the Global Stocktake.

An unusual aspect that came out of COP28 in the final hours of discussion was the number of decisions and documents which remain unfinished and not signed off. Notably, discussions on carbon markets collapsed in the final days of COP28 as no consensus could be reached on the country-to-country trading regimes or rules for the market in relation to Article 6 of the Paris Agreement. Negotiations will be continued at COP29 in Azerbaijan.

1.1.1.3 COP29 Climate Change Conference – Azerbaijan

The 29th COP of the UNFCCC, (COP29), held in Baku, Azerbaijan, from November 11th 2024 to November 22nd 2024.

COP29 focused on accelerating global efforts to address climate change, in particular global efforts related to climate finance. The New Collective Quantified Goal on Climate Finance (NCQG) was agreed in the final days of COP; while developing countries advocated for at least USD 1 trillion annually by 2035, developed nations agreed to triples finance to developing countries, with commitments increasing from USD 100 billion annually to USD 300 billion annually by 2035. The NCQG has already drawn criticism for being inadequate given the global financial need of developing nations to mitigate and adapt to climate change effects and due to its lack of strong terminology in relation to the requirements of developed nations and detailed implementation strategies.

At COP29, significant progress was made in the discussions surrounding carbon markets, with nearly 200 nations agreeing on critical rules under Article 6 of the Paris Agreement. These rules aim to establish an UN-backed international carbon market. The adoption of these rules is seen as a crucial step towards operationalising a robust and credible carbon market. Despite the advances, concerns were expressed about the potential for weak governance and risks of exploitation in the system; these issues must be addressed to ensure the market's full functionality.

Energy transition discussions focused on accelerating the global shift toward sustainable energy systems, aligned with the Paris Agreement goals of limiting warming to 1.5°C. The conference emphasized the need for robust policies to phase out coal, expand renewable energy infrastructure, and develop green hydrogen as a low-carbon alternative for hard-to-electrify sectors.

COP29 operationalized the Fund for responding to Loss and Damage (‘the Fund’) with $50 billion in initial pledges aimed at assisting vulnerable countries. The Fund is expected to begin financing initiatives by 2025, focusing on the most vulnerable populations facing extreme weather events and slow-onset climate impacts. Despite these advancements, ongoing discussions are required to define the Fund’s vision, scope, and integration with existing climate finance mechanisms.

1.1.1.4 United Nations Sustainable Development Goals Report

Transforming our World: the 2030 Agenda for Sustainable Development which includes 17 Sustainable Development Goals (SDGs), and 169 targets was adopted by all UN Member States at a UN summit held in New York in 2015. The agenda is universally applicable with all countries having a shared responsibility to achieve the goals and targets which came into effect on January 1st, 2016. The goals and targets are to be actions over the 15-year period, are integrated and indivisible i.e., all must be implemented together by each Member State.

On the 28th of June 2024, the United Nations published ‘*The Sustainable Development Goals Report 2024*’[5] (hereafter referred to as the UN SDG 2024 Report) highlighting how the lasting impacts of the COVID-19 pandemic, the war in Ukraine, ongoing and escalating geopolitical conflicts, and the increasing consequences of the climate crisis have hindered the achievement of the SDGs. The UN SDG 2024 Report finds that, following an assessment of all 169 targets, for which trend data is available, only 17% of the SDG targets are on track, 48% of SDG targets are showing minimum or moderate progress, 18% having stalled in progress and 17% having regressed from 2023. The UN SDG 2024 Report highlights the urgent need for stronger and more effective international cooperation to maximize progress, with immediate effect.

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[5] *The Sustainable Development Goals Report (2024). Available at: https://unstats.un.org/sdgs/report/2024/*

On the 17th of June 2024 the Dublin University Press published the *'Sustainable Development Report 2024'*.[6] The report highlights five key findings:

- On average, only 16% of the SDG targets are on track to be met globally by 2030, with the remaining 84% showing limited progress or a reversal of progress.
    - At the global level, SDG progress has been stagnant since 2020.
- The pace of SDG progress varies significantly across country groups.
    - As in previous years, European countries – notably the Nordic countries – top the 2024 SDG Index.
- Sustainable development remains a long-term investment challenge. Reforming global financial architecture is more urgent than ever. The world requires many essential public goods that far transcend the nation-state.
- Global challenges require global cooperation.
    - The report's new Index of support to UN-based multilateralism ranks countries based on their engagement with the UN system – including treaty ratification, votes at the UN General Assembly, membership in UN organisations, participation in conflicts and militarisation, use of unilateral sanctions, and financial contributions to the United Nations.
        - Ireland is ranked 28/167 with an overall country score of 78.7/100 (this is higher than the regional average 77.2); please see Figure 9-1 below for a detailed breakdown of Irelands SDG trends for each goal.
- The SDG targets related to food and land systems are particularly off-track.
    - Greenhouse gas emissions from agriculture, forestry, and other land use account for almost a quarter of total annual global GHG emissions.
    - The Food, Agriculture, Biodiversity, Land-Use, and Energy (FABLE) Consortium determined a "global sustainability" pathway which would avoid up to 100 million hectares of deforestation by 2030 and 100 gigatons of CO_2 emissions by 2050.

Figure 1-1 Ireland SDG Dashboard and Trends. Source: Sustainable Development Report 2024 pg. 244

In October 2022 the Department of Communications, Climate Action & Environment in partnerships with all Government Departments, key stakeholders, and based on input from two public consultation processes published the Sustainable Development Goals National Implementation Plan 2022-2024 ('the SDG Plan').[7] The SDG Plan identifies that, overall, the world is not on track to achieve the global Goals by 2030. The SDG Plan sets out how Ireland will work to achieve the goals and targets of the Agenda

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[6] *Dublin University Press (2024) Sustainable Development Report 2024 The SDGs and the UN Summit of the Future Includes the SDG Index and Dashboards. <https://s3.amazonaws.com/sustainabledevelopment.report/2024/sustainable-development-report-2024.pdf>*

[7] *National Implementation Plan for the Sustainable Development Goals 2022-2024. Available at: <https://www.gov.ie/en/publication/e950f-national-implementation-plan-for-the-sustainable-development-goals-2022-2024/>*

for Sustainable Development both domestically and internationally. Irelands first National Implementation Plan provided a framework for Ireland to work towards the implementation of the SDGs; the SDG Plan aims to build on the structures and mechanisms from the first National Implementation Plan and to develop and integrate additional approaches in areas identified as requiring further action.

In September 2023, the UN Summit on the SDGs took place in New York and was co-facilitated by Ireland and Qatar. Representing the halfway mark to achieving the SDGs by 2030, it marked the beginning of a new phase of accelerated progress towards the SDGs with high-level political guidance on transformative and accelerated actions. The Global Sustainable Development Report 2023[8] was published in September 2023. The previous Global Sustainable Development Report (2019[9]) found that for some targets the global community was on track, but for many others the world would need to quicken the pace. In 2023, the situation is much more worrisome owing to slow implementation and a confluence of crises. The 2023 Report goes on to highlight the current standing of each SDG and its relevant indicators. A 2023 UN Special Report[10] found that over 30% of the SDGs have seen either no improvement or reverse trends in progress. The push for transformation to achieve the SDGs will come through shifts in six key entry points:

1. *Human Well Being and Capabilities*
2. *Sustainable and Just Economies*
3. *Food Systems and Healthy Nutrition*
4. *Energy Decarbonisation with Universal Access*
5. *Urban and Peri-Urban Development*
6. *Global Environmental Commons*

The Proposed Project will contribute to Entry Point 4 due to the clean and renewable energy it will provide over its operational life. The phase out of fossil fuels in a manner that is globally and domestically just, while strengthening the transition to renewables by increasing energy efficiency and encouraging behavioural change will be key to achieving the relevant SDGs to the Proposed Development.

Relevant SDGs to the Proposed Project and how they are implemented into Irish National plans and policies can be found in Table 1 below.

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[8] *Global Sustainable Development Report 2023 <https://sdgs.un.org/sites/default/files/2023-09/FINAL%20GSDR%202023-Digital%20-110923_1.pdf>*

[9] *Global Sustainable Development Report 2019 <https://sdgs.un.org/sites/default/files/2020-07/24797GSDR_report_2019.pdf>*

[10] *The Sustainable Development Goals Report 2023: Special Edition <https://unstats.un.org/sdgs/report/2023/The-Sustainable-Development-Goals-Report-2023.pdf>*

Table 1 Sustainable Development Goals Report 2023, Relevant SDGs to the Proposed Development, and Implementation into Irish National Plans

SDG	**Targets**	**International Progress/Downfalls to Date (2024)**[11]	**National Relevant Policy**
SDG 7 Affordable and Clean Energy: *Ensure access to affordable, reliable, sustainable and modern energy for all*	› By 2030, ensure universal access to affordable, reliable and modern energy services › By 2030, increase substantially the share of renewable energy in the global energy mix › By 2030, double the global rate of improvement in energy efficiency › By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology › By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support	In 2022, global electricity access declined for the first time in a decade, primarily due to disruptions from COVID-19 and the Ukraine conflict. Despite improvements in energy intensity and renewable energy growth, international financial flows for clean energy in developing countries remain insufficient. At the current rate, 660 million people will still lack electricity and 1.8 billion will not have access to clean cooking by 2030. To achieve universal access to energy by 2030, we need to expedite electrification efforts, boost investments in renewable energy, enhance energy efficiency, and establish supportive policies and regulatory frameworks. In 2021 the global share of renewable sources in total final energy consumption stood at 18.7%. Excluding traditional use of biomass, the share of modern renewable sources rose gradually from 10% in 2015 to 12.5% in 2021. The electricity sector led the charge with renewables, contributing 28.2% to total final electricity consumption. However, insufficient progress in the heat and transport sectors underscores the need for stronger conservation measures and policy actions. Tripling world's installed renewable energy generation agreed at the COP28 is an important step aligning with the SDG7. Installed renewable energy capacity is on the rise worldwide, reaching 424 watts per person globally in 2022. Developed nations averaged 1,073 watts per person, while developing countries averaged 293 watts per person. This represents an 8.5% increase from 2021, maintaining a steady compound annual growth rate of 8.1% over five-year periods.	*Ireland's Transition to a Low Carbon Energy Future 2015-2030;* *Energy Poverty Action Plan;* *Ireland's Transition to a Low Carbon Energy Future 2015- 2030;* *National Mitigation Plan;* *National Energy Efficiency Action Plan;* *One World, One Future;* *The Global Island* *Economic Recovery Plan* *Project Ireland 2040: National Planning Framework;* *Project 2040;* *National Development Plan 2021-2030;* *Climate Action Plan 2024*
SDG 9: Industry, Innovation, and Infrastructure *Build resilient infrastructure, promote inclusive and sustainable*	› Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all. › Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line	Since 2022, the manufacturing sector has faced stagnation, attributed to geopolitical instability, inflation, logistical challenges, rising energy costs, and a broader global economic slowdown. Globally, manufacturing's share in employment has regressed. While there has been progress in reducing CO2 intensity in manufacturing, it falls short of 2030 target values. To expedite progress towards SDG 9, efforts should prioritize accelerating the green transition, strategically prioritizing sectors, and addressing inequalities in digital and innovation sectors.	*National Development Plan 2021-2030;* *National Economic Recovery Plan;* *Climate Action Plan 2024;* *National Implementation Plan on Persistent Organic Pollutants;* *Waste Action Plan for a Circular Economy;*

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[11] *United Nations, the 17 Goals – Sustainable Development <https://sdgs.un.org/goals>*

SDG	Targets	International Progress/Downfalls to Date (2024)[11]	National Relevant Policy
industrialisation and foster innovation	with national circumstances, and double its share in least developed countries - Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities	The manufacturing sector rebounded strongly in 2021 post-COVID, but growth has plateaued at around 2.7% since 2022, expected to continue in 2024. Despite this, global manufacturing value added per capita rose by 16% from 2015 to 2023, reaching $1,922 per capita. Regional gaps are stark, with Europe and Northern America hitting a record $4,986 per capita, contrasting with stagnant levels of $163 in sub-Saharan Africa. Since 2015, global manufacturing employment has fluctuated. Starting at 14.3% in 2015, it dipped to 14.2% in 2020 but saw a marginal recovery in 2021. However, by 2022, it declined to 14.1%, with notable regional disparities.	*National Waste Prevention Programme;* *A Better World*
SDG 11: Sustainable Cities and Communities *Make cities and human settlements inclusive, safe, resilient and sustainable*	- By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums - By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons - Strengthen efforts to protect and safeguard the world's cultural and natural heritage - By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management - By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement holistic disaster risk management at all levels	More than half the world's population currently reside in cities. However, cities are grappling with a multitude of complex issues, made more difficult by rising global urban poverty levels in the wake of COVID-19. From rising slum populations, insufficient public transport, city expansion outpacing population growth to threats to critical infrastructure and disruption of basic services by disasters, it is essential that cities are equipped to adequately handle these challenges. As the world turns more urban, with nearly 70% of the global population projected to reside in cities by 2050, critical infrastructure, affordable housing, efficient transport and essential social services are crucial for creating resilient, sustainable cities for all. On average, 104,049 critical infrastructure units and facilities were destroyed or damaged by disasters annually from 2015 to 2022. Furthermore, disasters disrupted over 1.6 million basic services, including educational and health services, each year. A comparison of air pollution five-year average before and after the development of the SDGs showed a significant decrease of 9% in fine particulate matter global levels and current alignment with the WHO Air Quality Guideline (AQG) Interim Target 1 value of 35 ug/m3.	*Rebuilding Ireland Action Plan for Housing and Homelessness;* *Housing for All;* *EU Regulation 1370/2007 on Public Passenger Transport Services by Rail and by Road;* *Project Ireland 2040* *National Planning Framework;* *National Clean Air Strategy;* *Rural Development Programme 2014-2022;* *National Implementation Plan on Persistent Organic Pollutants;* *Waste Action Plan for a Circular Economy;* *National Waste Prevention Programme;* *A Better World*
SDG 12 Responsible Consumption and	- By 2030, achieve the sustainable management and efficient use of natural resources.	Unsustainable patterns of consumption and production are the root cause of the triple planetary crisis:	*National Implementation Plan on Persistent Organic Pollutants;*

SDG	Targets	International Progress/Downfalls to Date (2024)[11]	National Relevant Policy
production: *Ensure sustainable consumption and production patterns.*	- By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment - Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle - Promote public procurement practices that are sustainable, in accordance with national policies and priorities. - Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products	1. *Climate Change* 2. *Biodiversity Loss* 3. *Pollution* The world is seriously off track in its effort to halve per-capita food waste and losses by 2030. While countries are fulfilling their environmental agreement obligations and embracing comprehensive approaches to address environmental degradation, public funding supporting the production and consumption of fossil fuels has more than tripled since 2015, impeding the transition to net-zero emissions. Each stage of production or manufacturing presents an opportunity to reduce resource and fossil fuel use, foster innovation, conserve energy, cut emissions, and advocate for a circular economy approach. From 2019 to 2023, one-third of member states (63 countries) have reported 516 policy instruments related to sustainable consumption and production. In 2021-2022, 73% of companies included in the sample published sustainability reports, with the number of companies tripling since 2016. This growth was observed in all regions in 2022. Fossil fuel subsidies hit a record high of $1.53 trillion in 2022, reversing the declining trend observed from 2012 to 2020. The post-COVID energy price surge inflated these subsidies, prompting some governments to introduce new support measures. Consequently, public funding for oil, coal, and gas production and consumption more than doubled from 2021 to 2022 and tripled since 2015, impeding progress towards net-zero transition.	*Waste Action Plan for a Circular Economy;* *National Waste Prevention Programme;* *Climate Action Plan 2024* *Tourism Action Plan;* *National Clean Air Strategy;* *Towards Responsible Business: Ireland's Second National Plan on Corporate Social Responsibility (CSR) 2017-2020;* *Sustainable, Inclusive and Empowered Communities 2019-2024;* *Climate Action Plan 2024*
SDG 13 Climate Action: *Take urgent action to combat climate change and its impacts* *Acknowledging that the United Nations Framework Convention on Climate Change is the primary international,*	- Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries - Integrate climate change measures into national policies, strategies and planning - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	Climate records were shattered in 2023, with the world watching the climate crisis unfold in real time. Communities around the world are suffering the effects of extreme weather, which is destroying lives and livelihoods on a daily basis. The roadmap to limit the rise in global temperature to 1.5°C and avoid the worst of climate chaos cannot afford any delays, indecision or half measures by the global community. It demands immediate action for drastic reductions in global greenhouse gas emissions in this decade and the achievement of net zero by 2050. The number of disaster-related deaths and missing persons per 100,000 population (excluding COVID-19 deaths) has nearly halved from 1.62 in the	*National Adaptation Framework;* *Building on Recovery: Infrastructure and Capital Investment 2016-2021;* *National Mitigation Plan;* *National Biodiversity Action Plan 2017-2021;* *National Policy Position on Climate Action and Low Carbon Development;*

SDG	**Targets**	**International Progress/Downfalls to Date (2024)**[11]	**National Relevant Policy**
intergovernmental forum for negotiating the global response to climate change.		decade 2005-2014 to 0.82 in 2013-2022. However, the absolute number remains high. Between 2013 and 2022, disasters worldwide claimed 42,553 mortalities each year. Further, the number of persons affected by disasters per 100,000 population has increased by over two-third, from 1,169 in 2005-2014 to 1,980 in 2013-2022. The year 2023 broke every single climate indicator and was the warmest year on record according to the World Meteorological Organization. Global temperatures rose to 1.45°C, dangerously close for the first time to the 1.5°C lower limit of the Paris Agreement on climate change. Despite some reduction in greenhouse gas emissions in developed countries, concentrations of greenhouse gases reached record high observed levels in 2022 and real-time data in 2023 show greenhouse gases continuing to increase. Carbon dioxide levels are 150% above pre-industrial levels. Climate finance, reported by Annex I Parties as support provided to developing countries, has increased at a compound rate of 5% from 2015 to 2020, amounting to $41 billion. Although there are a range of estimates and a lack of an agreed accounting methodology on the $100 billion per year goal, the goal was not yet met as of 2021. However, recent progress made in the provision and mobilization of climate finance amounted to $89.6 billion in 2021.	*Project 2040: National Development Plan 2021-2030;* *Climate Action Plan 2024;* *National Dialogue on Climate Action;* *Agriculture, Forest, and Seafood Climate Change Sectoral Adaptation Plan;* *The National Strategy on Education for Sustainable Development in Ireland*

1.1.1.5 Climate Change Performance Index

Established in 2005, the Climate Change Performance Index (CCPI)[12] is an independent monitoring tool which tracks countries climate protection performance. It assesses individual countries based on climate policies, energy usage per capita, renewable energy implementation and greenhouse gas emissions and ranks their performance in each category and overall. The 2025 CCPI was published in December 2024. While the CCPI 2025 indicates signs of potential reductions in global emissions, no country achieved its Paris Climate targets and therefore the first three places of the ranking system remain unoccupied.

Ireland, ranked 43rd in 2024, has risen 14 places to 29th for 2025, and is now considered a 'medium' performer in international performance. The CCPI states that Ireland's policies are missing a long-term strategy for phasing out fossil fuel infrastructure and shifting investments from natural gas towards an emissions-neutral energy supply. Coupled with low levels of battery storage and ongoing gas connections, the state is set to remain greatly dependent on fossil fuel generation. Ireland has remained in the 'low' category in 2025 on the Greenhouse Gas Emissions ratings.

In 2022, Ireland's government introduced legally binding five-year carbon budgets and sectoral emissions ceilings. It also resolved a legislative framework with annually revised Climate Action Plans to align with the country's 2030 net emissions reduction target of 51% (compared with 2018 levels) and net zero by 2050. The CCPI national experts note that, despite these legal requirements, the policy implementation remains problematic. Recent EPA projections indicate that while considerable emissions decline in 2023 (6.8%) brought Ireland closer to achieving its first carbon budget, the lack of substantial progress makes it unlikely Ireland will meet its second carbon budget in 2026–2030.

The CCPI experts indicate an urgent need for port infrastructure and grid strengthening to ensure medium-to-long-term offshore wind expansion and heating and transport electrification. Coupled with low levels of battery storage and ongoing gas connections, the state is set to remain greatly dependent on fossil fuel generation.

Ireland has remained in the 'low' category in 2025 on the Greenhouse Gas Emissions ratings and has risen from 54th in 2024 to 40th in 2025. Ireland remains in the 'Medium' category in the Renewable Energy rating table and has risen from 31st in 2024 to 21st in 2025.

1.1.1.6 State of the Global Climate 2024

The '*State of the Climate 2024 Update for COP29*'[13] report states that renewable energy generation, primarily driven by the dynamic forces of solar radiation, wind and the water cycle, has surged to the forefront of climate action for its potential to achieve decarbonization targets. There has been a substantial worldwide energy transition, with global renewable capacity expected to grow by 2.7 times by 2030, surpassing countries' current ambitions by nearly 25%, but it still falls short of tripling.[14] This growth represents the highest rate observed in the past two decades, signalling a significant momentum toward achieving the clean energy goal set at COP28 meeting in 2023 to triple renewable energy capacity globally to 11,000 GW by 2030.

In March 2025, the World Meteorological Organisation (WMO) published a report entitled the '*State of the Global Climate 2024*.[15] This report provided a summary on the state of the climate indicators in 2023 with sections on key climate indicators, extreme events and impacts. The key messages in the report include:

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[12] *Climate Change Performance Index 2024 <https://ccpi.org/>*

[13] *WMO (2024) State of the Climate 2024 Update for COP29 <https://wmo.int/publication-series/state-of-climate-2024-update-cop29>*

[14] *IEA (2024), Renewables 2023, IEA, Paris <https://www.iea.org/reports/renewables-2024>*

[15] *WMO (2025) State of the Global Climate 2024 <https://library.wmo.int/records/item/69455-state-of-the-global-climate-2024>*

- The annually averaged global mean near-surface temperature in 2024 was 1.55 °C ± 0.13 °C above the 1850–1900 average used to represent pre-industrial conditions.
- The year 2024 was the warmest year in the 175-year observational record, clearly surpassing the previous warmest year, 2023 at 1.45 °C ± 0.12 °C above the 1850–1900 average.
- In 2024, global mean sea level reached a record high in the satellite record (from 1993 to present).
    - The rate of global mean sea-level rise in the past 10 years (2015–2024) was more than twice the rate of sea-level rise in the first decade of the satellite record (1993–2002).

Alterations in the physical climate can trigger a series of repercussions on national advancement and the pursuit of SDGs (Section 1.1.3 above). The interconnections between the climate emergency and development pathways can foster synergistic endeavours, resulting in positive benefits for communities and human well-being (refer to Chapter 5 of this EIAR for more details). This synergy serves as a potent driver for adapt to climate change and lay the groundwork for the global energy transition. Emphasizing wind energy and other renewable sources enables the global energy transition towards sustainability.

1.1.1.7 Renewable Energy Directive

The Renewable Energy Directive (RED) is the legal framework for the development of clean energy across all sectors of the EU economy, supporting cooperation between EU countries towards this goal.

The first RED[16] is legislation that influenced the growth of renewable energy in the EU and Ireland for the decade ending in 2020. The directive set and confirmed mandatory national targets consistent with the EU's overall goal. It also required EU countries to develop indicative trajectories for achieving their targets, submit national renewable energy action plans and publish national renewable energy progress reports every two years.

In 2018, as part of the 'Clean Energy for all Europeans' package, the first revision of RED entered into force (the second Renewable Energy Directive (REDII)[17]) which continued to promote the growth of renewable energy out to 2030. REDII introduced a binding EU-wide target for overall RES of 32% in 2030 and requires Member States to set their national contributions to the EU-wide target. As per the National Energy and Climate Plan (NECP) 2021-2030, Ireland's overall RES target is 34.1% in 2030. This directive, which had to be transposed into national law by EU countries by June 2021, established a new binding renewable energy target for the EU of at least 32% of gross final energy consumption by 2030, along with an increased target of 14% for the share of renewable fuels in transport by 2030.

Under REDII, Ireland's National Energy and Climate Plan 2021-2030 included a planned renewable energy share in electricity (RES-E) of 70% in 2030, which has been replaced by the 80% by 2030 RES-E target as detailed in the most recent Climate Action Plan (2024).

Given the need to ratchet up the EUs clean energy transition, RED was revised in 2023, and the amending Directive EU/2023/2413 (REDIII)[18] entered into force on 20 November 2023. REDIII amended the EU-wide overall 2030 RES target from 32% to at least 42.5%, and it is assumed that Irelands 2030 RES target will increase accordingly. REDIII establishes the following sectoral and innovation targets for EU countries:

- In the industry sector, a binding target of 42% for renewable hydrogen in total hydrogen consumption by 2030 and 60% by 2035, with an indicative target of an annual average increase of 1.6 percentage points in renewable sources.

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[16] *Directive 2009/28/EC on the promotion of the use of energy from renewable sources. Available from: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:en:PDF*

[17] *Directive (EU) 2018/2001 on the promotion of the use of energy from renewable resources (recast). Available from: https://eurlex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32018L2001*

[18] *Directive (EU) 2023/2413 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources and repealing Council Directive (EU) 2015/652. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202302413*

- In the buildings sector, an indicative target of 49% for the share of renewable energy by 2030, with heating and cooling targets to increase by 0.8 percentage points per year until 2025 and by 1.1 percentage points from 2026 to 2030.
- In the transport sector, either a 29% target for the share of renewable energy by 2030, or a 14.5% reduction of greenhouse gas emissions, through greater use of advanced biofuels and renewable fuels of non-biological origin (RFNBO), such as hydrogen.
- In research and innovation, an indicative target of 5% of newly installed renewable energy capacity from innovative technologies by 2030.

1.1.1.8 European Green Deal

The European Green Deal was introduced by the European Commissioning in December 2019 as the EUs response to the Paris Agreement ambitions (COP21 (please see section 1.1.2.1 above)). The European Green Deal is a comprehensive package of policy initiatives aimed at achieving climate neutrality across the EU by 2050. It features a wide range of actions and targets in different sectors such as energy, transport, industry, environment and agriculture. The goal is to transform the EU into a resource-efficient, competitive circular economy that is fair and inclusive for every individual and region.

Key aspects of the European Green Deal include the adoption of the European Climate Law, which legally binds the EU to achieve net-zero emissions by 2050, and the establishment of a Carbon Border Adjustment Mechanism to prevent carbon leakage. Additionally, the Deal focuses on boosting green technologies, fostering clean energy, improving energy efficiency, and promoting biodiversity and sustainable agriculture.

To finance these ambitious goals, the European Green Deal is supported by the EU’s Green Deal Investment Plan, also known as the "Just Transition Mechanism," which aims to mobilize at least €1 trillion in investments over the next decade. This funding will be used to help EU regions and industries transition to greener alternatives while mitigating social and economic impacts on communities and workers. The European Green Deal also emphasizes the importance of international collaboration in tackling climate change and aims to align European policies with the global agenda of the Paris Agreement.

In its approach to decarbonisation, the EU has split greenhouse gas emissions into two categories, the Emissions Trading System (ETS) and the non-ETS. Under the European Green Deal, the targets for the ETS and non-ETS sectors will be revised upwards in order to achieve the commitment, at EU level, to reach an economy-wide 2030 reduction in emissions of at least 55%, compared to 1990 levels.

1.1.1.9 Council Regulation (EU) 2022/2577 and 2024/223

Arising from REPowerEU, Council Regulation (EU) 2022/2577 laying down a framework to accelerate the deployment of renewable energy was adopted on the 22 December 2022. Regulation 2022/2577 came into effect on the 23 December 2022 and has effect until the 30 June 2024. The Regulation made provision for a review by the commission within 12 months. Following this review the Council introduced Regulation 2024/223 on the 22 December 2023 amending Regulation 2022/2577. Regulation 2022/2577 and 2024/223 recognises the relative importance of renewable energy deployment in the current difficult energy context and provides significant policy and legislative support to enabling renewable energy projects.

Article 2(2) of Regulation EU 2022/2577 requires priority to be given to projects that are recognised as being of overriding public interest whenever the balancing of legal interests is required in individual cases and where those projects introduce additional compensation requirements for species protection. An analogous provision is not present in Directive (EU) 2018/2001. The first sentence of Article 3(2) of Regulation (EU) 2022/2577 has the potential, in the current urgent and still unstable energy situation on the energy market which the Union is facing, to further accelerate renewable energy projects since it requires Member States to promote those renewable energy projects by giving them priority when dealing with different conflicting interests beyond environmental matters in the context of Member States’ planning and the permit-granting process. The Commission’s report demonstrated the value of the first sentence of Article 3(2) of Regulation (EU) 2022/2577 which beyond the specific objectives of the derogations foreseen in the Directives referred to in Article 3(1) of Regulation (EU) 2022/2577. (emphasis added).

1.1.1.10 EU Nature Restoration Law

The Nature Restoration Law is the first continent-wide, comprehensive law of its kind. It is a key element of the EU Biodiversity Strategy, which sets binding targets to restore degraded ecosystems, in particular those with the most potential to capture and store carbon and to prevent and reduce the impact of natural disasters.

The law aims to restore ecosystems, habitats and species across the EU's land and sea areas in order to

- Enable the long-term and sustained recovery of biodiverse and resilient nature.
- Contribute to achieving the EU's climate mitigation and climate adaptation objectives.
- Meet international commitments.

The EU Nature Restoration Law was approved on June 17th 2024; EU countries are expected to submit National Restoration Plans to the Commission within two years of the Regulation coming into force (by mid-2026), showing how they will deliver on the targets. They will also be required to monitor and report on their progress.

1.1.1.11 EU Effort Sharing Regulation

The EU Effort Sharing Regulation (ESR[19]) was adopted in 2018 and establishes annual binding greenhouse gas emissions targets from 2020 to 2030 for each Member State. In its approach to decarbonisation, the EU has split greenhouse gas emissions into two categories, the Emissions Trading System (ETS) and the non-ETS. Emissions from electricity generation and large industry in the ETS are subject to EU-wide targets which require that emissions from these sectors be reduced by 43% by 2030, relative to 2005 levels. Within the ETS, participants are required to purchase allowances for every tonne of emissions, with the amount of these allowances declining over time to ensure the required reduction of 43% in greenhouse gas emissions is achieved at EU-level[20]. Emissions from all other sectors, including buildings, agriculture, waste, small industry, and transport, which account for around 60% of EU emission, are covered by the EU ESR.

The EU ESR focus on national accountability helps drive climate action at the local level while maintaining flexibility to account for economic disparities across Member States.

Considerable progress has been made in the decarbonisation of the electricity sector, with emissions falling by 45% between 2001 and 2022.[21] The decarbonisation of the Electricity Sector has been made possible through the deployment of renewables and their successful integration into the national grid, further facilitating the decarbonisation other sectors, such as transport, heating and industry as they look towards electrification.

1.1.2 National Greenhouse Gas Emission and Climate Targets

1.1.2.1 Programme for Government

The Programme for Government 2025 – Securing Ireland's Future (January 2025) places specific emphasis on climate change, recognising that time is critical in addressing the climate crisis. The Programme states that the Government is committed to taking *"decisive action to radically reduce our reliance on fossil fuels and to achieve a 51% reduction in emissions from 2018 to 2030, and to achieving net-zero emissions no later than 2050".*

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[19] Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013 (Text with EEA relevance)

[20] Department of the Environment, Climate and Communications (2023) - Climate Action Plan 2024 https://www.gov.ie/en/publication/79659-climate-action-plan-2024/

[21] Department of the Environment, Climate and Communications (2023) - Climate Action Plan 2024 https://www.gov.ie/en/publication/79659-climate-action-plan-2024/

The Programme states that the next ten years are a critical period in addressing the climate crisis, and therefore, a deliberate and swift approach to reducing more than half of Ireland's carbon emissions over the course of the decade (2020-2030) must be implemented. The programme states that the Government are committed to reducing greenhouse gas emissions by an average 7% per annum over the next decade in a push to achieve a net zero emissions by the year 2050.

With regard to renewable energy generation, the Programme notes that the Government is committed to the rapid decarbonisation of the energy sector. The Programme states the Government's ongoing support and commitment to take "*the necessary action to deliver at least 70% renewable electricity by 2030"*. This target has been updated by Climate Action Plan 2025 (Section 11.2.6 below).

1.1.2.2 Climate Action and Low Carbon Development Act 2015

The Climate Action and Low Carbon Development Act 2015 established Ireland's first statutory framework for tackling climate change for the purpose of pursuing the transition to a low carbon, climate resilient and environmentally sustainable economy. The 2015 Act Defined the national climate objective as 'transitioning to a climate-resilient, biodiversity-rich, environmentally sustainable, and climate-neutral economy by 2050'. To achieve this, the 2015 Act requires the Minister to develop and submit for government approval a suite of plans: carbon budgets, sectoral emission ceilings, a climate action plan, a national long-term climate strategy, and a national adaptation framework. It also established the Climate Change Advisory Council (CCAC) to provide independent oversight and annual progress reviews. Local authorities and public bodies were mandated to align policies and plans with these objectives, ensuring climate considerations are integrated throughout national and local governance structures.

1.1.2.3 Climate Action and Low Carbon Development (Amendment) Act 2021

The Climate Action and Low Carbon (Amendment) Act 2021(the '2021 Act') is a piece of legislation which commits the country to move to a climate resilient and climate neutral economy by 2050. This was passed into law in July 2021.

The Programme for Government has committed to a 7% average yearly reduction in overall greenhouse gas emissions over the next decade, and to achieve net zero emissions by 2050. This Act will manage the implementation of a suite of policies to assist in achieving these annual targets.

The Act includes the following key elements, among others:

- Places on a statutory basis a 'national climate objective', which commits to pursue and achieve no later than 2050, the transition to a climate resilient, biodiversity-rich, environmentally sustainable and climate-neutral economy.
- Embeds the process of carbon budgeting into law, Government are required to adopt a series of economy-wide five-year carbon budgets, including sectoral targets for each relevant sector, on a rolling 15-year basis, starting in 2021.
- Actions for each sector will be detailed in the Climate Action Plan, updated annually.
- A National Long Term Climate Action Strategy will be prepared every five years.
- Government Ministers will be responsible for achieving the legally binding targets for their own sectoral area with each Minister accounting for their performance towards sectoral targets and actions before an Oireachtas Committee each year.
- Strengthens the role of the Climate Change Advisory Council, tasking it with proposing carbon budgets to the Minister.

Provides that the first two five-year carbon budgets proposed by the Climate Change Advisory Council (CCAC) should equate to a total reduction of 51% emissions over the period to 2030, in line with the Programme for Government commitment.

1.1.2.4 Climate Change Advisory Council 2024

The Climate Change Advisory Council (CCAC) was established on 18th January 2016 under the Climate Action and Low Carbon Development Act 2015. The CCAC aims to provide independent evidence-based advice and recommendations on policy to support Ireland's Just Transition to a biodiversity-rich, environmentally sustainable, climate-neutral, and resilient society.

In July 2023, the CCAC published the 2023 Annual Review[22], this is the seventh annual review carried out by CCAC and details the CCAC concerns that the necessary national actions are not taking place or being enabled at the required speed, going on to state that 'at the current rate of policy implementation, Ireland will not meet the targets set in the first and second carbon budget periods unless urgent action is taken immediately, and emissions begin to fall much more rapidly.'

In 2024 the CCAC has changed it approach to produce sector specific annual reviews in order to emphasise the requirement for greater effort across all sectors to remain within their sectoral emission ceiling. In a statement released on 9th July 2024 the CCAC state that while '*the provisional greenhouse gas emissions data published today by the EPA shows some positive results across the sectors but overall, it is increasingly unlikely that the first carbon budget will be achieved. Much more urgent action is required from Government if Ireland is to achieve its climate change objectives.*'[23]

The Annual Review 2024: Electricity[24] report has been released by the CCAC and focuses specifically on key findings and recommendations for the Electricity sector. In 2023, emissions from the sector reduced by approximately 21% from 2022 to the lowest level since records began in 1990. This was driven by a considerable decline in the use of coal for electricity generation, coupled with a notable rise in imported electricity.

Renewables accounted for 41% of electricity demand in 2023, up from 39% in 2022 and approaching the 2025 target of a 50% renewable energy share in electricity generation. By the end of 2023, the total renewable grid capacity in Ireland was 5.7 GW, with the majority (4.7 GW) from onshore wind turbine installations. However, there is still a significant lack of progress towards onshore wind targets in 2023, with just 0.2GW of new onshore wind being connected to the grid in 2023.

1.1.2.5 Carbon Budgets

The first national carbon budget programme proposed by the CCAC, approved by Government and adopted by both Houses of the Oireachtas in April 2022 comprises three successive 5-year carbon budgets. The total emissions allowed under each budget are shown in Table 2 below.

Table 2 Proposed Carbon Budgets of the Climate Change Advisory Council

	2021 – 2025 Carbon Budget 1	2026 – 2030 Carbon Budget 2	2031 – 2035 Provisional Carbon Budget 3
	All Gases		
Carbon Budget (Mt CO_2eq)	295	200	151
Annual Average Percentage Change in Emissions	-4.8%	-8.3%	-3.5%

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[22] *Climate Change Advisory Council 2023 Review* <*https://www.climatecouncil.ie/councilpublications/annualreviewandreport/CCAC-AR-2023-FINAL%20Compressed%20web.pdf*>

[23] *https://www.climatecouncil.ie/news/chairs-statement-irelands-provisional-greenhouse-gas-emissions-1990-2023.html*

[24] *Climate Change Advisory Council (2024) Annual Report 2024: Electricity* <*https://www.climatecouncil.ie/councilpublications/annualreviewandreport/AR2024-Electricity-final.pdf*>

	2021 – 2025 Carbon Budget 1	2026 – 2030 Carbon Budget 2	2031 – 2035 Provisional Carbon Budget 3
The figures are consistent with emissions in 2018 of 68.3 Mt CO_2eq reducing to 33.5 Mt CO_2eq in 2030 thus allowing compliance with the 51% emissions reduction target by 2030			

Ireland has expended 47% of its emissions for the first carbon budget period in the budget first two years. Thus, only 53% is leftover, requiring a 12.4% reduction in emissions each year to stay in budget.

1.1.2.6 Sectoral Emissions Ceilings

The Sectoral Emissions Ceilings (SEC) were launched in September 2022. The objective of the initiative is to inform on the total amount of permitted greenhouse gas emissions that each sector of the Irish economy can produce during a specific time period. The SEC, alongside the annual published Climate Action Plan, provide a detailed plan for taking decisive action to achieve a 51% reduction in overall greenhouse gas emissions by 2030.

Section C of the Climate Action and Low Carbon Development (Amendment) Act 2021 provides the minister with a method of preparing the SEC within the bounds of the carbon budget. The SEC for each 5-year carbon budget period were approved by the government on the 28th of July 2022 and are shown in Table 3 below.

Table 3 Sectoral Emission Ceilings 2022

	Sectoral Emission Ceilings for each 5-year carbon budget period (MtCO2eq.)	
Sector	**2021 – 2025 Carbon Budget 1**	**2026 – 2030 Carbon Budget 2**
Electricity	**40**	**20**
Transport	54	37
Built Environment-Residential	29	23
Built Environment-Commercial	7	5
Industry	30	24
Agriculture	106	96
LULUCF[1]	Yet to be determined	Yet to be determined
Other (F-Gases, Waste & Petroleum refining)	9	8
Unallocated Savings		*-26*
Total[2]	Yet to be determined	Yet to be determined
Legally binding Carbon budgets and 2030 Emission Reduction Targets	295	200

[1] Finalising the Sectoral Emissions Ceiling for the land-use, Land-use Change and Forestry (LULUCF) sector has been deferred for up to 18 months to allow for the completion of the Land-use Strategy
[2] Once LULUCF sector figures are finalised, total figures will be available.

The electricity sector is the third largest emitting sector in Ireland and the successful decarbonisation of this sector could lead to decarbonisation in other sectors, such as the electrification of transport and heating. The CCAC 2023 Annual Review, detailed above, stated that the electricity sector had been set one of the smallest sectoral emission ceilings and the steepest decline in emissions of all sectors with emission ceilings of 40MtCO_2eq for the first carbon budget period (2021–2025) and 20MtCO_2eq for the second carbon budget period (2026–2030). This equates to a headline target of a 75% reduction in emissions in the sector from 2018 levels by 2030, which will be achieved by increasing the share of renewable electricity to 80%, encompassing 9GW of onshore wind capacity, at least 5GW of offshore wind capacity, with 2 GW earmarked for green hydrogen production, and 8GW of solar photovoltaic capacity, supported by a range of actions set out in the Climate Action Plan 2024.

The Annual Review 2024: Electricity, detailed above in Section 11.3.2.3 stated that to stay within the agreed carbon budget, the Electricity sector needs to achieve the largest reduction in sectoral emissions of all sectors, i.e., a 75% decrease by 2030 compared with 2018. The CCAC has found that approximately 49% of the Electricity sectoral emissions ceiling has now been used in the first 2 years of the first carbon budget period; with the SEAI[25] estimating that 68% of the Electricity sectoral emissions ceiling has now been used in the first 3 years of the first carbon budget period. Accelerated deployment of onshore wind and solar electricity generation is crucial if the Electricity sector is to meet its sectoral emissions ceiling for the first carbon budget period, whilst also looking forward to the second carbon budget period.

1.1.2.7 Climate Action Plan 2025

The National Climate Action Plan 2025 (CAP 2025)[26] was launched in April 2025. CAP 2025 marks the fourth update to the Climate Action Plan 2019, and the third to be prepared under the Climate Action and Low Carbon Development (Amendment) Act 2021, and the introduction of the 2022 Sectoral Emissions Ceilings (SEC) and the establishment of economy-wide carbon budgets.

CAP 2025 seeks to build on the progress made under Climate Action Plan 2024 by delivering policies, measurements and actions that will support the achievement of Irelands carbon budgets, sectoral emission ceilings, and 2030 and 2050 climate targets; while further enabling the closure of identified emissions gaps and the allocation of unallocated emission savings associated with each carbon budget period.

Building on previous iterations, CAP 2025 offers a detailed sector-by-sector roadmap outlining the key actions required to transition Ireland to a low-carbon society and reaffirms the goals of a 51% reduction in greenhouse gas emissions by 2030 and reaching climate neutrality no later than 2050. Major measures include a significant scale-up of renewable energy, especially wind and solar power, extensive retrofitting of homes to improve energy efficiency, support for nearly one million electric vehicles by 2030, and reforms in agriculture and land use aimed at promoting sustainability. CAP 2025 also emphasises public engagement, a just transition, and effective carbon pricing to ensure that the costs and benefits of climate action are distributed equitably across society. As with Climate Action Plan 2024, CAP 2025 provides an Annex of Actions[27], which only contain new, high-impact actions for delivery in 2025. The full set of measures for CAP 2025 (i.e., proposed new actions and existing actions) are still located within CAP 2025.

Six Vital High Impact Sectors were identified within Climate Action Plan 2023[28] relating to the sectoral emission ceilings. CAP 2025 has reaffirmed the following sectors and targets with no proposed changes:

Powering Renewables – 75% Reduction in emissions by 2030

We will facilitate a large-scale deployment of renewables that will be critical to decarbonising the power sector as well as enabling the electrification of other technologies.

- Accelerate the delivery of onshore wind, offshore wind, and solar.
- Dial up to 9 GW onshore wind, 8 GW solar, and at least 7 GW of offshore wind by 2030 (with 2 GW earmarked for green hydrogen production).
- Support at least 500 MW of local community-based renewable energy projects and increased levels of new micro-generation and small-scale generation.
- Phase out and end the use of coal and peat in electricity generation.

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[25] *Sustainable Energy Authority of Ireland (2024) Technical Highlights of Interim 2023 National Energy Balance. Available at: https://www.seai.ie/data-and-insights/seai-statistics/key-publications/national-energy-balance/*

[26] *Department of the Environment, Climate and Communications (2025) Climate Action Plan 2025. Available at: https://www.gov.ie/en/department-of-the-environment-climate-and-communications/publications/climate-action-plan-2025/*

[27] *https://assets.gov.ie/static/documents/Climate_Action_Plan_2025_-_Annex_of_Actions.pdf*

[28] *Department of the Environment, Climate and Communications (2022) Climate Action Plan 2023 – Summary Document*

Achievement of the 75% reduction in emissions by 2030 and the decarbonisation of the grid in Ireland would assist in the achievement of the Electricity sectoral emission ceiling.

Building Better – 45% (Commercial/Public) and 40% (Residential) Reduction in Emissions by 2030

We will increase the energy efficiency of existing buildings, put in place policies to deliver zero-emissions new builds, and continue to ramp up our retrofitting programme.

- Ramp up retrofitting to 120,000 dwellings to BER B2 by 2025, jumping to 500,000 by 2030.
- Generation up to 0.8 TWh of district heating by 2025 and up to 2.5 TWh by 2030.

Achievement of the 45% (Commercial/Public) and 40% (Residential) reduction in emissions by 2030 would assist in the achievement of the Built Environment (Commercial/Residential) sectoral emission ceiling.

Turning Transport Around – 50% Reduction in Emissions by 2030

We will drive policies to reduce transport emissions by improving our town, cities, and rural planning, and by adopting the Avoid-Shift-Improve approach: reducing or avoiding the need for travel, shifting to public transport, walking, and cycling and improving the energy efficiency of vehicles.

- Change the way we use our road space.
- Reduce the total distance driven across all car journeys by 20%.
- Walking, cycling and public transport to account for 50% of our journeys.
- Nearly 1 in 3 private cars will be an Electric Vehicle.
- Increase walking and cycling networks.
- 70% of people in rural Ireland will have buses that provide at least 3 trips to the nearby town daily by 2030.

Achievement of the 50% reduction in emissions relating to transport by 2030 would assist in the achievement of the Transport sectoral emission ceiling.

Making Family Farms More Sustainable – 25% Reduction in Emissions by 2030

We will support farmers to continue to produce world class, safe and nutritious food while also seeking to diversify income through tillage, energy generation and forestry.

- Significantly reduce our use of chemical nitrogen as a fertilizer.
- Increase uptake of protected urea on grassland farms to 90-100%.
- Increase organic farming to up to 450,000 hectares, the area of tillage to up to 400,000 ha.
- Expand the indigenous biomethane sector through anaerobic digestion, reaching up to 5.7TWh of biomethane.
- Contribute to delivery of the land use targets for afforestation and reduced management intensity of organic soils.

Achievement of a 25% reduction in emissions by 2030 in agriculture and farming practices would assist in the achievement of the agriculture sectoral emission ceiling.

Greening Business and Enterprise – 35% Reduction in Emissions by 2030

We're changing how we produce, consume, and design our goods and services by breaking the link between fossil fuels and economic progress. Decarbonising industry and enterprise are key to Ireland's economy and future competitiveness.

- Reduce clinker content in cement and substitute products with lower carbon content for construction materials, ensuring 35% reduction in emissions by 2030 (against 2018).
- Reduce fossil fuel use from 64% of final consumption (2021) to 45% by 2025 and further by 2030.
- Increase total share of heating to carbon neutral to 50-55% by 2025, up to 70-75% by 2030.
- Significantly grow the circular economy and bioeconomy.

Achievement of a 35% reduction in emissions by 2030 in relation to Irish production and consumption would enable a more circular economy and assist in the achievement of the Industry and Other sectoral emission ceilings.

Changing our land use

The first phase of the land use review will tell us how we are using our land now. Then, we can map, with evidence, how it can be used most effectively to capture and store carbon and to produce better, greener food and energy.

- Increase our annual afforestation rates to 8,000 hectares per annum from 2023 onwards.
- Promote forest management initiatives in both public and private forests to increase carbon sinks and stores.
- Improve carbon sequestration of 450,000 ha of grasslands on mineral soils and reduce the management intensity of grasslands on 80,000 ha of drained organic soils.
- Rehabilitate 77,600 hectares of peatlands.

Exact reduction target for this sector is yet to be determined. By improving the manner in which Ireland utilises its land use, Ireland can achieve emission reductions and mitigate the ongoing climate and biodiversity crisis's. The LULUCF sectoral emission ceiling will be set after completion of the Land-use Strategy.

Adaptation

CAP 2025 highlights the need for adaptation to climate change. Adaptation is the process of adjustment to actual or expected climate change and its effects. Observations show that Irelands climate is changing in terms of coastline, sea level rise, seasonal temperatures, and changes in typical weather patterns. Climate change is expected to have diverse and wide-ranging impacts on Ireland's environment, society, and economic development, including managed and natural ecosystems, water resources, agriculture and food security, the built environment, human health, and coastal zones.

Climate Sectoral Adaptation Planning[29] includes for 12 sectoral adaptation plans that describe and assess the extent of the risks presented by climate change to a sector, and present contingency plans to address these risks and ensure climate resilience. They include actions to mainstream adaptation into policy and administration at sectoral level to improve the resilience of existing and planned critical infrastructure, systems, and procedures, to the effects and variability of climate change, as well as to improve cooperation and coherence within and across sectors, as well as on a local and national level.

CAP 2025 acknowledges the current shortfalls towards interim (2025) targets and underscores the need for faster implementation, stronger governance, and more coordinated cross-sectoral action to close the gap between ambition and delivery.

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[29] *Department of the Environment, Climate and Communications (2020) Sectoral Adaptation Planning.* *https://www.gov.ie/en/collection/51df3-sectoral-adaptation-planning/*

1.1.2.8 Irelands Climate Change Assessment

In 2023 the EPA published Irelands Climate Change Assessment (ICCA).[30] This assessment provides a comprehensive overview and breakdown of the state of knowledge around key aspects of climate change with a focus on Ireland. The ICCA report is presented in four volumes.

- Volume 1: Climate Science – Ireland in a Changing World
- Volume 2: Achieving Climate Neutrality in 2050
- Volume 3: Being Prepared for Irelands Future
- Volume 3: Realising the Benefits of Transition and Transformation

The ICCA Synthesis Report states that having peaked in 2001, Irelands greenhouse gas emissions have reduced in all sectors except agriculture. However, Ireland currently emits more greenhouse gases per person than the EU average. The report goes on to state that there has been an identified gap in policy that indicates that Ireland will not meet its statutory greenhouse gas emission targets. Already Ireland has seen significant and ongoing deterioration in environmental quality, including declines in water quality, biodiversity and ecosystem quality. Developing a climate-resilient Ireland will require sufficient public and private investment and financial support in ways that adequately recognise the value of ecosystem services and the importance of societal wellbeing.

There are well-established 'no-regret options' that need to happen now, which can get Ireland most of the way to net zero carbon dioxide emissions. Beyond that, there are 'future energy choices' relating to the scale and magnitude of technologies that will assist in achieving Ireland statutory climate targets. Ireland's no-regret options are demanding reduction (e.g. through energy efficiency and reduced consumption), electrification (e.g. electric vehicles and heat pumps), deployment of market-ready renewables (e.g. wind energy and solar photovoltaics) and low-carbon heating options (e.g. district heating). Irelands future choices include hydrogen, carbon capture and storage, nuclear energy and electro-fuels.

Achieving net zero carbon dioxide emissions by 2050 requires significant and unprecedented changes to Ireland's energy system. Policies tailored to suit different stages of technology development are critical for achieving a net zero energy system. Established technologies, such as wind energy, solar photovoltaics and bioenergy, will be key in meeting short-term emission reduction targets (i.e. 2030), whereas offshore wind infrastructure is expected to be the backbone of future energy systems (i.e., 2050).

The ICCA serves as a stark warning: Ireland stands to face a myriad of challenges in efforts to mitigate and adapt to climate change at the almost halfway mark to 2030. Further decisive action is imperative to mitigate the escalating impacts of climate change on Irelands environment, economy, and society that are highlighted throughout the four volumes of the ICCA.

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[30] *Environmental Protection Agency (2023) Irelands Climate Change Assessment* <https://www.epa.ie/our-services/monitoring--assessment/climate-change/irelands-climate-change-assessment-icca/>

APPENDIX 11-2

CARBON CALCULATIONS

Core input data

ENTER INPUT DATA HERE! VALUES SHOULD ONLY BE CHANGED ON THIS SHEET. **DO NOT USE EXAMPLE VALUES AS DEFAULTS!** ENTER YOUR OWN VALUES THAT ARE SPECIFIC TO YOUR PARTICULAR SITE.

Note: The input parameters include some variables that can be specified by default values, but others that must be site specific. Variables that can be taken from defaults are marked with purple tags on left hand side.

Click here to move to Payback Time Click here

Click here to return to Instructions Click here

Input data	**Expected values**		**Possible range of values**			
	Enter expected value here	Record source of data	Enter minimum value here	Record source of data	Enter maximum value here	Record source of data
Windfarm characteristics						
Dimensions						
No. of turbines	11		11		11	
Lifetime of windfarm (years)	10	Fixed	10		10	
Performance						
Power rating of turbines (turbine capacity) (MW)	2.3		2.2		2.4	
Capacity factor	Direct input of capacity fact ▼		Direct input of capacity facti ▼		Direct input of capacity facti ▼	
Enter estimated capacity factor (percentage efficiency)	0.37		0.36		0.38	
Backup						
Extra capacity required for backup (%)	5		5		5	
Additional emissions due to reduced thermal efficiency of the reserve generation (%)	10		10		10	
Carbon dioxide emissions from turbine life - (eg. manufacture, construction, decommissioning)	Calculate wrt installed capa ▼		Calculate wrt installed capa ▼		Calculate wrt installed capa ▼	
Characteristics of peatland before windfarm development						
Type of peatland	Acid b ▼		Acid b ▼		Acid b ▼	
Average annual air temperature at site (^oC)	10.7		6.1		16	
Average depth of peat at site (m)	1.600		1.50		1.70	
C Content of dry peat (% by weight)	53.23		52		53.46	
Average extent of drainage around drainage features at site (m)	15.00		10.00		20.00	
Average water table depth at site (m)	0.50		0.10		1.00	
Dry soil bulk density (g cm^{-3})	0.13		0.11		0.15	
Characteristics of bog plants						
Time required for regeneration of bog plants after restoration (years)	10		5		15	
Carbon accumulation due to C fixation by bog plants in undrained peats (tC ha^{-1} yr^{-1})	0.25		0.2		0.3	
Forestry Plantation Characteristics						
Method used to calculate CO_2 loss from forest felling	Enter simple data ▼		Enter simple data ▼		Enter simple data ▼	
Area of forestry plantation to be felled (ha)	105.5		105.4		105.6	
Average rate of carbon sequestration in timber (tC ha-1 yr-1)	3.60		3.50		3.70	
Counterfactual emission factors						
To update counterfactual emission factors from the web Click here (not yet operational)						
Coal-fired plant emission factor (t CO_2 MWh^{-1})	0.945		0.945		0.945	
Grid-mix emission factor (t CO_2 MWh^{-1})	0.207		0.207		0.207	
Fossil fuel-mix emission factor (t CO_2 MWh^{-1})	0.424		0.424		0.424	
Borrow pits						
Number of borrow pits	0		0		0	
Average length of pits (m)	0		0		0	
Average width of pits (m)	0		0		0	
Average depth of peat removed from pit (m)	0.00		0.00		0.00	
Foundations and hard-standing area associated with each turbine						
Method used to calculate CO_2 loss from foundations and hard-standing	Rectangular with vertical w ▼		Rectangular with vertical w ▼		Rectangular with vertical w ▼	
Average length of turbine foundations (m)	7.8		7.8		7.8	
Average width of turbine foundations (m)	7.8		7.8		7.8	
Average depth of peat removed from turbine foundations (m)	1.600		1.50		1.70	
Average length of hard-standing (m)	30.5		30.5		30.5	
Average width of hard-standing (m)	17.4		17.4		17.4	
Average depth of peat removed from hard-standing (m)	1.600		1.50		1.70	
Access tracks						
Total length of access track (m)						
Existing track length (m)	8410		8410		8410	
Length of access track that is floating road (m)						
Floating road width (m)						
Floating road depth (m)						
Length of floating road that is drained (m)						
Average depth of drains associated with floating roads (m)						
Length of access track that is excavated road (m)						
Excavated road width (m)						
Average depth of peat excavated for road (m)						
Length of access track that is rock filled road (m)						
Rock filled road width (m)						
Rock filled road depth (m)						
Length of rock filled road that is drained (m)						
Average depth of drains associated with rock filled roads (m)						
Cable Trenches						
Length of any cable trench on peat that does not follow access tracks and is lined with a permeable medium (eg. sand) (m)						
Average depth of peat cut for cable trenches (m)						
Additional peat excavated (not already accounted for above)						
Volume of additional peat excavated (m^3)						
Area of additional peat excavated (m^2)						
Peat Landslide Hazard						
Weblink: Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments						
Improvement of C sequestration at site by blocking drains, restoration of habitat etc						
Improvement of degraded bog						
Area of degraded bog to be improved (ha)						
Water table depth in degraded bog before improvement (m)						
Water table depth in degraded bog after improvement (m)						
Time required for hydrology and habitat of bog to return to its previous state on improvement (years)						
Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years)						
Improvement of felled plantation land						
Area of felled plantation to be improved (ha)						
Water table depth in felled area before improvement (m)						
Water table depth in felled area after improvement (m)						
Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years)						
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)						
Restoration of peat removed from borrow pits						
Area of borrow pits to be restored (ha)						
Depth of water table in borrow pit before restoration with respect to the restored surface (m)						
Depth of water table in borrow pit after restoration with respect to the restored surface (m)						
Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)						
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)						
Early removal of drainage from foundations and hardstanding						
Water table depth around foundations and hardstanding before restoration (m)						
Water table depth around foundations and hardstanding after restoration (m)						
Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years)						
Restoration of site after decomissioning						
Will the hydrology of the site be restored on decommissioning?	No		No		No	
Will you attempt to block any gullies that have formed due to the windfarm?	No ▼		No ▼		No ▼	
Will you attempt to block all artificial ditches and facilitate rewetting?	No ▼		No ▼		No ▼	
Will the habitat of the site be restored on decommissioning?	No		No		No	
Will you control grazing on degraded areas?	No ▼		No ▼		No ▼	
Will you manage areas to favour reintroduction of species	No ▼		No ▼		No ▼	

Choice of methodology for calculating emission factors	Site specific (required for planning applications) ▼

Note: Capacity factor. The capacity factor of any power plant is the proportion of energy produced during a given period with respect to the energy that would have been produced had the wind farm been running continually and at maximum output (DECC (2004); see also www.bwea.com/ref/capacityfactors.html).
Capacity Factor = Electricity generated during the period [kWh]/ (Installed capacity [kW] x number of hours in the period [h])
We recommend that a site-specific capacity factor ~~site~~ should be used (as measured during planning stage), and should represent the average emission factor expected over the lifetime of the windfarm, accounting for decline in efficiency with age (Hughes, 2012). The 5 year average capacity factor (or "load factor") for UK onshore wind between 2010 and 2014, based on average beginning and end of year capacity, was 29.2% (DUKES, 2015).

Note: Extra capacity required for backup. If 20% of national electricity is generated by wind energy, the extra capacity required for backup is 5% of the rated capacity of the wind plant (Dale et al 2004). We suggest this should be 5% of the actual output. If it is assumed that less than 20% of national electricity is generated by wind energy, a lower percentage should be entered (0%). The House of Lords Economic Affairs Committee report on The Economics of Renewable Energy (Parliamentary Business, 2008) notes that to cover peak demand a '20% margin of extra capacity has been sufficient to keep the risk of a power cut due to insufficient generation at a very low level.' The estimate provided by BERR was a range of 10% to 20% of installed capacity of wind energy. E.ON is reported as proposing that the capacity credit of wind power should be 8%, and The Renewable Energy Foundation proposed the use of the square root of the wind capacity (in GW) as conventional capacity (e.g. 36 GW of wind plant to match 6 GW of conventional plant).

Note: Extra emissions due to reduced thermal efficiency of the reserve power generation ≈ 10% (Dale et al 2004).

Note: Emissions from turbine life. If total emissions for the windfarm are unknown, emissions should be calculated according to turbine capacity. The normal range of CO_2 emissions is 394 to 8147 t CO_2 MW (White & Kulcinski, 2000; White, 2007).

Note: Type of peatland An 'acid bog' is fed primarily by rainwater and often inhabited by sphagnum moss, thus making it acidic (Stoneman & Brooks,1997).
A 'fen' is a type of wetland fed by surface and/or groundwater (McBride et al., 2011).

Note: Time required for regeneration of previous habitat. Loss of fixation should be assumed to be over lifetime of windfarm only. This time could be longer if plants do not regenerate. The requirements for after-use planning include the provision of suitable refugia for peat-forming vegetation, the removal of structures, or an assessment of the impact of leaving them in situ. Methods used to reinstate the site will affect the likely time for regeneration of the previous habitat. This time could also be shorter if plants regenerate during lifetime of windfarm. If so, enter number of years estimated for regeneration.

Note: Carbon fixation by bog plants
Apparent C accumulation rate in peatland is 0.12 to 0.31 t C ha^{-1} yr^{-1} (Turunen et al., 2001; Botch et al., 1995). The SNH guidance uses a value of 0.25 t C ha^{-1} yr^{-1}.

Note: Area of forestry plantation to be felled. If the forestry was planned to be removed, with no further rotations planted, before the windfarm development, the area to be felled should be entered as zero.

Note: Plantation carbon sequestration. This is dependent on the yield class of the forestry. The SNH technical guidance assumed yield class of 16 m^3 ha^{-1} yr^{-1}, compared to the value of 14 m^3 ha^{-1} yr^{-1} provided by the Forestry Commission. Carbon sequestered for yield class 16 m^3 ha^{-1} y^{-1} = 3.6 tC ha^{-1} yr^{-1} (Cannell, 1999).

Note: Coal-Fired Plant and Grid Mix Emission Factors. Coal-fired plant emission factor (EF) from electricity supplied in 2014 = 0.093 t CO_2 $MWh^{-1;}$ Grid-Mix EF for 2014 = 0.394 t CO_2 $MWh^{-1.}$ Source = DUKES, 2015b.

Note: Fossil Fuel-Mix Emission Factor. The emission factor from electricity supplied in 2014 from all fossil fuels = 0.642 t CO_2 MWh^{-1}. Source = DUKES, 2015b.

Note: Total length of access track. If areas of access track overlap with hardstanding area, exclude these from the total length of access track to avoid double counting of land area lost.

Note: Floating road depth. Accounts for sinking of floating road. Should be entered as the average depth of the road expected over the lifetime of the windfarm. If no sinking is expected, enter as zero.

Note: Length of floating road that is drained. Refers to any drains running along the length of the road.

Note: Rock filled roads. Rock filled roads are assumed to be roads where no peat has been removed and rock has been placed on the surface and allowed to settle.

Note: Depth of peat cut for cable trenches. In shallow peats, the cable trenches may be cut below the peat. To avoid overestimating the depth of peat affected by the cable trenches, only enter the depth of the peat that is cut.

Note: Peat Landslide Hazard. It is assumed that measures have been taken to limit damage (Scottish Executive, 2006, Peat Landslide Hazard and Risk Assessments. Best Practice Guide for Proposed Electricity Generation Developments. Scottish Executive, Edinburgh. pp. 34-35) so that C losses due to peat landslide can be assumed to be negligible. Link: http://www.scotland.gov.uk/Publications/2006/12/21162303/1.

Note: Period of time when improvement can be guaranteed. This guarantee should be absolute. Therefore, if you enter a value beyond the lifetime of the windfarm you should provide strong supporting evidence that this improvement can be guaranteed for the full period given. This includes the time requirement for the improvement to become effective. For example if time required for hydrology and habitat to return to its previous state is 10 years and the restoration can be guaranteed over the lifetime of the windfarm (25 years), the period of time when the improvement can be guaranteed should be entered as 25 years, and the improvement will be effective for (25 -10) = 15 years.

Note: Period of time when improvement can be guaranteed. This gurantee should be absolute. Therefore, if you enter a value beyond the lifetime of the windfarm you should provide strong supporting evidence that this improvement can be guaranteed for the full period given. This includes the time requirement for the improvement to become effective. For example if time required for hydrology and habitat to return to its previous state is 10 years and the restoration can be guaranteed over the lifetime of the windfarm (25 years), the period of time when the improvement can be guaranteed should be entered as 25 years, and the improvement will be effective for (25 -10) = 15 years.

Note: Period of time when improvement can be guaranteed. This gurantee should be absolute. Therefore, if you enter a value beyond the lifetime of the windfarm you should provide strong supporting evidence that this improvement can be guaranteed for the full period given. This includes the time requirement for the improvement to become effective. For example if time required for hydrology and habitat to return to its previous state is 10 years and the restoration can be guaranteed over the lifetime of the windfarm (25 years), the period of time when the improvement can be guaranteed should be entered as 25 years, and the improvement will be effective for (25 -10) = 15 years.

Note: Period of time when improvement can be guaranteed. This is assumed to be the lifetime of the windfarm as restoration after windfarm decommissioning is already accounted for in restoration of the site

Note: Restoration of site. If the water table at the site is returned to its original level or higher on decommissioning, and habitat at the site is restored, it is assumed that C losses continue only over the lifetime of the windfarm. Otherwise, C losses from drained peat are assumed to be 100%.

Note: Choice of methodology for calculating emission factors. The IPCC default methodology is the internationally accepted standard (IPCC, 1997). However, it is stated in IPCC (1997) that these are rough estimates, and "these rates and production periods can be used if countries do not have more appropriate estimates". Therefore, we have developed more site specific estimates for use here based on work from the Scottish Government funded ECOSSE project (Smith et al, 2007. ECOSSE: Estimating Carbon in Organic Soils - Sequestration and Emissions. Final Report. SEERAD Report. ISBN 978 0 7559 1498 2. 166pp.).

Core input data

ENTER INPUT DATA HERE! VALUES SHOULD ONLY BE CHANGED ON THIS SHEET. **DO NOT USE EXAMPLE VALUES AS DEFAULTS!** ENTER YOUR OWN VALUES THAT ARE SPECIFIC TO YOUR PARTICULAR SITE.

Note: The input parameters include some variables that can be specified by default values, but others that must be site specific. Variables that can be taken from defaults are marked with purple tags on left hand side.

Click here to move to Payback Time Click here

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Windfarm CO_2 emission saving

Note: The total emission savings are given by estimating the total possible electrical output of the windfarm multiplied by the emission factor for the counterfactual case (coal-fire generation and electricity from grid)

Click here to move to Payback Time **Click here**

Values taken from input sheet	Total			Forestry Area 1			Forestry Area 2			Forestry Area 3			Forestry Area 4			Forestry Area 5		
	Exp	**Min**	**Max**	**Exp**	**Min**	**Max**	**Exp**	**Min**	**Max**	**Exp**	**Min**	**Max**	**Exp**	**Min**	**Max**	**Exp**	**Min**	**Max**
Power Generation Characteristics																		
No. of turbines	11	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power rating of turbines (turbine capacity) (MW)	2.3	2.2	2.4	2.3	2.2	2.4	2.3	2.2	2.4	2.3	2.2	2.4	2.3	2.2	2.4	2.3	2.2	2.4
Power of windfarm (MW)	25.3	24.2	26.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Estimated downtime for maintenance etc (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Counterfactual emission factors																		
Coal-fired plant emission factor (t CO_2 MWh^{-1})	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945
Grid-mix emission factor (t CO_2 MWh^{-1})	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207
Fossil fuel-mix emission factor (t CO_2 MWh^{-1})	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424	0.424

Calculation of capacity factor	1	Direct input of capacity factor		
		Exp	Min	Max
Entered capacity factor (%)		0.37	0.36	0.38

Parameters	*Slope (a)*			*Intercept (b)*		
Partial power curves for different turbines	Exp	Min	Max	Exp	Min	Max
User-defined	0.0	0.0	0.0	0.0	0.0	0.0
Vestas 2.0 MW Optispeed C2	1392.5	1392.5	1392.5	-4291.9	-4291.9	-4291.9

Calculation of capacity factor from forestry management	Total			Forestry Area 1			Forestry Area 2			Forestry Area 3			Forestry Area 4			Forestry Area 5		
	Exp	**Min**	**Max**	**Exp**	**Min**	**Max**	**Exp**	**Min**	**Max**	**Exp**	**Min**	**Max**	**Exp**	**Min**	**Max**	**Exp**	**Min**	**Max**
Wind speed ratio calculated in 7d				#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######
Average site windspeed (m s^{-1})	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual theoretical energy output from turbine (MW $turbine^{-1}$ yr^{-1})	20148	19272	21024	20148	19272	21024	20148	19272	21024	20148	19272	21024	20148	19272	21024	20148	19272	21024
Power curve				User-defined	User-defined	User-defined	Partial power curves for different turbines	Partial power curves for different turbines	Partial power curves for different turbines	Partial power curves for different turbines	Partial power curves for different turbines	Partial power curves for different turbines	Partial power curves for different turbines	Partial power curves for different turbines	Partial power curves for different turbines	Partial power curves for different turbines	Partial power curves for different turbines	Partial power curves for different turbines
(Power curve code)				1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Slope (a)				0	0	0	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max
Intercept (b)				0	0	0	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max

Annual power output from an individual turbine (MW turbine^{-1} yr^{-1})				#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######
Calculated capacity factor (%)				#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######

	Total			Forestry Area 1			Forestry Area 2			Forestry Area 3			Forestry Area 4			Forestry Area 5		
Calculation of annual energy output from wind farm																		
Direct input of capacity factor Capacity factor(%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual energy output from windfarm (MW yr^{-1})	**820**	**763**	**879**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

RESULTS	**Total**			**Area 1**			**Area 2**			**Area 3**			**Area 4**			**Area 5**		
Windfarm CO$_2$ emission saving over…																		
…coal-fired electricity generation (tCO$_2$ yr^{-1})	**775**	**721.197**	**830.469**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
…grid-mix of electricity generation (tCO$_2$ yr^{-1})	**170**	**157.976**	**181.912**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
…fossil fuel - mix of electricity generation (tCO$_2$ yr^{-1})	**348**	**323.585**	**372.613**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Click here to move to Payback Time Click here

Windfarm CO$_2$ emission saving

Note: The total emission savings are given by estimating the total possible electrical output of the windfarm multiplied by the emission factor for the counterfactual case (coal-fire generation and electricity from grid)

Emissions due to turbine life

Note: The carbon payback time of the windfarm due to turbine life (eg. manufacture, construction, decomissioning) is calculated by comparing the emissions due to turbine life with carbon-savings achieved by the windfarm while displacing electricity generated from coal-fired capacity or grid-mix.

Method used to estimate CO_2 emissions from turbine life (eg. manufacture, construction,	Calculate wrt installed capacity

	Exp	Min	Max
Direct input of emissions due to turbine life (t CO_2 windfarm^{-1})	**0**	**0**	**0**
Calculation of emissions due to turbine life from energy output			
CO_2 emissions due to turbine life (tCO_2 turbine^{-1})	1681	1588	1775
No. of turbines	11	11	11
Total calculated CO_2 emission of the wind farm due to turbine life (t CO_2 windfarm^{-1})	18496	17468	19524

	Total			Construction Area 1			Construction Area 2			Construction Area 3			Construction Area 4			Construction Area 5		
	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max
Calculation of emissions due to cement used in construction																		
Volume of cement used (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO_2 emission rate (t CO_2 m^{-3} cement)	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316
Total CO_2 emissions due to cement used in construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

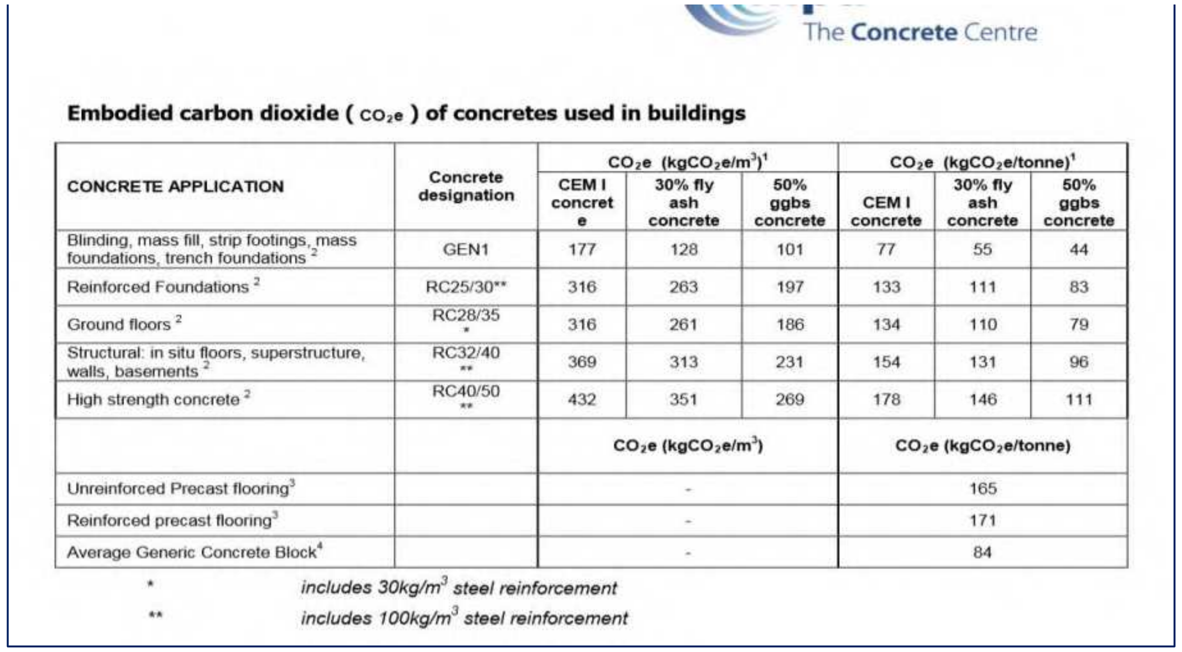
RESULTS			
Losses due to turbine life (eg.	18496	17468	19524
Additional CO_2 payback time of windfarm due to turbine life (eg. manufacture, contruction, decomissioning)			
…coal-fired electricity generation (months)	286	291	282
…grid-mix of electricity generation (months)	1308	1327	1288
…fossil fuel - mix of electricity generation (months)	638	648	629

Click here to move to Payback Time Click here

Emissions due to turbine life

Note: The carbon payback time of the windfarm due to turbine life (eg. manufacture, construction, decomissioning) is calculated by comparing the emissions due to turbine life with carbon-savings achieved by the windfarm while displacing electricity generated from coal-fired capacity or grid-mix.

http://www.concretecentre.com/PDF/SCF_Table%207%20Embodied%20CO2_April%202013.pdf



The Concrete Centre

Embodied carbon dioxide (CO_2e) of concretes used in buildings

CONCRETE APPLICATION	Concrete designation	CO_2e ($kgCO_2e/m^3$)[1]			CO_2e ($kgCO_2e$/tonne)[1]		
		CEM I concrete	30% fly ash concrete	50% ggbs concrete	CEM I concrete	30% fly ash concrete	50% ggbs concrete
Blinding, mass fill, strip footings, mass foundations, trench foundations [2]	GEN1	177	128	101	77	55	44
Reinforced Foundations [2]	RC25/30**	316	263	197	133	111	83
Ground floors [2]	RC28/35 *	316	261	186	134	110	79
Structural: in situ floors, superstructure, walls, basements [2]	RC32/40 **	369	313	231	154	131	96
High strength concrete [2]	RC40/50 **	432	351	269	178	146	111
		CO_2e ($kgCO_2e/m^3$)			CO_2e ($kgCO_2e$/tonne)		
Unreinforced Precast flooring[3]		-			165		
Reinforced precast flooring[3]		-			171		
Average Generic Concrete Block[4]		-			84		

* includes 30kg/m³ steel reinforcement

** includes 100kg/m³ steel reinforcement

Emissions due to backup power generation

Note: CO_2 loss due to back up is calculated from the extra capacity required for backup of the windfarm given in the input data.

Note: Wind generated electricity is inherently variable, providing unique challenges to the electricity generating industry for provision of a supply to meet consumer demand (Netz, 2004). Backup power is required to accompany wind generation to stabilise the supply to the consumer. This backup power will usually be obtained from a fossil fuel source. At a high level of wind power penetration in the overall generating mix, and with current grid management techniques, the capacity for fossil fuel backup may become strained because it is being used to balance the fluctuating consumer demand with a variable and highly unpredictable output from wind turbines (White, 2007). The Carbon Trust (Carbon Trust/DTI, 2004) concluded that increasing levels of intermittent generation do not present major technical issues at the percentages of renewables expected by 2010 and 2020, but the UK renewables target at the time of that report was only 20%. When national reliance on wind power is low (less than ~20%), the additional fossil fuel generated power requirement can be considered to be insignificant and may be obtained from within the spare generating capacity of other power sectors (Dale et al, 2004). However, as the national supply from wind power increases above 20%, without improvements in grid management techniques, emissions due to backup power generation may become more significant. The extra capacity needed for backup power generation is currently estimated to be 5% of the rated capacity of the wind plant if wind power contributes more than 20% to the national grid (Dale et al 2004). Moving towards the SG target of 50% electricity generation from renewable sources, more short-term capacity may be required in terms of pumped-storage hydro-generated power, or a better mix of offshore and onshore wind generating capacity. Grid management techniques are anticipated to reduce this extra capacity, with improved demand side management, smart meters, grid reinforcement and other developments. However, given current grid management techniques, it is suggested that 5% extra capacity should be assumed for backup power generation if wind power contributes more than 20% to the national grid. At lower contributions, the extra capacity required for backup should be assumed to be zero. These assumptions should be revisited as technology improves.

Reserve capacity required for backup	**Expected**	**Minimum**	**Maximum**
No. of turbines	11	11	11
Power rating of turbines (turbine capacity) (MW)	2.3	2.2	2.4
Power of wind farm (MW h^{-1})	25.3	24.2	26.4
Rated capacity (MW yr^{-1})	221628	211992	231264
Extra capacity required for backup (%)	5	5	5
Additional emissions due to reduced thermal efficiency of the reserve generation (%)	10	10	10
Reserve capacity (MWh yr^{-1})	1108	1060	1156

Carbon dioxide emissions due to backup power generation			
Coal-fired plant emission factor (t CO_2 MWh^{-1})	0.945	0.945	0.945
Grid-mix emission factor (t CO_2 MWh^{-1})	0.207	0.207	0.207
Fossil fuel- mix emission factor (t CO_2 MWh^{-1})	0.424	0.424	0.424
Lifetime of windfarm (years)	10	10	10
Annual emissions due to backup from…			
…coal-fired electricity generation (tCO_2 yr^{-1})	1047	1002	1093
…grid-mix of electricity generation (tCO_2 yr^{-1})	229	219	239
…fossil fuel - mix of electricity generation (tCO_2 yr^{-1})	470	449	490

RESULTS			
Total emissions due to backup from…			
…coal-fired electricity generation (tCO_2)	10472	10017	10927
…grid-mix of electricity generation (tCO_2)	2294	2194	2394
…fossil fuel - mix of electricity generation (tCO_2)	**4699**	**4494**	**4903**
Additional CO_2 payback time of windfarm due to backup			
…coal-fired electricity generation (months)	162	167	158
…grid-mix of electricity generation (months)	162	167	158
…fossil fuel - mix of electricity generation (months)	162	167	158

Assumption: Backup assumed to be by fossil-fuel-mix of electricity generation. Note that hydroelectricity may also be used for backup, so this assumption may make the value for backup generation too high. These assumptions should be revisited as technology develops.

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Emissions due to backup power generation

Note: CO_2 loss due to back up is calculated from the extra capacity required for backup of the windfarm given in the input data.

Emissions due to loss of bog plants

Note: Annual C fixation by the site is calculated by multiplying area of the windfarm by the annual C accumulation due to bog plant fixation

	Expected	Minimum	Maximum
Area where carbon accumulation by bog plants is lost			
Total area of land lost due to windfarm construction (m^2)	6507	6507	6507
Total area affected by drainage due to windfarm construction (m^{-2})	30855	18370	45540
Total area where fixation by plants is lost (m^2)	37362	24877	52047
Total loss of carbon accumulation			
Carbon accumulation in undrained peats (tC ha^{-1} yr^{-1})	0.25	0.2	0.3
Lifetime of windfarm (years)	10	10	10
Time required for regeneration of bog plants after restoration (years)	10	5	15
Carbon accumulation up to time of restoration (tCO$_2$ eq. ha^{-1})	18	11	28
RESULTS			
Total loss of carbon accumulation by bog plants			
Total area where fixation by plants is lost (ha)	4	2	5
Carbon accumulation over lifetime of windfarm (tCO$_2$ eq. ha^{-1})	18	11	28
Total loss of carbon fixation by plants at the site (t CO$_2$)	**69**	**27**	**143**
Additional CO$_2$ payback time of windfarm due to loss of CO2 fixing potential			
…coal-fired electricity generation (months)	1	0	2
…grid-mix of electricity generation (months)	5	2	9
…fossil fuel - mix of electricity generation (months)	2	1	5

Assumptions:
1. Bog plants are 100% lost from the area where peat is removed for construction.
2. Bog plants are 100% lost from the area where peat is drained.
3. The recovery of carbon accumulation by plants on restoration of land is as given in inputs.

Click here to move to Payback Time Click here

Emissions due to loss of bog plants

Note: Annual C fixation by the site is calculated by multiplying area of the windfarm by the annual C accumulation due to bog plant fixation

Emissions due to loss of soil organic carbon

Note: Loss of C stored in peatland is estimated from % site lost by peat removal (sheet 5a), CO_2 loss from removed peat (sheet 5b), % site affected by drainage (sheet 5c), and the CO2 loss from drained peat (sheet 5d).

		Expected result	Minimum result	Maximum result
	CO_2 loss due to windfarm construction			
Check	CO_2 loss from removed peat (t CO_2 equiv)	2408	1867	3008
Check	CO_2 loss from drained peat (t CO_2 equiv)	571	0	3509
	RESULTS **Total CO_2 loss from peat (removed + drained) (t CO_2 equiv)**	**2979**	**1867**	**6517**
	Additional CO_2 payback time of windfarm due to loss of soil CO2			
	…coal-fired electricity generation (months)	46	31	94
	…grid-mix of electricity generation (months)	211	142	430
	…fossil fuel - mix of electricity generation (months)	103	69	210

Click here to move to Payback Time Click here

Emissions due to loss of soil organic carbon

Note: Loss of C stored in peatland is estimated from % site lost by peat removal (sheet 5a), CO_2 loss from removed peat (sheet 5b), % site affected by drainage (sheet 5c), and the CO2 loss from drained peat (sheet 5d).

Volume of Peat Removed

Note: % site lost by peat removal is estimated from peat removed in borrow pits, turbine foundations, hard-standing and access tracks.

If peat is removed for any other reason, this must be added in as additional peat excavated in the core input sheet.

Peat removed from borrow pits		**Total**	
	Exp	**Min**	**Max**
Number of borrow pits	0	0	0
Average length of pits (m)	0	0	0
Average width of pits (m)	0	0	0
Average depth of peat removed from pit (m)	0	0	0
Area of land lost in borrow pits (m^2)	0	0	0
Volume of peat removed from borrow pits (m^3)	0	0	0

Peat removed from turbine foundations		**Total**		**Construction Area 1**			**Construction Area 2**			**Construction Area 3**			**Construction Area 4**			**Construction Area 5**		
	Exp	**Min**	**Max**	**Exp**	**Min**	**Max**	**Exp**	**Min**	**Max**	**Exp**	**Min**	**Max**	**Exp**	**Min**	**Max**	**Exp**	**Min**	**Max**
Method used to calculate CO_2 loss from foundations	Rectangular with vertical walls																	
Calculation method code		1																
No. of turbines	11	11	11	11	11	11	0	0	0	0	0	0	0	0	0	0	0	0
Diameter at surface (m)				8	8	8	0	0	0	0	0	0	0	0	0	0	0	0
				8	8	8	0	0	0	0	0	0	0	0	0	0	0	0
Diameter at bottom (m)				8	8	8	0	0	0	0	0	0	0	0	0	0	0	0
				8	8	8	0	0	0	0	0	0	0	0	0	0	0	0
Depth of foundations (m)				2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
"Area" of land lost in hard-standing (m^2)	669	669.24	669.24	669	669	669	0	0	0	0	0	0	0	0	0	0	0	0
Volume of peat removed from foundation area (m^3)	1070.784	1003.86	1137.708	1070.784	1003.86	1137.708	0	0	0	0	0	0	0	0	0	0	0	0

Peat removed from hard-standing																		
Method used to calculate CO_2 loss from foundations	Rectangular with vertical walls																	
Calculation method code		1																
No. of turbines	11	11	11	11	11	11	0	0	0	0	0	0	0	0	0	0	0	0
Diameter at surface (m)				31	30.5	30.5	0	0	0	0	0	0	0	0	0	0	0	0
				17	17.4	17.4	0	0	0	0	0	0	0	0	0	0	0	0
Diameter at bottom (m)				31	30.5	30.5	0	0	0	0	0	0	0	0	0	0	0	0
				17	17.4	17.4	0	0	0	0	0	0	0	0	0	0	0	0
Depth of hardstanding (m)				2	1.5	1.7	0	0	0	0	0	0	0	0	0	0	0	0
Area of land lost in hard-standing (m^2)	5838	5838	5838	5838	5837.7	5837.7	0	0	0	0	0	0	0	0	0	0	0	0
Volume of peat removed from hardstandingarea (m^3)	9340.32	8756.55	9924.09	9340.32	8756.55	9924.09	0	0	0	0	0	0	0	0	0	0	0	0

Peat removed from access tracks		**Total**	
	Exp	**Min**	**Max**
Floating roads			
Length of access track that is floating road (m)	0	0	0

Floating road width (m)	0	0	0
Floating road depth (m)	0	0	0
Area of land lost in floating roads (m^2)	0	0	0
Volume of peat removed for floating roads	0	0	0
Excavated roads			
Length of access track that is excavated road (m)	0	0	0
Excavated road width (m)	0	0	0
Average depth of peat excavated for road (m)	0	0	0
Area of land lost in excavated roads (m^2)	0	0	0
Volume of peat removed for excavated roads	0	0	0
Rock-filled roads			
Length of access track that is rock filled road (m)	0	0	0
Rock filled road width (m)	0	0	0
Rock filled road depth (m)	0	0	0
Area of land lost in excavated roads (m^2)	0	0	0
Volume of peat removed for rock-filled roads	0	0	0
Total area of land lost in access tracks (m^2)	0	0	0
Total volume of peat removed due to access tracks (m^3)	0	0	0

Additional peat excavated - (not already accounted for above)			
Volume of additional peat excavated (m^3)	0	0	0
Area of additional peat excavated (m^2)	0	0	0

RESULTS		**Total**	
	Exp	**Min**	**Max**
Total volume of peat removed (m^3) due to windfarm construction	**10411.1**	**9760.41**	**11061.8**
Total area of land lost due to windfarm construction (m^2)	**6507**	**6506.94**	**6506.94**

Click here to move to 5b. CO2 loss from removed peat	Click here
Click here to move to Payback Time	Click here

Volume of Peat Removed

Note: % site lost by peat removal is estimated from peat removed in borrow pits, turbine foundations, hard-standing and access tracks.

If peat is removed for any other reason, this must be added in to the volume of peat removed, area of land lost and % site lost at the bottom of this worksheet.

CO_2 loss from removed peats

Note: If peat is treated in such a way that it is permanently restored, so that less than 100% of the C is lost to the atmosphere, a lower percentage can be entered in cell C10

	Expected	Minimum	Maximum
CO_2 loss from removed peat			
C Content of dry peat (% by weight)	53.23	52	53.46
Dry soil bulk density (g cm^{-3})	0.13	0.11	0.15
% C contained in removed peat that is lost as CO_2	100	100	100
Check Total volume of peat removed (m^3) due to windfarm construction	10411	9760	11062
CO_2 loss from removed peat (t CO_2)	2682	2084	3296

Assumption: If peat is not restored, 100% of the carbon contained in the removed peat is lost as CO_2

CO_2 loss from undrained peat left in situ			
Total area of land lost due to windfarm construction (ha)	1	1	1
CO_2 loss from undrained peat left in situ (t CO_2 ha^{-1})	422	335	443
CO_2 loss from undrained peat left in situ (t CO_2)	275	218	288

CO_2 loss attributable to peat removal only			
CO_2 loss from removed peat (t CO_2)	2682	2084	3296
CO_2 loss from undrained peat left in situ (t CO_2)	275	218	288
RESULTS **CO_2 loss attributable to peat removal only (t CO_2)**	**2408**	**1867**	**3008**

Click here to move to 5. Loss of soil CO_2 Click here

Click here to move to Payback Time Click here

CO_2 loss from removed peats

Note: If peat is treated in such a way that it is permanently restored, so that less than 100% of the C is lost to the atmosphere, a lower percentage can be entered in cell C10

Volume of peat drained

Note: Extent of site affected by drainage is calculated assuming an average extent of drainage around each drainage feature as given in the input data.

Extent of drainage around each metre of drainage ditch	Total		
	Exp	Min	Max
Average extent of drainage around drainage features at site (m)	15	10	20

Peat affected by drainage around borrow pits	Total		
	Exp	Min	Max
Number of borrow pits	0	0	0
Average length of pits (m)	0	0	0
Average width of pits (m)	0	0	0
Average depth of peat removed from pit (m)	0.0	0.0	0.0
Area affected by drainage per borrow pit (m^2)	900	400	1600
Total area affected by drainage around borrowpits (m^2)	0	0	0
Total volume affected by drainage around borrowpits (m^3)	0	0	0

Peat affected by drainage around turbine foundation and hardstanding	Total			Construction Area 1			Construction Area 2			Construction Area 3			Construction Area 4			Construction Area 5		
	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max	Exp	Min	Max
No. of turbines	11	11	11	11	11	11	0	0	0	0	0	0	0	0	0	0	0	0
Average length of turbine foundations at base (m)				8	8	8	0	0	0	0	0	0	0	0	0	0	0	0
Average width of turbine foundations at base(m)				8	8	8	0	0	0	0	0	0	0	0	0	0	0	0
Average depth of peat removed from turbine foundations (m)				1.6	1.5	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average length of hard-standing at base (m)				31	31	31	0	0	0	0	0	0	0	0	0	0	0	0
Average width of hard-standing at base (m)				17	17	17	0	0	0	0	0	0	0	0	0	0	0	0
Average depth of peat removed from hard-standing (m)				1.6	1.5	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum depth of drains (m)				1.6	1.5	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total length of foundation and hardstanding (m)				38	38	38	0	0	0	0	0	0	0	0	0	0	0	0
Total width of foundation and hardstanding (m)				25	25	25	0	0	0	0	0	0	0	0	0	0	0	0
Area affected by drainage of foundation and hardstanding area (m^2)	2805	1670	4140	2805	1670	4140	0	0	0	0	0	0	0	0	0	0	0	0
Total area affected by drainage of foundation and hardstanding area (m^2)	30855	18370	45540	30855	18370	45540	0	0	0	0	0	0	0	0	0	0	0	0
Total volume affected by drainage of foundation and hardstanding area (m^3)	24684	13778	38709	24684	13778	38709	0	0	0	0	0	0	0	0	0	0	0	0

Peat affected by drainage of access tracks	Total		
	Exp	Min	Max
Floating roads			

Length of floating road that is drained (m)	0	0	0
Floating road width (m)	0.0	0.0	0.0
Average depth of drains associated with floating roads (m)	0.00	0.00	0.00
Area affected by drainage of floating roads (m^2)	0	0	0
Volume affected by drainage of floating roads (m^3)	0	0	0
Excavated Road			
Length of access track that is excavated road (m)	0	0	0
Excavated road width (m)	0	0	0
Average depth of peat excavated for road (m)	0.0	0.0	0.0
Area affected by drainage of excavated roads (m^2)	0	0	0
Volume affected by drainage of excavated roads (m^3)	0	0	0
Rock-filled roads			
Length of rock filled road that is drained (m)	0	0	0
Rock filled road width (m)	0	0	0
Average depth of drains associated with rock filled roads (m)	0.0	0.0	0.0
Area affected by drainage of rock-filled roads (m^2)	0	0	0
Volume affected by drainage of rock-filled roads (m^2)	0	0	0
Total area affected by drainage of access track (m^2)	0	0	0
Total volume affected by drainage of access track (m^3)	0	0	0

Peat affected by drainage of cable trenches	**Total**		
	Exp	**Min**	**Max**
Length of any cable trench on peat that does not follow access tracks and is lined with a permeable medium (eg. sand) (m)	0	0	0
Average depth of peat cut for cable trenches (m)	0.0	0.0	0.0
Total area affected by drainage of cable trenches (m^2)	0	0	0
Total volume affected by drainage of cable trenches (m^3)	0.00	0.00	0.00

Drainage around additional peat excavated	**Total**		
	Exp	**Min**	**Max**
Volume of additional peat excavated (m^3)	0.0	0.0	0.0
Area of additional peat excavated (m^2)	0.0	0.0	0.0
Average depth of excavated peat (m)	0	0	0
Radius of area excavated (m)	0	0	0

Assumption: Area excavated is assumed to be a circle

Radius of excavated and drained area (m)	0	0	0
Total area affected by drainage (m^2)	0	0	0
Total volume affected by drainage (m^3)	0.00	0.00	0.00

assumed to be a circle

RESULTS		**Total**	
	Exp	**Min**	**Max**
Total area affected by drainage due to windfarm (m^2)	**30855**	**18370**	**45540**
Total volume affected by drainage due to windfarm (m^3)	**24684**	**13777.5**	**38709**

Click here to move to 5d. CO2 loss from drained peat	Click here
Click here to move to Payback Time	Click here

Volume of peat drained

Note: Extent of site affected by drainage is calculated assuming an average extent of drainage around each drainage feature as given in the input data.

CO_2 loss due to drainage

Note: Note, CO_2 losses are calculated using two approaches: IPCC default methodology and more site specific equations derived for this project. The IPCC methodology is included because it is the established approach, although it contains no site detail. The new equations have been derived directly from experimental data for acid bogs and fens (see Nayak et al, 2008 - Final report).

Click here to move to 5. Loss of soil CO_2 Click here
Click here to move to Payback Time Click here

	Expected	Minimum	Maximum
Drained Land			
Total area affected by drainage due to wind farm construction (ha)	3	2	5
Will the hydrology of the site be restored on decommissioning?	No	No	No
Will the habitat of the site be restored on decommissioning?	No	No	No

Calculations of C Loss from Drained Land if Site is NOT Restored after Decommissioning

		Expected	Minimum	Maximum
Check	Total volume affected by drainage due to wind farm (m^3)	24684	13778	38709
	C Content of dry peat (% by weight)	53	52	53
	Dry soil bulk density (g cm^{-3})	0.13	0.11	0.15
	Total GHG emissions from Drained Land (t CO_2 equiv.)	6360	2942	11534
	Total GHG Emissions from Undrained Land (t CO_2 equiv.)	5789	2942	8025

Assumption: Losses of GHG from drained and undrained land have the same proportion throughout the emission period.

Calculations of C loss from Drained Land if Site IS Restored after Decommissioning

1. Losses if Land is Drained

		Expected	Minimum	Maximum
	Flooded period (days $year^{-1}$)	0	0	0
	Lifetime of windfarm (years)	10	10	10
	Time required for regeneration of bog plants after restoration (years)	10	5	15
	Methane Emissions from Drained Land			
Check	Rate of methane emission in drained soil ((t CH_4-C) ha^{-1} yr^{-1})	0.001	-0.015	0.020
	Conversion factor: CH_4-C to CO_2 equivalents	30.67	30.67	30.67
	CH_4 emissions from drained land (t CO_2 equiv.)	2	-13	69
	Carbon Dioxide Emissions from Drained Land			
Check	Rate of carbon dioxide emission in drained soil (t CO_2 ha^{-1} yr^{-1})	23.16	22.78	24.86
	CO_2 emissions from drained land (t CO_2)	1429	628	2830
	Total GHG emissions from Drained Land (t CO_2 equiv.)	1431	615	2900

Assumption: The drained soil is not flooded at any time of the year.

Note:Conversion = (23 x 16/12) = 30.67 CO_2 equiv. $(CH_4\text{-}C)^{-1}$

2. Losses if Land is Undrained

		Expected	Minimum	Maximum
	Flooded period (days $year^{-1}$)	178	178	178
	Lifetime of windfarm (years)	10	10	10
	Time required for regeneration of bog plants after restoration (years)	10	5	15
	Methane Emissions from Undrained Land			
Check	Rate of methane emission in undrained soil ((t CH_4-C) ha^{-1} yr^{-1})	0.00	-0.02	0.17
	Conversion factor: CH_4-C to CO_2 equivalents	30.67	30.67	30.67
	CH_4 emissions from undrained land (t CO_2 equiv.)	3	-13	317
	Carbon Dioxide Emissions from Undrained Land			
Check	Rate of carbon dioxide emission in undrained soil (t CO_2 ha^{-1} yr^{-1})	18.86	22.78	4.51
	CO_2 emissions from undrained land (t CO_2)	1300	628	1701
	Total GHG Emissions from Undrained Land (t CO_2 equiv.)	1303	615	2017

Note:Conversion = (23 x 16/12) = 30.67 CO_2 equiv. $(CH_4\text{-}C)^{-1}$

3. CO_2 Losses due to Drainage

Total GHG emissions from drained land (t CO_2 equiv.)	6360	2942	11534
Total GHG emissions from undrained land (t CO_2 equiv.)	5789	2942	8025
RESULTS **Total GHG emissions due to drainage (t CO_2 equiv.)**	**571**	**0**	**3509**

Click here to move to 5. Loss of soil CO_2 Click here

Click here to move to Payback Time Click here

CO_2 loss due to drainage

Note: Note, CO_2 losses are calculated using two approaches: IPCC default methodology and more site specific equations derived for this project. The IPCC methodology is included because it is the established approach, although it contains no site detail. The new equations have been derived directly from experimental data for acid bogs and fens (see Nayak et al, 2008 - Final report).

Emission rates from soils

Note: Note, CO_2 losses are calculated using two approaches: IPCC default methodology and more site specific equations derived for this project. The IPCC methodology is included because it is the established approach, although it contains no site detail. The new equations have been thoroughly tested against experimental data (see Nayak et al, 2008 - Final report).

Click here to move to 5d. Click here

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Selected Methodology = Site specific (required for planning applications)
Type of peatland = Acid Bog

Calculations following IPCC default methodology

Emission characteristics of acid bogs (IPCC, 1997)

	Expected	Minimum	Maximum
Flooded period (days year^{-1})	178	178	178
Annual rate of methane emission (t CH_4-C ha^{-1} yr^{-1})	0.04015	0.04015	0.04015
Annual rate of carbon dioxide emission (t CO_2 ha^{-1} yr^{-1})	35.2	35.2	35.2

Emission characteristics of fens (IPCC, 1997)

Flooded period (days year^{-1})	169	169	169
Annual rate of methane emission (t CH_4-C ha^{-1} yr^{-1})	0.219	0.219	0.219
Annual rate of carbon dioxide emission (t CO_2 ha^{-1} yr^{-1})	35.2	35.2	35.2

Selected emission characteristics (IPCC, 1997)

Flooded period (days year^{-1})	178	178	178
Annual rate of methane emission (t CH_4-C ha^{-1} yr^{-1})	0.04015	0.04015	0.04015
Annual rate of carbon dioxide emission (t CO_2 ha^{-1} yr^{-1})	35.2	35.2	35.2

Assumption: The period of flooding is taken to be 178 days yr^{-1} for acid bogs and 169 days yr^{-1} based on the monthly mean temperature and the lengths of inundation (IPCC, 1997, Revised 1996 IPCC guidelines for national greenhouse gas inventories, Vol 3, table 5-13)

Assumption: The CH_4 emission rate provided for acid bogs is 11 (1-38) mg CH_4-C m^{-2} day^{-1} x 365 days; and for fens is 60 (21-162) mg CH_4-C m^{-2} day^{-1} x 365 days (Aselmann & Crutzen ,1989. J.Atm.Chem. 8, 307-358)

Assumption: CO_2 emissions on drainage of organic soils for upland crops (e.g., grain, vegetables) are 3.667x9.6 (7.9-11.3) t CO_2 ha^{-1} yr^{-1} in temperate climates (Armentano and Menges, 1986. J. Ecol. 74, 755-774).

Calculations following ECOSSE based methodology

Drained Land

Total area affected by drainage due to wind farm construction (ha)	3	2	5
Total volume affected by drainage due to wind farm construction (m^3)	24684	13778	38709

Soil Characteristics that Determine Emission Rates

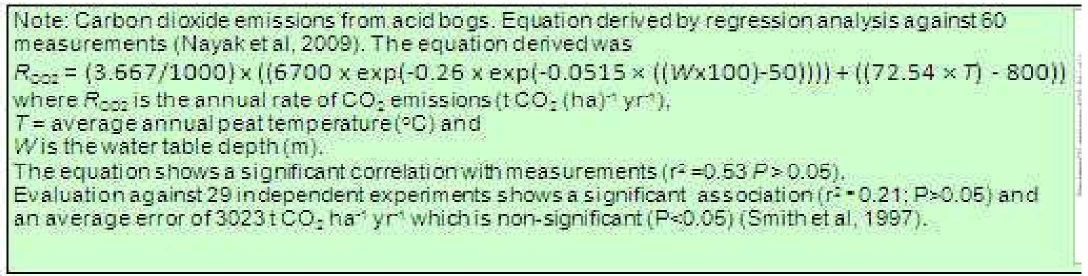
Average annual air temperature at the site (^{o}C)	10.7	6.1	16
Average water table depth at site (m)	0.50	1.00	0.10
Average water table depth of drained land (m)	0.80	1.00	0.85

Annual Emission Rates following site specific methodology

Acid bogs			
Rate of carbon dioxide emission in drained soil (t CO_2 ha^{-1} yr^{-1})	23.16	22.78	24.86
Rate of carbon dioxide emission in undrained soil (t CO_2 ha^{-1} yr^{-1})	18.86	22.78	4.51
Rate of methane emission in drained soil ((t CH_4-C) ha^{-1} yr^{-1})	0.001	-0.015	0.020
Rate of methane emission in undrained soil ((t CH_4-C) ha^{-1} yr^{-1})	0.00	-0.02	0.17
Fens			
Rate of carbon dioxide emission in drained soil (t CO_2 ha^{-1} yr^{-1})	64.43	62.73	67.76
Rate of carbon dioxide emission in undrained soil (t CO_2 ha^{-1} yr^{-1})	55.97	62.73	11.14
Rate of methane emission in drained soil ((t CH_4-C) ha^{-1} yr^{-1})	-0.003	-0.006	0.001
Rate of methane emission in undrained soil ((t CH_4-C) ha^{-1} yr^{-1})	0.00	-0.01	0.21

Selected emission characteristics following site specific methodology

Rate of carbon dioxide emission in drained soil (t CO_2 ha^{-1} yr^{-1})	23.16	22.78	24.86
Rate of carbon dioxide emission in undrained soil (t CO_2 ha^{-1} yr^{-1})	18.86	22.78	4.51
Rate of methane emission in drained soil ((t CH_4-C) ha^{-1} yr^{-1})	0.001	-0.015	0.020
Rate of methane emission in undrained soil ((t CH_4-C) ha^{-1} yr^{-1})	0.00	-0.02	0.17



Note: Carbon dioxide emissions from acid bogs. Equation derived by regression analysis against 60 measurements (Nayak et al, 2009). The equation derived was

R_{CO2} = (3.667/1000) x ((6700 x exp(-0.26 x exp(-0.0515 × ((*W*x100)-50)))) + ((72.54 × *T*) - 800))

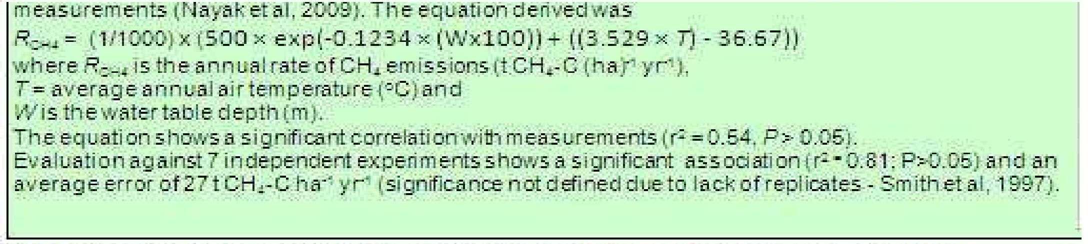
where R_{CO2} is the annual rate of CO_2 emissions (t CO_2 (ha)$^{-1}$ yr^{-1}),

T = average annual peat temperature (°C) and

W is the water table depth (m).

The equation shows a significant correlation with measurements (r^2 =0.53 *P* > 0.05).

Evaluation against 29 independent experiments shows a significant association (r^2 • 0.21; P>0.05) and an average error of 3023 t CO_2 ha^{-1} yr^{-1} which is non-significant (P<0.05) (Smith et al, 1997).



measurements (Nayak et al, 2009). The equation derived was

R_{CH4} = (1/1000) x (500 × exp(-0.1234 × (Wx100)) + ((3.529 × *T*) - 36.67))

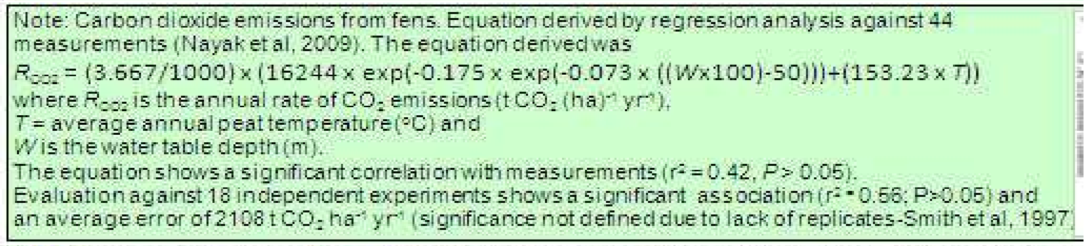
where R_{CH4} is the annual rate of CH_4 emissions (t CH_4-C (ha)$^{-1}$ yr^{-1}),

T = average annual air temperature (°C) and

W is the water table depth (m).

The equation shows a significant correlation with measurements (r^2 = 0.54, *P* > 0.05).

Evaluation against 7 independent experiments shows a significant association (r^2 • 0.81; P>0.05) and an average error of 27 t CH_4-C ha^{-1} yr^{-1} (significance not defined due to lack of replicates - Smith et al, 1997).



Note: Carbon dioxide emissions from fens. Equation derived by regression analysis against 44 measurements (Nayak et al, 2009). The equation derived was

R_{CO2} = (3.667/1000) x (16244 x exp(-0.175 x exp(-0.073 x ((*W*x100)-50)))+(153.23 x *T*))

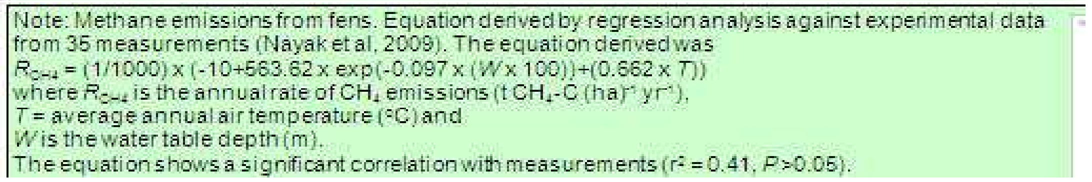
where R_{CO2} is the annual rate of CO_2 emissions (t CO_2 (ha)$^{-1}$ yr^{-1}),

T = average annual peat temperature (°C) and

W is the water table depth (m).

The equation shows a significant correlation with measurements (r^2 = 0.42, *P* > 0.05).

Evaluation against 18 independent experiments shows a significant association (r^2 • 0.56; P>0.05) and an average error of 2108 t CO_2 ha^{-1} yr^{-1} (significance not defined due to lack of replicates-Smith et al, 1997)



Note: Methane emissions from fens. Equation derived by regression analysis against experimental data from 35 measurements (Nayak et al, 2009). The equation derived was

R_{CH4} = (1/1000) x (-10+563.62 x exp(-0.097 x (*W* x 100))+(0.662 x *T*))

where R_{CH4} is the annual rate of CH_4 emissions (t CH_4-C (ha)$^{-1}$ yr^{-1}),

T = average annual air temperature (°C) and

W is the water table depth (m).

The equation shows a significant correlation with measurements (r^2 = 0.41, *P* >0.05).

Evaluation against 7 independent experiments shows a significant association ($r^2 = 0.69$; $P>0.05$) and an average error of 164 t CH_4-C ha^{-1} yr^{-1} (significance not defined due to lack of replicate-Smith et al, 1997)

RESULTS

Selected Emission Rates

Rate of carbon dioxide emission in drained soil (t CO_2 ha^{-1} yr^{-1})	23.16	22.78	24.86
Rate of carbon dioxide emission in undrained soil (t CO_2 ha^{-1} yr^{-1})	18.86	22.78	4.51
Rate of methane emission in drained soil ((t CH_4-C) ha^{-1} yr^{-1})	0.001	-0.015	0.020
Rate of methane emission in undrained soil ((t CH_4-C) ha^{-1} yr^{-1})	0.00	-0.02	0.17

Click here to move to 5d. CO2 loss from drained peat Click here

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Emission rates from soils

Note: Note, CO_2 losses are calculated using two approaches: IPCC default methodology and more site specific equations derived for this project. The IPCC methodology is included because it is the established approach, although it contains no site detail. The new equations have been thoroughly tested against experimental data (see Nayak et al, 2008 - Final report).

Emissions due to loss of DOC and POC

Note: Note, CO_2 losses from DOC and POC are calculated using a simple approach derived from generic estimates of the percentage of the total CO2 loss that is due to DOC or POC leaching

No POC losses for bare soil included yet. If extensive areas of bare soil is present at site need modified calculation (Birnie et al, 1991)

	Expected	Minimum	Maximum
Total C loss			
Gross CO_2 loss from restored drained land (t CO_2)	0	0	0
Gross CH_4 loss from restored drained land (t CO_2 equiv.)	0	0	0
Gross CO_2 loss from improved land (t CO_2)			
Degraded Bog	0	0	0
Felled Forestry	0	0	0
Borrow Pits	0	0	0
Foundations & Hardstanding	0	0	0
Gross CH_4 loss from improved land (t CO_2 equiv.)			
Degraded Bog	0	0	0
Felled Forestry	0	0	0
Borrow Pits	0	0	0
Foundations & Hardstanding	0	0	0
Conversion factor: CH_4-C to CO_2 equivalents	30.6667	30.6667	30.6667
% total soil C losses, lost as DOC	26	7	40
% DOC loss emitted as CO_2 over the long term	100	100	100
% total soil C losses, lost as POC	8	4	10
% POC loss emitted as CO_2 over the long term	100	100	100
Total gaseous loss of C (t C)	0	0	0
Total C loss as DOC (t C)	0	0	0
Total C loss as POC (t C)	0	0	0

Note: Only restored drained land included because if land is not restored, the C lost has already been counted as carbon dioxide

Assumption: DOC loss ranges between 7 - 40% of the total gaseous loss if calculated from the reported (minimum and maximum) values in Worrall 2009 and is **26%** of the total gaseous loss if calculated from the mean of reported maximum and minimum value in Worrall 2009. These DOC values are flux based on soil water concentration (i.e. 12.5 - 85.9 MgC/KM^2/yr)

and not on flux at catchment outlet (i.e. 10.3 - 21.8 MgC/KM^2/yr)

Worrall, F. et al., 2009. The multi-annual carbon budget of a peat-covered catchment. *Science of The*

Assumption: In the long term, 100% of leached DOC is assumed to be lost as CO_2

Assumption: POC loss ranges between 4-10% of the total gaseous loss if calculated from the reported values and is **8%** of the total gaseous loss if calculated from the mean of reported maximum and minimum value in Worrall 2009. POC range is (7 - 22.4 MgC/KM^2/yr) (Worrall et al, 2009).

Assumption: In the long term, 100% of leached POC is assumed to be lost as CO_2

RESULTS			
Total CO_2 loss due to DOC leaching (t CO_2)	**0**	**0**	**0**
Total CO_2 loss due to POC leaching (t CO_2)	**0**	**0**	**0**
Total CO_2 loss due to DOC & POC leaching (t CO_2)	**0**	**0**	**0**
Additional CO_2 payback time of windfarm due to DOC & POC			
…coal-fired electricity generation (months)	0	0	0
…grid-mix of electricity generation (months)	0	0	0
…fossil fuel - mix of electricity generation (months)	0	0	0

Click here to move to Payback Time Click here

Emissions due to loss of DOC and POC

Note: Note, CO_2 losses from DOC and POC are calculated using a simple approach derived from generic estimates of the percentage of the total CO2 loss that is due to DOC or POC leaching

No POC losses for bare soil included yet. If extensive areas of bare soil is present at site need modified calculation (Birnie et al, 1991)

Emissions due to forest felling - calculation using simple management data

Note: Emissions due to forestry felling are calculated from the reduced carbon sequestered per crop rotation. If the forestry was due to be removed before the planned development, this C loss is not attributable to the wind farm and so the area of forestry to be felled should be entered as zero.

	Expected	Minimum	Maximum
Emissions due to forestry felling			
Area of forestry plantation to be felled (ha)	105.5	105.4	105.6
Carbon sequestered (tC ha^{-1} yr^{-1})	3.6	3.5	3.7
Lifetime of windfarm (years)	10	10	10
Carbon sequestered over the lifetime of the windfarm (t C ha^{-1})	36	35	37
RESULTS			
Total carbon loss due to felling of forestry (t CO$_2$)	**13927**	**13528**	**14328**
Additional CO$_2$ payback time of windfarm due to management of forestry			
…coal-fired electricity generation (months)	216	225	207
…grid-mix of electricity generation (months)	985	1028	945
…fossil fuel - mix of electricity generation (months)	481	502	461

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Emissions due to forest felling - calculation using simple management data

Note: Emissions due to forestry felling are calculated from the reduced carbon sequestered per crop rotation. If the forestry was due to be removed before the planned development, this C loss is not attributable to the wind farm and so the area of forestry to be felled should be entered as zero.

Gains due to site improvement

Note: Note, CO_2 losses are calculated using two approaches: IPCC default methodology and more site specific equations derived for this project. The IPCC methodology is included because it is the established approach, although it contains no site detail. The new equations have been thoroughly tested against experimental data (see Nayak et al, 2008 - Final report).

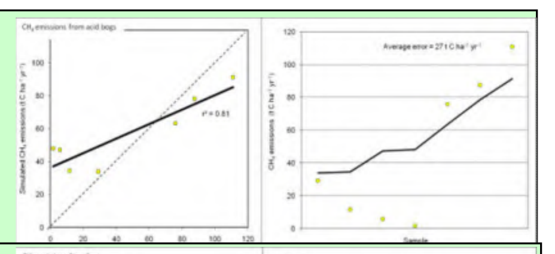
Selected Methodology = Site specific (required for planning applications)
Type of peatland = Acid Bog

Reduction in GHG emissions due to improvement of site	**Expected result**				**Minimum result**				**Maximum result**			
Improvement of…	**Degraded Bog**	**Felled Forestry**	**Borrow Pits**	**Foundations & Hardstanding**	**Degraded Bog**	**Felled Forestry**	**Borrow Pits**	**Foundations & Hardstanding**	**Degraded Bog**	**Felled Forestry**	**Borrow Pits**	**Foundations & Hardstanding**
1. Description of site												
Period of time when effectiveness of the improvement can be guaranteed (years)	0	0	0	10	0	0	0	10	0	0	0	10
Area to be improved (ha)	0	0	0	0	0	0	0	0	0	0	0	0
Average air temperature at site (^oC)	10.7	10.7	10.7	10.7	6.1	6.1	6.1	6.1	16	16	16	16
Depth of peat drained (m)	1.60	1.60	0.00	1.60	1.50	1.50	0.00	1.50	1.70	1.70	0.00	1.70
Depth of peat above water table before improvement (m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Depth of peat above water table after improvement (m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Losses with improvement												
Flooded period (days $year^{-1}$)	178	178	178	178	178	178	178	178	178	178	178	178
Time required for hydrology and habitat to return to its previous state on restoration (years)	0	0	0	0	0	0	0	0	0	0	0	0
Improved period (years)	0	0	0	10	0	0	0	10	0	0	0	10
Methane emissions from improved land												
Site specific methane emission from improved soil on acid bogs (t CH_4-C ha^{-1} yr^{-1})	0.501	0.501	0.501	0.501	0.485	0.485	0.485	0.485	0.520	0.520	0.520	0.520
Site specific methane emission from improved soil on fens (t CH_4-C ha^{-1} yr^{-1})	0.561	0.561	0.561	0.561	0.558	0.558	0.558	0.558	0.564	0.564	0.564	0.564
IPCC annual rate of methane emission on acid bogs (t CH_4-C ha^{-1} yr^{-1})	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
IPCC annual rate of methane emission on fens (t CH_4-C ha^{-1} yr^{-1})	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219
Selected annual rate of methane emission (t CH_4-C ha^{-1} yr^{-1})	0.501	0.501	0.501	0.501	0.485	0.485	0.485	0.485	0.520	0.520	0.520	0.520
CH_4 emissions from improved land (t CO_2 equiv.)	0	0	0	0	0	0	0	0	0	0	0	0
Carbon dioxide emissions from improved land												
Site specific CO_2 emission from improved soil on acid bogs (t CO_2 ha^{-1} yr^{-1})	0.72	0.72	0.72	0.72	-0.51	-0.51	-0.51	-0.51	2.13	2.13	2.13	2.13
Site specific CO_2 emissions from improved soil on fens (t CO_2 ha^{-1} yr^{-1})	6.07	6.07	6.07	6.07	3.49	3.49	3.49	3.49	9.05	9.05	9.05	9.05
IPCC annual rate of carbon dioxide emission on acid bogs (t CO_2 ha^{-1} yr^{-1})	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IPCC annual rate of carbon dioxide emission on fens (t CO_2 ha^{-1} yr^{-1})	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selected annual rate of carbon dioxide emission (t CO_2 ha^{-1} yr^{-1})	0.72	0.72	0.72	0.72	-0.51	-0.51	-0.51	-0.51	2.13	2.13	2.13	2.13
CO_2 emissions from improved land (t CO_2)	0	0	0	0	0	0	0	0	0	0	0	0
Total GHG emissions from improved land (t CO_2 equiv.)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3. Losses without improvement												
Flooded period (days $year^{-1}$)	0	0	0	0	0	0	0	0	0	0	0	0
Time required for hydrology and habitat to return to its previous state on restoration (years)	0	0	0	0	0	0	0	0	0	0	0	0
Improved period (years)	0	0	0	10	0	0	0	10	0	0	0	10
Methane emissions from unimproved land												
Site specific methane emission from unimproved soil on acid bogs (t CH_4-C ha^{-1} yr^{-1})	0.501	0.501	0.501	0.501	0.485	0.485	0.485	0.485	0.520	0.520	0.520	0.520
Site specific methane emission from unimproved soil on fens (t CH_4-C ha^{-1} yr^{-1})	0.561	0.561	0.561	0.561	0.558	0.558	0.558	0.558	0.564	0.564	0.564	0.564
IPCC annual rate of methane emission on acid bogs (t CH_4-C ha^{-1} yr^{-1})	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IPCC annual rate of methane emission on fens (t CH_4-C ha^{-1} yr^{-1})	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Selected annual rate of methane emission (t CH_4-C ha^{-1} yr^{-1})	0.501	0.501	0.501	0.501	0.485	0.485	0.485	0.485	0.520	0.520	0.520	0.520
CH_4 emissions from unimproved land (t CO_2 equiv.)	0	0	0	0	0	0	0	0	0	0	0	0
Carbon dioxide emissions from unimproved land												
Site specific CO_2 emission from unimproved soil on acid bogs (t CO_2 ha^{-1} yr^{-1})	0.72	0.72	0.72	0.72	-0.51	-0.51	-0.51	-0.51	2.13	2.13	2.13	2.13
Site specific CO_2 emissions from unimproved soil on fens (t CO_2 ha^{-1} yr^{-1})	6.07	6.07	6.07	6.07	3.49	3.49	3.49	3.49	9.05	9.05	9.05	9.05
IPCC annual rate of carbon dioxide emission on acid bogs (t CO_2 ha^{-1} yr^{-1})	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20
IPCC annual rate of carbon dioxide emission on fens (t CO_2 ha^{-1} yr^{-1})	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20	35.20
Selected annual rate of carbon dioxide emission (t CO_2 ha^{-1} yr^{-1})	0.72	0.72	0.72	0.72	-0.51	-0.51	-0.51	-0.51	2.13	2.13	2.13	2.13
CO_2 emissions from unimproved land (t CO_2)	0	0	0	0	0	0	0	0	0	0	0	0
Total GHG emissions from unimproved land (t CO_2 equiv.)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
RESULTS **4. Reduction in GHG emissions due to improvement of site**												
Total GHG emissions from improved land (t CO_2 equiv.)	0	0	0	0	0	0	0	0	0	0	0	0
Total GHG emissions from unimproved land (t CO_2 equiv.)	0	0	0	0	0	0	0	0	0	0	0	0
Reduction in GHG emissions due to improvement (t CO_2 equiv.)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Additional CO_2 payback time of windfarm due to site improvement												
…coal-fired electricity generation (months)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
…grid-mix of electricity generation (months)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
…fossil fuel - mix of electricity generation (months)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Note: Methane emissions from acid bogs. Equation derived by regression analysis against 57 measurements (Nayak et al, 2009). The equation derived was

R_{CH4} = (1/1000) x (500 × exp(-0.1234 × (Wx100)) + ((3.529 × T) - 36.67))

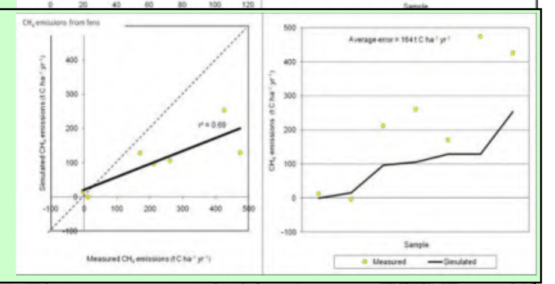
where R_{CH4} is the annual rate of CH_4 emissions (t CH_4-C $(ha)^{-1}$ yr^{-1}),
T = average annual air temperature (^oC) and
W is the water table depth (m).
The equation shows a significant correlation with measurements (r^2 = 0.54, P > 0.05).
Evaluation against 7 independent experiments shows a significant association (r^2 = 0.81; P>0.05) and an average error of 27 t CH_4-C ha^{-1} yr^{-1} (significance not defined due to lack of replicates - Smith et al, 1997).



Note: Methane emissions from fens. Equation derived by regression analysis against experimental data from 35 measurements (Nayak et al, 2009). The equation derived was

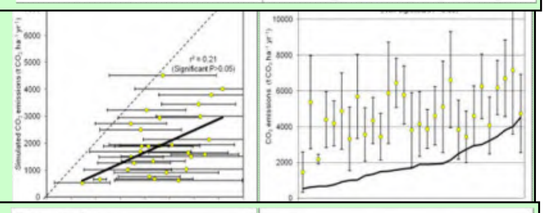
R_{CH4} = (1/1000) x (-10+563.62 x exp(-0.097 x (W x 100))+(0.662 x T))

where R_{CH4} is the annual rate of CH_4 emissions (t CH_4-C $(ha)^{-1}$ yr^{-1}),
T = average annual air temperature (^oC) and
W is the water table depth (m).
The equation shows a significant correlation with measurements (r^2 = 0.41, P >0.05).
Evaluation against 7 independent experiments shows a significant association (r^2 = 0.69; P>0.05) and an average error of 164 t CH_4-C ha^{-1} yr^{-1} (significance not defined due to lack of replicate-Smith et al, 1997)



R_{CO2} = (3.667/1000) x ((6700 x exp(-0.26 x exp(-0.0515 × ((Wx100)-50)))) + ((72.54 × T) - 800))

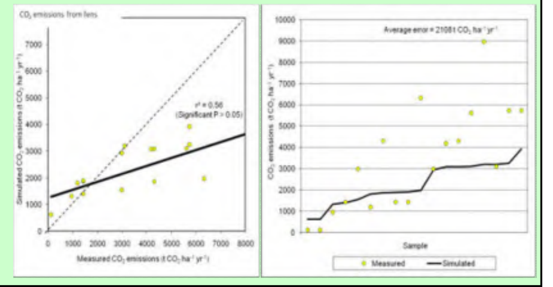
where R_{CO2} is the annual rate of CO_2 emissions (t CO_2 $(ha)^{-1}$ yr^{-1}),
T = average annual peat temperature (^oC) and
W is the water table depth (m).
The equation shows a significant correlation with measurements (r^2 =0.53 P > 0.05).
Evaluation against 29 independent experiments shows a significant association (r^2 = 0.21; P>0.05) and an average error of 3023 t CO_2 ha^{-1} yr^{-1} which is non-significant (P<0.05) (Smith et al, 1997).



Note: Carbon dioxide emissions from fens. Equation derived by regression analysis against 44 measurements (Nayak et al, 2009). The equation derived was

R_{CO2} = (3.667/1000) x (16244 x exp(-0.175 x exp(-0.073 x ((Wx100)-50)))+(153.23 x T))

where R_{CO2} is the annual rate of CO_2 emissions (t CO_2 $(ha)^{-1}$ yr^{-1}),
T = average annual peat temperature (^oC) and
W is the water table depth (m).
The equation shows a significant correlation with measurements (r^2 = 0.42, P > 0.05).
Evaluation against 18 independent experiments shows a significant association (r^2 = 0.56; P>0.05) and an average error of 2108 t CO_2 ha^{-1} yr^{-1} (significance not defined due to lack of replicates-Smith et al, 1997)



Note: Methane emissions from acid bogs. As above

Note: Methane emissions from fens. As above

Note: CO_2 emissions from acid bogs. As above

Note: CO_2 emissions from fens. As above

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Gains due to site improvement

Note: Note, CO_2 losses are calculated using two approaches: IPCC default methodology and more site specific equations derived for this project. The IPCC methodology is included because it is the established approach, although it contains no site detail. The new equations have been thoroughly tested against experimental data (see Nayak et al, 2008 - Final report).

TII CARBON TOOL

Ch 15: Material Assets, Section 15.1, Table 15-7					Distance Assumptions	TII Embodied Carbon Tool Inputs (https://web.tii.ie/index.html)						TII Transport Inputs (https://web.tii.ie/index.html)		
Material	Total no. Truck Loads	Truck Types	TII Embodied Carbon	TII Traffic	Distance (km)	Category	Sub-Category	Material	Quantity	Unit	Embodied tCO2e	Transport Type	Distance (km)	Transport TCO2e
Delivery of plant	5	Large Artic		✓	17.16							HGV- All - Average	85.8	0.09
Cranes for site	1	Large Artic		✓	17.16							HGV- All - Average	17.16	0.02
Additional Crane Materials Delivery	3	Large Artic		✓	17.16							HGV- All - Average	51.48	0.06
Refuelling for plant	5	Large Artic		✓	17.16							HGV- All - Average	85.8	0.09
Removal of plant	5	Large Artic		✓	17.16							HGV- All - Average	85.8	0.09
Delivery of Soil	17	Large Artic	✓	✓	17.16	Series 600 Earthworks	Backfill/Fill	Aggregates and sand, expanded clay, bulk, loose	425,000.00	kg	142.38	HGV- All - Average	291.72	0.32
Total											142.38			0.67

List of Assumptions

Embodied Carbon Assumptions		
Item	Description	Assumption
Volume of Average Artic Truck	Calculation completed based on the average artic truck having a carrying capacity of 25 tonnes	25 tonnes
Volume of Soil Material To Be Used for Decommissioning	As identified in Table 15-2 in Chapter 15 the EIAR, approximately 17 truckloads of soil material will be required for the decommissioning of the Proposed Lifetime Extension. Based on the assumption that all HGVs have a carrying capacity of 25 tonnes, it is assumed that 425 tonnes of soil material will be required for decommissioning. This equates to 425,000kg of soil material.	425,000.00 kg
Ducting and cabling (internal)	Embodied carbon of electrical equipment not included as an option in TII Carbon Tool	-
Grid connection cable laying	Embodied carbon of electrical equipment not included as an option in TII Carbon Tool	-
Turbine Lifecycle	Embodied carbon of the overall turbine lifecycle is included in the Macauley Institute Carbon Calculator for Wind Farms on Peatland	-
Soil Emission Factor	Calculated from an Series 600 Earthworks – Backfill/Fill - Aggregates and sand, expanded clay, bulk, loose emission factor as provided in the TII Carbon Tool.	0.335 kgCO2e per unit

Please note that the assumptions for the embodied carbon and traffic assumptions are made based on best estimates of material sources. In reality the location of material sources will be dependent on what is available at the time of construction. The implications of distance variations on the estimation for carbon calculations is of a very low magnitude within the context of the overall carbon calculations and considered appropriate for the purposes of assessment in the EIAR.

Traffic Assumptions		
Item	Description	Assumption
Quarry (Q) Distance	For modelling purposes, the average distance from Newmarket Co. Cork, Abbeyfeale Co. Limerick, Rockchapel Co. Cork, Castleisland Co. Kerry, and Ballydesmond Co. Cork to the Proposed Project site was used to determine the distance of transportation of all materials for the Proposed Lifetime Extension.	17.16km
Large Artic Emission Factor	Calculated from an HGV - All - Average emission factor as provided in the TII Carbon Tool	1.0845 kgCO2e per unit

Please note that the assumptions for the embodied carbon and traffic assumptions are made based on best estimates of material sources. In reality the location of material sources will be dependent on what is available at the time of construction. The implications of distance variations on the estimation for carbon calculations is of a very low magnitude within the context of the overall carbon calculations and considered appropriate for the purposes of assessment in the EIAR.

Macauley Assumptions		
Item	Description	Assumption
Capacity Factors	Macauley Carbon Calculator (version 2.14.0) is the most up to date version of the tool, it uses the most up to date emission factors available and is continually reviewed for updates. While the Proposed Project was constructed in 2006, due to the lack of available emissions factors within the tool and to assess carbon losses under a precautionary scenario, 2025 emission factors were used when determining the carbon losses of the Proposed Project via the Macauley Carbon Calculator.	Use of 2025 Emission Factors
Average peat depth	Assumed average peat depth of 1.6m as per Appendix 8-1 Peat Stability Risk Assessment.	1.6m

List of Assumptions

Carbon Saving Assumptions		
Item	Description	Assumption
Existing Taurbeg Wind Farm	The Existing Taurbeg Wind Farm has been operational for 19 years at the time of writing. The carbon savings assessment contained in Section 11.4..3.2 of Chapter 11 is only in relation to the extended 10 year operational life associated with the Proposed Lifetime Extension; i.e., the offset period identified is only for those emissions associated with the Proposed Project. Emissions associated with the Existing Taurbeg Wind Farm are assumed to have been offset by the operation of the Existing Taurbeg Wind Farm over the past 19 years of operation.	Existing Taurbeg Wind Farm Carbon Losses have been offset by the 19 Year Operational Phase of the Existing Taurbeg Wind Farm