FEHILY TIMONEY

CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX 9.1

Geotechnical Assessment Report

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

ANNAGH WIND FARM

GEOTECHNICAL ASSESSMENT REPORT

Prepared for: EMPower

EMPower

Date: October 2021

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1. INTRODUCTION

1.1 General

Annagh Wind Farm Limited (a subsidiary of Emerging Markets Power Ltd (EMPower)) intends to apply to Cork County Council for planning permission to construct the proposed Annagh Wind Farm, near Charleville, County Cork.

The proposed turbines are located in an agricultural area in north County Cork, approximately 6km south west of Charleville and approximately 3km north of the village of Churchtown. The proposed Annagh Wind Farm Site includes lands contained within the following townlands: Annagh North, Fiddane, Cooliney, Coolcaum.

The underground grid connection route connecting the wind farm to the national grid at the Charleville Substation traverses the following townlands: Cooliney, Rathnacally, Farranshonikeen, Ardnageehy and Clashganniv.

The general site layout of the site is shown in Figure 1.1 in Appendix 1.

1.2 Details of Proposed Works

The proposed Annagh Wind Farm will consist of up to 6 no. wind turbine generators (WTGs), 1 no. meteorological mast, construction of new site tracks, the upgrade of existing agricultural tracks and 1 no. substation compound along with ancillary civil and electrical infrastructure.

The associated grid connection cable which will connect the on-site substation to the existing Charleville Substation within the townland of Rathnacally, County Cork will consist of 38kV cables and will be approx. 5.9km in length including 3.4km to be constructed primarily within the existing road corridor and of 2.5km of underground cable to be laid within private lands within the proposed wind farm site.

The proposed GCR arrangement is presented in Figure 1.1 in Appendix 1.

1.3 Scope of Works and Proposed Objectives

Fehily Timoney and Company (FT) were engaged by EMPower to undertake a geotechnical assessment of the proposed wind farm site.

This study was carried out in accordance with Eurocode 7: Part 2 (NSAI, 2007). In addition to the Eurocode 7 guidance, an assessment was undertaken in accordance with the Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (PLHRA, 2017).

The scope of this report included the investigation and reporting on the following information:

- Site details including location, present use, proposed use etc.
- Site Geology (bedrock, superficial deposits and made ground)
- Site Hydrogeology
- Site Hydrology

- Any site-specific requirements
- A summary of the intrusive site investigations completed at the site

The study includes the following interpretative elements:

- Interpretation of the findings of the site walkovers and intrusive site investigations
- Details of site constraints which may affect proposed site layout and engineering options.
- List of potential hazards at the site arranged into a Design Risk Register which will highlight any topographic, geological or man-made hazards in the area and potential mitigation measures to be taken during the next stages of the project.

2. DESK STUDY

Prior to undertaking the site walkover and intrusive site investigations, a desk study was undertaken to help determine the baseline conditions within the study area and planning boundary to provide relevant background information. The desk top study involved an examination of the following sources of information:

- OSI (2020), Current and historic Ordnance Survey Ireland mapping and ortho-photography.
- Taluntais (1980), General Soil Map of Ireland
- Geological Survey of Ireland (2021) GSI Public Data Viewer (www.spatial.dcenr.gov.ie)
- Environmental Protection Agency (2021) Review of the EPA online mapping (http://gis.epa.ie/Envision).
- Study of the proposed layout of the development.

To determine the existing hydrogeological regime within the study area the following EPA and GSI online datasets and mapping from the sources outlined above were reviewed:

- Catchment & Management Units;
- Groundwater Bodies Status and Risk;
- Drinking Water Protection Areas;
- Groundwater Resources (Aquifers);
- Groundwater Wells and Springs;
- Karst Features; and
- Groundwater Vulnerability

2.1 Geology

2.1.1 Quaternary Deposits

The Quaternary Geology underlying the proposed development is discussed below and presented in Figure 2.1. The subsoils present within the development site and wider study area were taken from the Geological Survey of Ireland (GSI) online mapping - Quaternary Geology of Ireland (1:50,000 scale) and comprise:

- Alluvium (A);
- Till derived from Namurian Sandstones and Shales (TNSSs);
- Bedrock outcrop or subcrop (Rck).

As shown in Figure 2.1 the majority of turbine location and associated infrastructure are located within areas classified as Alluvium.

The majority of the proposed grid connection route is underlain by Till derived from Namurian sandstones and shales.

2.1.2 Solid Geology

The Geological Survey of Ireland (GSI) 1:100,000 scale bedrock geology map shows that the proposed wind farm development site is underlain by the Copstone Formation, which is described as dark grey well bedded muddy limestone and the Hazelwood Limestone Formation, described as a pale grey massive mud grade limestone. The north of the site is underlain by the Caherduggan Limestone Formation, which is described as crinoidal limestone and some nodular chert and the Liscarroll Limestone Formation, described as a grey, cherty bioclastic limestone.

There is one main fault-line within the bedrock of the site boundary. The fault has northeast to southwest trend.

The proposed grid connection route traverses the Clare Shale Formation, described as a mudstone, cherty at base.

The bedrock geology of the proposed development and surrounding area is presented in Figure 2.2.

2.2 Hydrogeology

2.2.1 Groundwater Vulnerability

The Groundwater Vulnerability within the proposed development boundary is classified by the GSI as generally being classified as 'Low' and 'Moderate', with localised areas classified as 'Extreme'. Along the proposed grid connection, the vulnerability classification ranges from 'Moderate' to 'Extreme' with localised areas of exposed bedrock (X). The GSI distribution of groundwater vulnerability for the site area is shown in Figure 2.3.

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

2.2.2 Groundwater Bodies Description

The majority of the proposed wind farm site and a portion of the proposed grid connection is located within the Mitchelstown Groundwater Body (GWB). The majority of the grid connection and northern extremity of the proposed development site is underlain by the Rathnacally GWB.

The descriptions of the GWBs within the study area have been taken from the 'Summary of Initial Characterisation' draft reports for each defined GWB published by the GSI in accordance with the Groundwater Working Group Publication: Guidance Document GW2 (2003). The GWB Characterisation Reports are available from the GSI Public Data Viewer. Site specific data including depth to bedrock and subsoil type encountered during intrusive investigations has been used to supplement and validate the published information.

The Mitchelstown GWB is located over a large low-lying area in north County Cork with the highest ground present around the margins of the GWB. The GWB is generally flat to gently undulating (20-190m AOD). The GWB is defined by east-west trending valleys between Buttevant and Mitchelstown in the north, and Mallow and Fermoy in the south.

The Rathnacally GWB is a small GWB in north County Cork, bounded by the Charleville GWB to the north, the Mitchelstown GWB to the south, the Ballylongford GWB to the west and the Newtown Ballyhea GWB to the east. The GWB is situated in an upland area ranging from 100 to 190m AOD. The drainage is to the south and southeast.

3. SITE WALKOVER

As part of the geotechnical assessment and peat stability assessment site walkovers were carried out by FT during July 2020. The objective of the site walkovers was to determine the baseline characteristics of the proposed wind farm site. This included the recording of salient geomorphological features with respect to the wind farm development and to investigate peat thickness and peat strength where peat deposits were encountered.

The survey covered the proposed locations for the turbine bases, substation, met mast, construction compounds, existing and proposed new access roads and all associated infrastructure. During site walkover there were no indication of the presence of peat on the development site. No evidence of peat was recorded during the intrusive ground investigation.

The method adopted for carrying out the site walkover relied on practitioners carrying out a visual assessment of the site supplemented with measurement of slope inclinations.

3.1 General

As outlined above, site walkovers were carried out by FT during July 2020. The method adopted for carrying out the site walkovers relied on practitioners carrying out a visual assessment of the site supplemented with recording of slope inclinations.

The assessment included a series of hand-held probes and hand shear vanes at proposed infrastructure locations to determine the presence/depth of peat within the proposed development site. Visual observations were also made to assess the stability of other soil slopes and rock exposures across the site.

The main findings of the site walkovers within the wind farm site are as follows:

The slopes of the proposed development site are characterised by lands with typical elevations of between 80m to 100m AOD.

Slopes at proposed turbine locations in the development range from 1 to 2 degrees.

No evidence of peat deposits were noted on site.

No evidence of slope instability in other soil or rock slopes was observed at the site and there are no historical records of landslide activity within or close to the site, on the GSI database.

Mineral Soils and Glacial Till were occasionally exposed at the ground surface within the numerous drainage ditches that are present on the site

From site walkovers completed by FT it was noted all existing access tracks on site have been constructed using a founded construction method based on observations made during site walkovers. The access tracks for the proposed development will comprise upgrading of existing founded access tracks and construction of new proposed access tracks using excavate and replace construction techniques.

A summary of the information obtained during the field assessments is provided below in Table 3.1 over.

Table 3.1: Site Walkover Summary

Proposed Infrastructure	Land use	Quaternary Deposits (GSI Online Mapping)	Ground conditions encountered	Slope (degrees)	Depth to Bedrock (m) from Site Investigations	Groundwater Vulnerability (GSI Online Mapping
T01	Agricultural	Alluvium	Stiff Silt over slightly sandy Gravel	1-2	-	Moderate
T02	Forestry	Till	Stiff Silt over Sand and Gravel	1-2	-	Low
T03	Forestry	Alluvium	Stiff Silt over silty Sand	1-2	-	Moderate
T04	Forestry	Alluvium	-	1-2	-	Moderate
T05	Agricultural	Alluvium	Firm to stiff sandy Silt	1-2	-	Moderate
T06	Forestry	Alluvium	Stiff Silt/Clay	1-2	-	Moderate
Substation	Agricultural	Alluvium	-	1-2	-	Moderate
Met Mast	Agricultural	Alluvium	-	1-2	-	Moderate
Temporary Compound	Agricultural	Alluvium	Soft to firm Silt over stiff slightly gravelly Silt	1-2	-	Moderate

4. GROUND INVESTIGATIONS

Intrusive site investigations were undertaken by Irish Drilling Ltd (IDL) under the supervision of an Engineering Geologist from FT in March 2021.

The scope of the site investigations is summarised below with the information obtained referenced in this chapter:

- Advancement of 8 No. trial pits to a maximum depth of 4.5m below ground level (BGL) at proposed turbine locations and various infrastructure locations.

The ground investigation was carried out in accordance with the principles in BS 5930:2015 and Eurocode 7 Part 2. A ground investigation location plan showing all trial pit locations is included as Figure 4.1 in Appendix 1 of this report.

4.1 Summary of Ground Conditions Encountered

The following section describes the ground conditions encountered during ground investigation completed at selected proposed turbine locations and the proposed borrow pit location.

4.1.1 Proposed Turbine Locations

Trial pits were excavated closer to the turbine locations with the exception of T4. Geotechnical samples were collected from trial pits.

4.1.2 Groundwater Encountered

Groundwater was recorded in the majority of the trial pits, as summarised below.

Table 4.1: Summary of Groundwater Encountered

Trial Pit ID	Groundwater Strike (m bgl)
TP-01	1.6
TP-02	1.55
TP-03	1.2
TP-05	2.8
TP-06	1.2
TP-CC	2.1
TP-SS	1.3

5. GROUND MODEL

The site walkover and ground investigations have generally confirmed the anticipated geology described in the Desk Study. A summary of the geological strata encountered during the ground investigations is summarised in Table 5.1 below.

Table 5.1: Summary of Geology Encountered

Strata	General Description	Depth to Top Range (m bgl)	Depth to Bottom Range (m bgl)
Topsoil	Firm to stiff Silt/Clay	0	0.2 – 0.35
Alluvium	Soft to firm slightly gravelly silty Clay	0.2 – 0.35	0.6 – 1.5
Glacial Till (Granular)	Sandy subangular to subrounded Gravel	0.6 – 1.5	1.5 – 2.4
Glacial Till (Cohesive)	Stiff slightly gravelly Silt	0.7 – 3.2	0.3 - 2.3

6. GEOTECHNICAL CONSIDERATIONS

6.1 Turbine Foundations

Based on the findings of the site investigations undertaken to date, a preliminary assessment of the likely foundation types found that a gravity foundation construction (founded) would be suitable for all of the proposed turbine foundations.

At the underside of the turbine foundation, a layer of structural up-fill (class 6N/6P - in accordance with TII requirements) will be required.

It should be noted that at detailed design stage a confirmatory ground investigation will be carried out at each proposed turbine locations to confirm the turbine foundation type. The ground investigation will be in the form of a borehole with in-situ SPT testing at 1.0m intervals in the overburden and follow-on rotary core through bedrock.

A summary of turbine foundation type, estimated depth and founding stratum is provided below in Table 6.1.

Table 6.1: Turbine Foundation Summary

Proposed Infrastructure	Quaternary Deposits (GSI)	Ground Conditions Encountered	Slope (degrees)	Depth to Bedrock	Foundation Recommendation
T01	Alluvium	Stiff Silt over slightly sandy Gravel	1 - 2	-	Gravity foundation up to 3.0m bgl.
T02	Till	Stiff Silt over Sand and Gravel	1 - 2	-	Gravity foundation up to 3.0m bgl
T03	Alluvium	Stiff Silt over silty Sand	1 - 2	-	Gravity foundation up to 3.0m bgl
T04	Alluvium	-	1 - 2	-	Gravity foundation up to 3.0m bgl
T05	Alluvium	Firm to stiff sandy Silt	1 - 2	-	Gravity foundation up to 3.0m bgl
T06	Alluvium	Stiff Silt/Clay	1 - 2	-	Gravity foundation up to 3.0m bgl

6.2 Access Tracks

It is considered all newly constructed access road will be of the founded type. Existing access road infrastructure will be incorporated into the design or improved upon through the use of widening and strengthening.

Founded roads are used in areas where competent ground is encountered at shallow depth. These roads are constructed by excavating until competent strata is encountered and then filling with a compacted 6F2 granular fill to road level. A layer of Class 804 material (in accordance with 800 series of the Specification for Road Works) is then used as a surfacing layer.

Tracks shall be observed during earthworks operations, if excessive rutting occurs, the pavement depth shall be increased.

Stone fill of suitable Class 6F2 material will be placed and compacted in accordance with the TII Specification for Road Works.

Where bearing stratum has slope greater than 1:1.5, benching should be carried out. Benches to be 0.5m Vertical & 1.0m Horizontal, with maximum crossfall of 2% on Horizontal section.

6.3 Crane Hardstands

Crane hardstands will all be founded. Crane hardstands are generally constructed using compacted Class 1/6F material on a suitable sub-formation to achieve the required bearing resistance. The hardstands will be designed for the most critical loading combinations from the crane. The founding levels for the hardstands may be variable across the site and will be determined during confirmatory ground investigation/detailed design stage.

The typical make-up of the hardstands would include up to 1.0m of compacted Class 1/6F material with geotextile and/or geogrid layers incorporated as required during detailed design stage.

6.4 Substation Foundations and Platforms

The substation platforms will be constructed using the founded technique. The substation foundations may comprise strip/raft foundations under the main footprint of the building with possibly a basement/pit for cable connections. Substation platforms are generally constructed using compacted Class 1/6F material with a suitable sub-formation to achieve the required bearing resistance.

Given the ground conditions present at the proposed substations, it is envisaged that the foundations will require to be founded on Glacial Till deposits. The typical make-up of the substation platform may include up to 750mm of granular stone fill with possibly a layer of geotextile and/or geogrid. At the underside of the substation foundations, a layer of structural up-fill (class 6N/6P) will likely be required.

6.5 Temporary Construction Compound Platforms

The construction compound platforms will be constructed using founded techniques. The construction compound platforms are generally constructed using compacted Class 1/6F material on a suitable sub-formation to achieve the required bearing resistance.

The typical make-up of the construction compound platform would include up to 500mm compacted Class 1/6F material with a suitable sub-formation to achieve the required bearing resistance. Geotextile and/or geogrid layers will be incorporated as required during detailed design stage.

7. CONCLUSIONS AND RECOMMENDATIONS

Fehily Timoney & Company (FT) were retained by Coillte to undertake a geotechnical site assessment at the proposed Annagh Wind Farm located in County Cork.

The slopes of the proposed development site are characterised by lands with typical elevations of between 80m to 100m AOD.

A review of the published GSI datasets for the site indicated that the site is underlain by Alluvium deposits and Glacial Till, underlain by the Copstone and Hazelwood Formation, which is described as pale grey and dark grey muddy limestone. The findings of the intrusive site investigation confirm the geological profiles outlined by the GSI mapping and datasets.

There is a risk of water ingress during excavation for the footings within the granular deposits at the site. As such, provisions should be made for sump pumping should water ingress occur.

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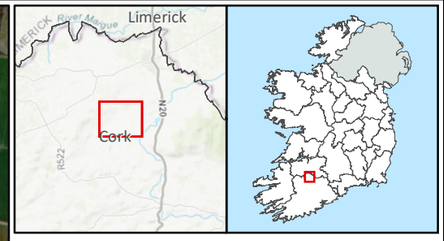

Legend

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

Roads

- New
- Upgrade

TITLE: Wind Farm Site Layout			
PROJECT: Annagh Wind Farm, Co. Cork			
FIGURE NO:	1.1		
CLIENT:	EMPower		
SCALE:	1:12500	**REVISION:**	0
DATE:	14/10/2021	**PAGE SIZE:**	A3

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N W E S

0.5 0.25 0 0.5 Kilometers

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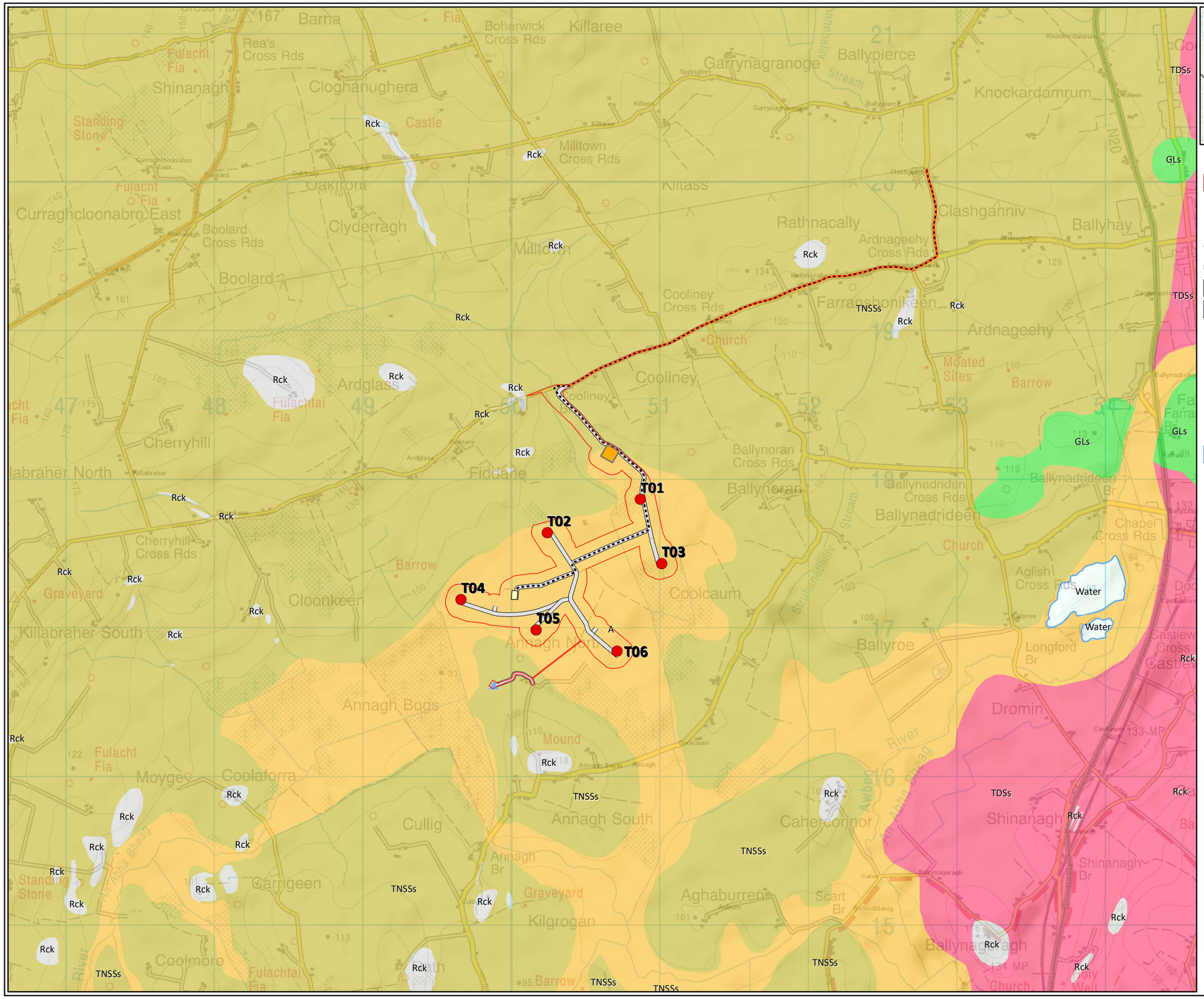

Legend

- Site Boundary
- Met Mast
- Turbine Layout
- Underground Cable Route
- Site Internal Roads
- Substation
- Construction Compound

Quaternary Sediments

- A, Alluvium
- GLs, Gravels derived from Limestones
- Rck, Bedrock outcrop or subcrop
- TDSs, Till derived from Devonian sandstones
- TNSSs, Till derived from Namurian sandstones and shales
- Water

Kilometers
0 0.5 1 2

TITLE:	Quaternary Geology		
PROJECT:	Annagh Wind Farm, Co. Cork		
FIGURE NO:	2.1		
CLIENT:	EMPower		
SCALE:	1:25000	**REVISION:**	0
DATE:	15/10/2021	**PAGE SIZE:**	A3

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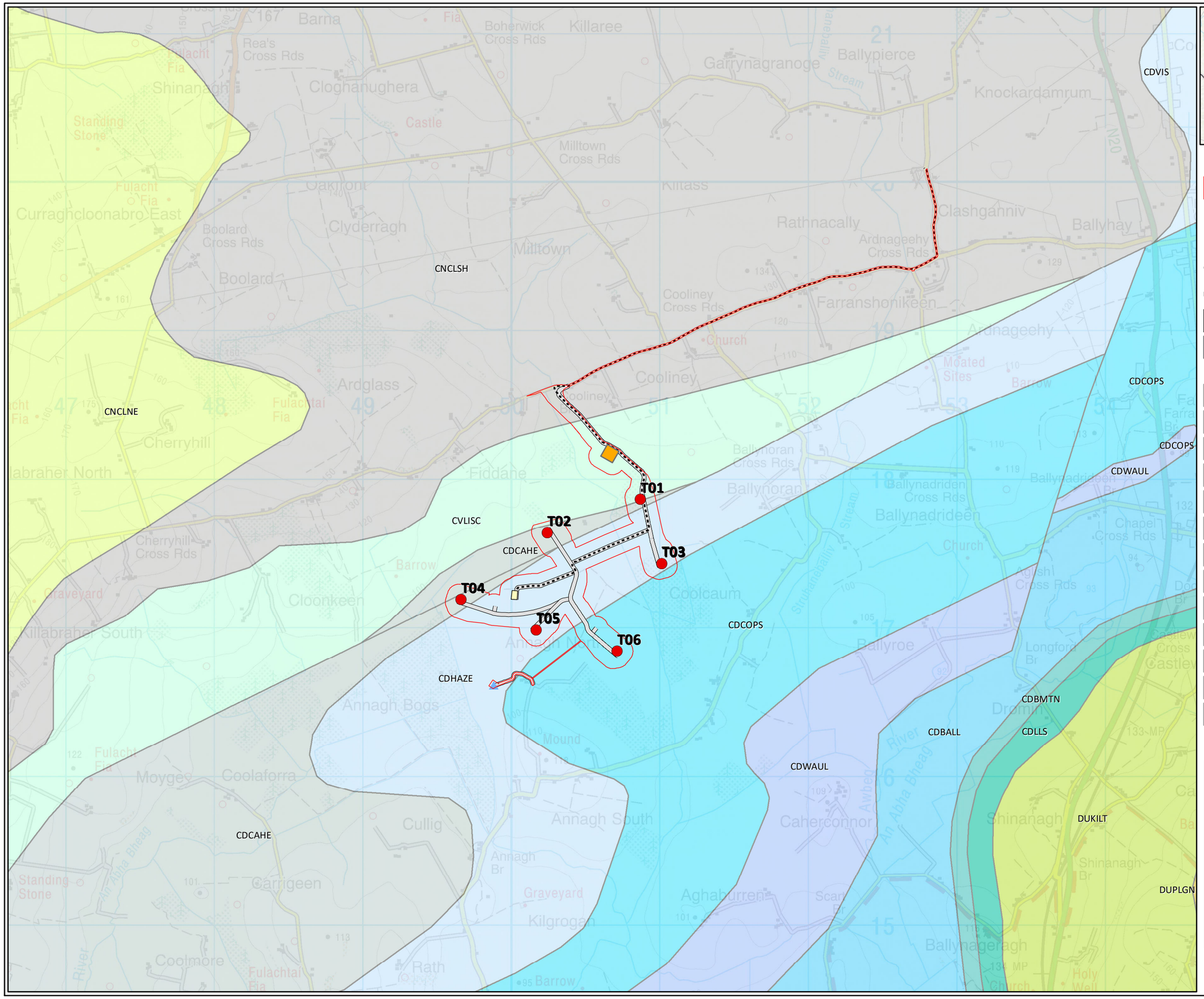

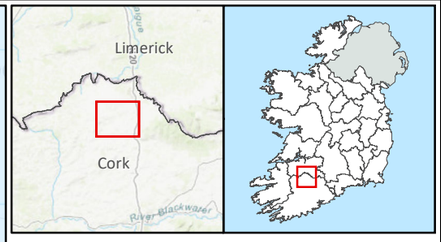

Legend

- Site Boundary
- Turbine Layout
- Met Mast
- Underground Cable Route
- Site Internal Roads
- Substation
- Construction Compound

Bedrock Geology

- Ballysteen Formation
- Ballymartin Formation
- Caherduggan Limestone Formation
- Copstown Limestone Formation
- Hazelwood Limestone Formation
- Lower Limestone Shale
- Visean Limestones (undifferentiated
- Waulsortian Limestones
- Cloone Flagstone Formation
- Clare Shale Formation
- Liscarroll Limestone Formation
- Kiltorcan Formation
- Poulgrania Sandstone Formation

TITLE:	Bedrock Geology		
PROJECT:	Annagh Wind Farm, Co. Cork		
FIGURE NO:	2.2		
CLIENT:	EMPower		
SCALE:	1:25000	**REVISION:**	0
DATE:	15/10/2021	**PAGE SIZE:**	A3

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N W E S

0 0.5 1 2 Kilometers

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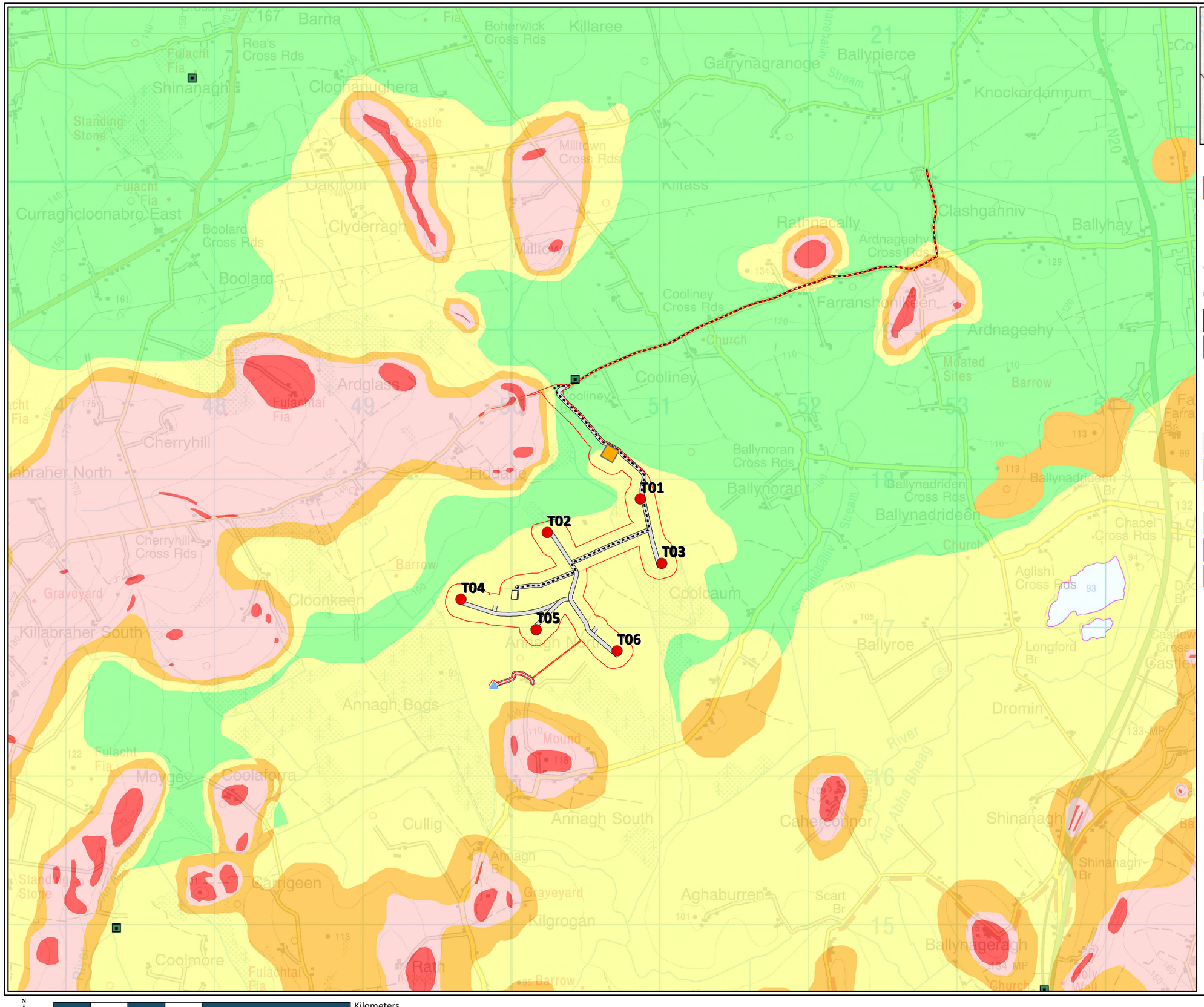

Legend

- Site Boundary
- Turbine Layout
- Met Mast
- Underground Cable Route
- Site Internal Roads
- Substation
- Construction Compound

Karst Features

- Spring

Groundwater Vulnerability

- E - Extreme
- H - High
- M - Moderate
- L - Low
- Water
- X - Rock Near Surface or Karst

TITLE:	Groundwater Vulnerability		
PROJECT:	Annagh Wind Farm, Co. Cork		
FIGURE NO:	2.3		
CLIENT:	EMPower		
SCALE:	1:25000	**REVISION:**	0
DATE:	15/10/2021	**PAGE SIZE:**	A3

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APPENDIX A

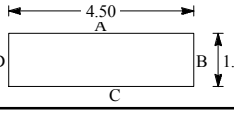
Ground Investigation Trial Pit Logs

PROJECT: Annagh Wind Farm	**TRIALPIT: TP-01**
LOCATION: Co Cork	**Sheet 1 of 1**
CLIENT: EM Power	**Co-ordinates:**
ENGINEER: Fehily Timoney & Co	**E 550,699.0 N 618,007.0**
	Rig: Hyundai 145LCR-9
	Rev: DRAFT
Ground level: m O.D.	**DATE: 10.3.21**

GROUNDWATER

Water strikes: Rose to after:
1st: 1.60m
2nd:
3rd:

PIT DIRECTION: 090-270
PIT DIMENSION: 1.20 * 4.50m
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit unstable. Sidewall collapse from 1.50m to 3.20m bgl.

Depth (m)	Date	Water	Samples	Depth (m)	In-situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION
0								0.30	TOPSOIL: Grass over stiff brown CLAY with rootlets.
								0.60	Stiff greyish brown mottled orange sandy SILT. Sand is corse.
			B 1 D 2 VANE	0.70-0.90 0.70-0.90 0.75	19mm vane 89 kN/m²			1.00	Stiff orangish brown mottled grey slightly gravelly SILT. Gravel is subangular to subrounded fine to coarse.
1								1.50	Firm orangish brown slightly sandy slightly gravelly SILT. Gravel is subrounded to rounded fine to coarse.
		▼1	B 3	1.60-1.80				3.20	Grey slightly sandy subangular to subrounded fine to coarse GRAVEL with high cobble content. Cobbles are subangular to subrounded. Increase of cobbles with depth.
2									
3									
			B 4 D 5	3.40-3.60 3.40-3.80				4.25	Stiff brown slightly gravelly SILT. Gravel is angular to subrounded fine to medium.
4						END			TP terminated at 4.25m bgl on REs instruction.
5									

Remarks: Ingress of water at 1.60m bgl. TP backfilled with arisings.

Scale: 1:25

irish drilling

Ph.
Fax

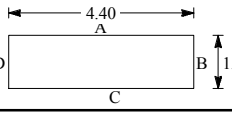
TRIAL PIT VANE & WL RISES ANNAGH WF TPS FILE 1 APRIL 8 2021.GPJ IRISHDRL.GDT 8/4/21

PROJECT: Annagh Wind Farm	**TRIALPIT: TP-02**
LOCATION: Co Cork	**Sheet 1 of 1**
CLIENT: EM Power	**Co-ordinates:**
ENGINEER: Fehily Timoney & Co	**E 550,199.0 N 617,819.0**
Rig: Hyundai 145LCR-9	
Rev: DRAFT	
Ground level: m O.D.	**DATE: 10.3.21**

GROUNDWATER

Water strikes: **Rose to after:**
1st: 1.55m
2nd:
3rd:

PIT DIRECTION: 000-180
PIT DIMENSION: 1.20 * 4.40m
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit unstable. Sidewall collapse from g/l.

Depth (m)	Date	Water	Samples	Depth (m)	In-situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION
0								0.20	TOPSOIL: Grass over firm greyish brown gravelly SILT. Gravel is subrounded medium.
			B 1 D 2 VANE	0.40-0.60 0.40-0.60 0.55	19mm vane 139 kN/m			0.60	Stiff grey slightly gravelly SILT with high cobble content. Gravel is subrounded to rounded fine to coarse. Cobbles are subrounded.
1			B 3	1.00-1.20				1.55	Grey coarse SAND and subrounded to rounded fine to coarse GRAVEL with high cobble content. Cobbles are subrounded.
2								2.60	Orangish brown sandy subrounded to rounded fine to coarse GRAVEL with high cobble content. Cobbles are subrounded.
								2.80	Brown slightly silty fine SAND.
3			B 4 D 5	2.80-3.00 2.80-3.00				3.10	Brown sandy SILT. Sand is fine.
									END TP terminated at 3.10m bgl. Unable to keep TP open - sidewall collapse.
4									
5									

Remarks: Ingress of water at 1.55m bgl. TP backfilled with arisings.

Scale: 1:25

irish drilling

Ph.
Fax

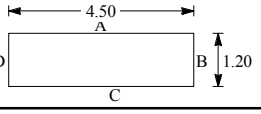
TRIAL PIT VANE & WL RISES ANNAGH WF TPS FILE 1 APRIL 8 2021.GPJ IRISHDRL.GDT 8/4/21

PROJECT: Annagh Wind Farm	**TRIALPIT: TP-03**
LOCATION: Co Cork	**Sheet 1 of 1**
CLIENT: EM Power	**Co-ordinates:**
ENGINEER: Fehily Timoney & Co	**E 550,923.0 N 617,564.0**
Rig: Hyundai 145LCR-9	
Rev: DRAFT	
Ground level: m O.D.	**DATE: 11.3.21**

GROUNDWATER

Water strikes: **Rose to after:**
1st: 1.20m
2nd:
3rd:

PIT DIRECTION: 090-270
PIT DIMENSION: 1.20 * 4.50m
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit moderately stable.

Depth (m)	Date	Water	Samples	Depth (m)	In-situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION
0								0.20	TOPSOIL: Grass over soft brown organic SILT.
								0.35	Stiff light brown SILT with rootlets.
			B 1 D 2 VANE	0.50-0.70 0.50-0.70 0.70	19mm vane 119 kN/m²			0.90	Stiff light grey mottled orangish brown SILT with rootlets.
1		1	B 3	1.30-1.50				1.80	Grey slightly silty SAND and subrounded to rounded fine to coarse GRAVEL.
2			B 4 D 5	2.50-2.70 2.50-2.70				4.50	Stiff brown slightly gravelly SILT with low cobble content. Gravel is subrounded fine.
3						END			TP terminated at 4.50m bgl on REs instruction.
4									
5									

Remarks: Seepage of water at 1.20m bgl. TP backfilled with arisings.

Scale: 1:25

irish drilling

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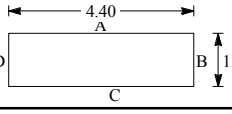
TRIAL PIT VANE & WL RISES ANNAGH WF TPS FILE 1 APRIL 8 2021.GPJ IRISHDRL.GDT 8/4/21

PROJECT: Annagh Wind Farm	**TRIALPIT: TP-05**
LOCATION: Co Cork	**Sheet 1 of 1**
CLIENT: EM Power	**Co-ordinates:**
ENGINEER: Fehily Timoney & Co	**E 550,243.0 N 617,155.0**
Rig: Hyundai 145LCR-9	
Rev: DRAFT	
Ground level: m O.D.	**DATE: 11.3.21**

GROUNDWATER

Water strikes: Rose to after:
1st: 2.80m
2nd:
3rd:

PIT DIRECTION: 090-270
PIT DIMENSION: 1.20 * 4.40m
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit unstable. Sidewall collapse.

Depth (m)	Date	Water	Samples	Depth (m)	In-situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION
0								0.20	TOPSOIL: Grass over firm brown CLAY.
								0.60	Stiff orangish brown slightly sandy SILT with low cobble content.
			B 1 D 2 VANE	0.60-0.80 0.60-0.80 0.75	19mm vane 101 kN/m²			0.90	Stiff grey SILT.
1								1.50	Firm orangish brown sandy gravelly SILT. Gravel is subangular to rounded fine to coarse.
			B 3	1.50-1.70				1.90	Grey sandy subangular to subrounded fine to coarse GRAVEL.
2								3.50	Stiff grey SILT with low cobble content. Cobbles are subrounded.
			B 4 D 5	2.60-2.80 2.60-2.80					
3		▼1				END			TP terminated at 3.50m bgl. Unable to keep TP open - sidewall collapse.
4									
5									

Remarks: Seepage of water at 2.80m bgl. TP backfilled with arisings.

Scale: 1:25

irish drilling

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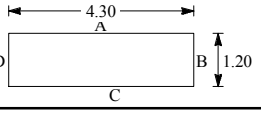
TRIAL PIT VANE & WL RISES ANNAGH WF TPS FILE 1 APRIL 8 2021.GPJ IRISHDRL.GDT 8/4/21

PROJECT: Annagh Wind Farm	**TRIALPIT: TP-06**
LOCATION: Co Cork	**Sheet 1 of 1**
CLIENT: EM Power	**Co-ordinates:**
ENGINEER: Fehily Timoney & Co	**E 550,450.0 N 616,806.0**
Rig: Hyundai 145LCR-9	
Rev: DRAFT	
Ground level: m O.D.	**DATE: 11.3.21**

GROUNDWATER

Water strikes: Rose to after:
1st: 1.20m
2nd:
3rd:

PIT DIRECTION: 000-180
PIT DIMENSION: 1.20 * 4.30m
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit stable.

Depth (m)	Date	Water	Samples	Depth (m)	In-situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION
0								0.20	TOPSOIL: Grass over firm brown SILT.
								0.40	Stiff grey SILT.
			B 1 D 2	0.50-0.70 0.50-0.70					Stiff orangish brown and grey CLAY.
			VANE	0.80	19mm vane 114 kN/m²				
1		▼1						1.20	
			B 3 B 4	1.40-1.60 1.40-1.60					Stiff orangish brown mottled grey slightly gravelly CLAY with high cobble content. Gravel is subrounded medium to coarse. Cobbles are subangular to rounded.
2								2.10	
								2.35	Brown silty fine SAND.
									Stiff light brown slightly sandy gravelly SILT with high cobble content and low boulder content. Gravel is subrounded to rounded fine to coarse. Cobbles are subrounded. Boulders are angular of limestone.
3			D 5	3.40-3.60					
4								4.50	
						END			TP terminated at 4.50m bgl on REs instruction.
5									

Remarks: Seepage of water at 1.20m bgl. TP backfilled with arisings.

Scale: 1:25

irish drilling

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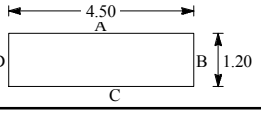
TRIAL PIT VANE & WL RISES ANNAGH WF TPS FILE 1 APRIL 8 2021.GPJ IRISHDRL.GDT 8/4/21

PROJECT: Annagh Wind Farm	**TRIALPIT: TP-ADD2**
LOCATION: Co Cork	**Sheet 1 of 1**
CLIENT: EM Power	**Co-ordinates:** **Rig: Hyundai 145LCR-9**
ENGINEER: Fehily Timoney & Co	**E 550,437.0 N 618,469.0** **Rev: DRAFT**
Ground level: m O.D.	**DATE: 10.3.21**

GROUNDWATER

Water strikes: Rose to after:
1st: 0.00m
2nd:
3rd:

PIT DIRECTION: 000-180
PIT DIMENSION: 1.20 * 4.50m
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit stable.

Depth (m)	Date	Water	Samples	Depth (m)	In-situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION
0								0.30	TOPSOIL: Grass over firm brown sandy SILT.
			B 1 D 2	0.50-0.70 0.50-0.70				0.70	Stiff orangish brown slightly sandy CLAY.
			VANE	0.70	19mm vane 150 kN/m²			1.80	Stiff orange and grey slightly sandy slighty gravelly SILT with low cobble content. Gravel is angular to rounded fine to coarse. Cobbles are subangular to rounded.
1			B 3 D 4	1.20-1.40 1.20-1.40					
2			B 5	2.20-2.40				4.30	Stiff greenish grey slightly gravelly SILT with medium cobble content and low boulder content. Gravel is subangular to subrounded fine to coarse. Cobbles are angular to rounded. Boulders are subrounded of limestone. Boulders are up to 450mm in length. Increase in boulder content with depth. Hard digging.
3									
4			B 6	3.80-4.00					
						END			TP terminated at 4.30m bgl on REs instruction.
5									

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:25

irish drilling

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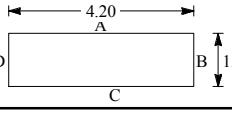
TRIAL PIT VANE & WL RISES ANNAGH WF TPS FILE 1 APRIL 8 2021.GPJ IRISHDRL.GDT 8/4/21

PROJECT: Annagh Wind Farm	**TRIALPIT: TP-CC**
LOCATION: Co Cork	**Sheet 1 of 1**
CLIENT: EM Power	**Co-ordinates:**
ENGINEER: Fehily Timoney & Co	**E 550,608.0 N 618,253.0**
Rig: Hyundai 145LCR-9	
Rev: DRAFT	
Ground level: m O.D.	**DATE: 10.3.21**

GROUNDWATER

Water strikes: Rose to after:
1st: 0.50m
2nd:
3rd:

PIT DIRECTION: 000-180
PIT DIMENSION: 1.20 * 4.20m
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit unstable. Sidewall collapse from g/l.

Depth (m)	Date	Water	Samples	Depth (m)	In-situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION
0								0.20	TOPSOIL: Grass over firm brown SILT.
								0.40	Stiff grey mottled orange SILT with rootlets.
		▼1	VANE B 1 D 2	0.60 0.60-0.80 0.60-0.80	19mm vane 116 kN/m²			0.85	Stiff orangish brown slightly gravelly SILT. Gravel is angular to rounded fine to coarse.
1			B 3	0.90-1.10				2.40	Grey gravelly medium to coarse SAND with medium cobble content. Gravel is subrounded to rounded fine to coarse. Cobbles are subrounded. 1.60m: with high cobble content.
2			B 4 D 5	2.60-2.80 2.60-2.80				4.20	Stiff brown slightly gravelly SILT. Gravel is angular fine. 3.20m: with medium cobble content. Cobbles are subrounded.
3			B 6	3.80-4.00					
4									
									END TP terminated at 4.20m bgl. Unable to keep TP open - sidewall collapse.
5									

Remarks: Ingress of water at 2.10m bgl. TP backfilled with arisings.

Scale: 1:25

irish drilling

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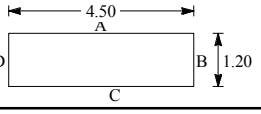
TRIAL PIT VANE & WL RISES ANNAGH WF TPS FILE 1 APRIL 8 2021.GPJ IRISHDRL.GDT 8/4/21

PROJECT: Annagh Wind Farm		**TRIALPIT: TP-SS**
LOCATION: Co Cork		**Sheet 1 of 1**
CLIENT: EM Power	**Co-ordinates:**	**Rig: Hyundai 145LCR-9**
ENGINEER: Fehily Timoney & Co	**E 550,299.0 N 616,660.0**	**Rev: DRAFT**
Ground level: m O.D.		**DATE: 11.3.21**

GROUNDWATER

Water strikes: **Rose to after:**
1st: 1.30m
2nd:
3rd:

PIT DIRECTION: 000-180
PIT DIMENSION: 1.20 * 4.50m
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit moderately stable.

Depth (m)	Date	Water	Samples	Depth (m)	In-situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION
0								0.35	TOPSOIL: Grass over firm dark brown organic SILT.
			VANE B 1 D 2 VANE	0.60 0.60-0.80 0.60-0.80 0.80	19mm vane 37 kN/m² 19mm vane 73 kN/m²			0.90	Soft bluish grey organic SILT. 0.80m: firm.
1		1						1.30	Firm grey sandy SILT. Sand is fine.
								1.50	Grey gravelly medium to coarse SAND. Gravel is subangular to subrounded fine to coarse.
			B 3 B 4	1.60-1.80 1.60-1.80					Stiff brown slightly gravelly SILT. Gravel is subangular fine.
2									2.00m: with medium cobble content. Cobbles are subrounded.
									2.60m: with high cobble content. Cobbles are subrounded.
3			D 5	3.20-3.50					
4								4.50	
						END			TP terminated at 4.50m bgl on REs instruction.
5									

Remarks: Ingress of water at 1.30m bgl. TP backfilled with arisings.

Scale: 1:25

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CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX 10.1

Photographs of Existing Hydrological Features

PHOTOGRAPHIC LOG	Consultants in Engineering and Environmental Sciences FEHILY TIMONEY

Client Name: EMPOWER	**Site Location:** Annagh, Co. Cork	**Project Number:** P2359

Hydrology feature:
Field drain

Description:

Access road towards the proposed turbine T4 and T5 will cross drain.

During the site visits this drain was completely dry. Drain is approximately 0.6m wide and 0.8m deep.

Hydrology features are marked as WF-HF12 and WF-HF15.

Please refer to Figure 10-5 of the main EIAR for location of the crossing points.

Hydrology feature:
The Oakfront Stream

Description:

The Oakfront Stream just west of the northern site entrance.

The Oakfront Stream is between 3m and 6m wide and 0.8 to 1.5m deep along the reach.

No heavy vegetations were identified along the stream.

PHOTOGRAPHIC LOG	Consultants in Engineering and Environmental Sciences FEHILY TIMONEY

Client Name: EMPOWER	**Site Location:** Annagh, Co. Cork	**Project Number:** P2359

Hydrology feature:
WF-HF5

Description:

It is proposed to construct a single span bridge over the Oakfront Stream.

Bank to bank width: 4.5m
Western bank heigh: 1.8m
Eastern bank height: 1.7m

PHOTOGRAPHIC LOG	Consultants in Engineering and Environmental Sciences FEHILY TIMONEY

Client Name: EMPOWER	**Site Location:** Annagh, Co. Cork	**Project Number:** P2359

Hydrology feature:
WF-HF14

Description:

Drainage district channel which runs in west-east direction south of the proposed turbine T4 and T5.

The proposed development will not interact with this drain.

PHOTOGRAPHIC LOG	Consultants in Engineering and Environmental Sciences FEHILY TIMONEY

Client Name: EMPOWER	**Site Location:** Annagh, Co. Cork	**Project Number:** P2359

Hydrology feature:
WF-HF16

Description:

Arch bridge over the Oakfront Stream.

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX 10.2

Flood Risk Assessment

FEHILY TIMONEY
30 YEARS

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

ANNAGH WIND FARM, CO. CORK

PRELIMINARY FLOOD RISK ASSESSMENT

Prepared for: EMPower Ltd.

EMPower

Date: October 2021

Core House, Pouladuff Road
Cork, T12 D773, Ireland

T: +353 1 496 4133 | E: info@ftco.ie

CORK | DUBLIN | CARLOW

www.fehilytimoney.ie

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1. INTRODUCTION

1.1 Introduction

Preliminary Flood risk assessment is prepared as a part of the EIAR for the proposed wind farm development at Annagh, Co. Cork.

This report addresses the extent of the catchment which has the potential to be impacted upon by the development. The history of flooding in the existing environment, along with any potential increase in the risk of flooding due to the development.

Under the Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHLG & OPW, 2009) the proposed development must undergo a Flood Risk Assessment to ensure sustainability and effective management of flood risk.

1.2 Objectives

This study is being completed to inform the future development of the site as it relates to flood risk. It aims to identify, quantify and communicate to Planning Authority officials and other stakeholders the risk of flooding to land, property and people and the measures that would be recommended to manage the risk.

The objective of this FRA

- Identify potential sources of flood risk,
- Confirm the level of flood risk and identify key hydraulic features,
- Assess the impact that the proposed development has on flood risk,
- Develop appropriate flood risk mitigation and management measures which will allow for the long-term development of the site.
- A review of the likely effects of climate change, and the long-term impacts this may have.

1.3 Proposed Development

The proposed project will primarily consist of a wind farm of up to 6 no. wind turbine generators (WTG's), 1 no. permanent meteorological masts (PMM's), and 1 no. substation compound along with ancillary civil and electrical infrastructure. The project also includes underground cabling within the site and along the public road.

Detailed description of the proposed development is provided in Chapter 3 of the EIAR.

The proposed wind farm layout is shown on Figure 3.2 of the EIAR.

1.4 Report Structure

Section 2 of this report gives an overview of the study location and associated watercourses. Section 3 provides general information on flooding, the definition of flood risk, flood zones.

Section 4 contains background information and identifies the flood risk. Flood risk assessment is demonstrated in Sections 5 and 6. Conclusion is provided in Section 7.

2. DESCRIPTION OF THE SITE

This section describes the proposed wind farm development site including watercourses, geology and wider geographical area.

2.1 Existing Environment

The wind farm site is situated within Awbeg (Buttevant)_SC_010 sub-catchment as defined by the WFD and shown on Figure 10 2 of the EIAR. This sub-catchment is part of the Blackwater Munster (ID 18) catchment.

The main hydrology features within the wind farm site are the Ardglass Stream and Oakfront Stream which drain into the River Awbeg (Buttevant) West approximately 1.3km downstream of the site. This river is part of the Blackwater River (Cork/Waterford) SAC. The vast majority of the site drains into the Oakfront Stream due to handmade field and forestry drain. During the site visit agricultural and forestry drains were identified.

The average annual rainfall in period 1981-2010 in the area of the wind farm site is 1,002 mm. M5-60 at development location is 16.9 mm according to the Met Éireann rainfall data. This is the predicted rainfall depth in a sixty minute storm with an annual exceedance probability of 20%.

Utilising the OPW Flood Studies Update web portal, the catchment area of the Oakfront River was delineated. The total catchment area of the Oakfront Stream is approximately 11.6 km^2 to the downstream boundary of the proposed site. Assessment of the existing upstream catchment area indicates a rural catchment area, with no significant urban development within the catchment area.

Figure 2-1: Site Location

2.2 Site Topography

Figure 2-2 shows 1m contour map. The site is relatively flat. The elevations range between 102mOD at the northern part of the site to 94m OD at the south-western part. There are no significant low points within the site.

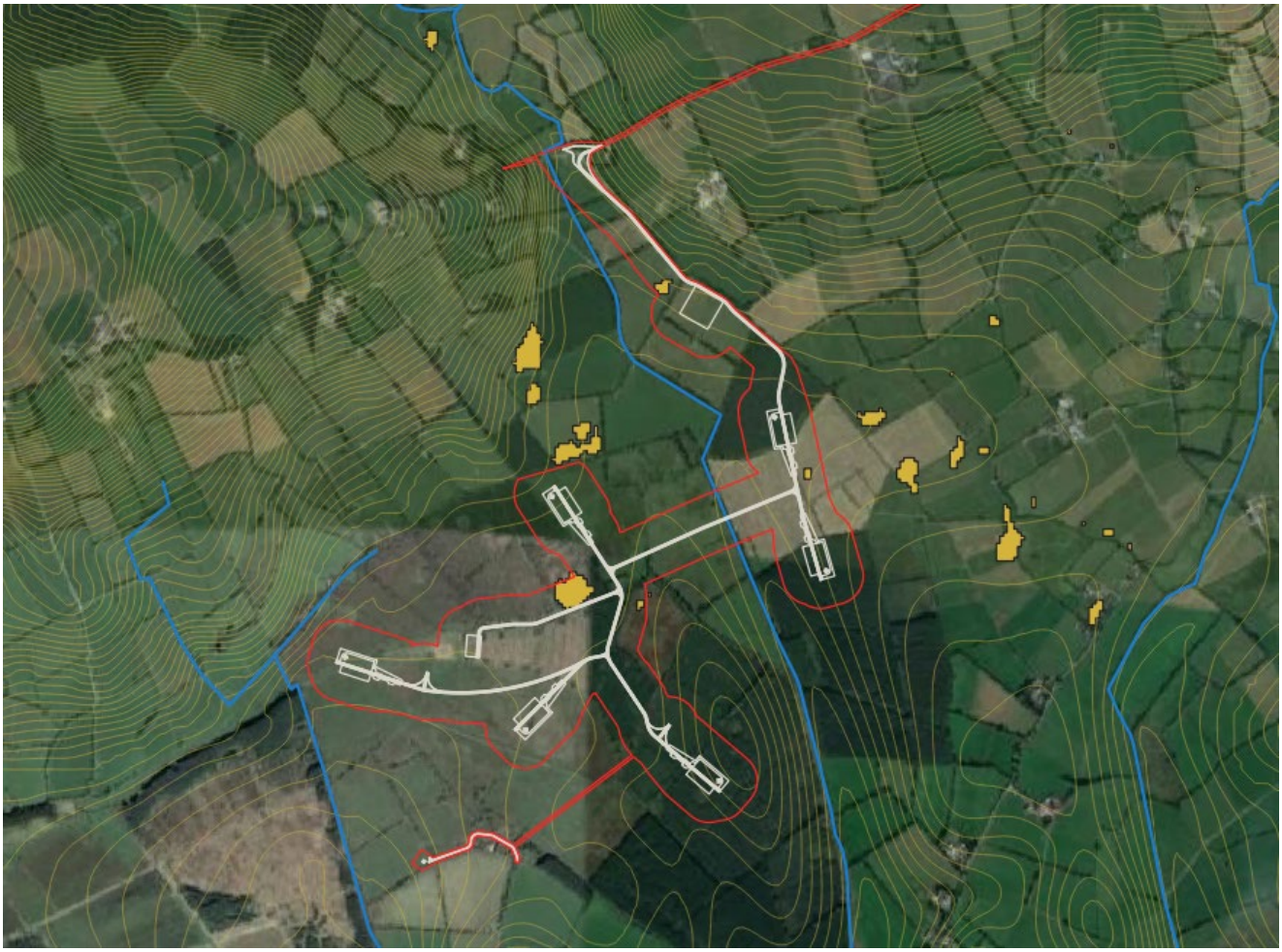


Figure 2-2: Topography Data

2.3 Site Geology

The Geological Survey of Ireland (GSI) groundwater and geological data viewer was consulted to review the sites and local area. The bedrock underlaying the site is Hazelwood Limestones and Copstown Limestone Formation which is described as Pale grey massive mud grade limestone and dark-grey well-bedded muddy limestone.

The predominant subsoils at the proposed site are Alluvium and Till derived from Namurian sandstones and shales.

The soil permeability for the sites is classified mostly as moderate suggesting the land is reasonably well drained as shown on Figure 2-3.

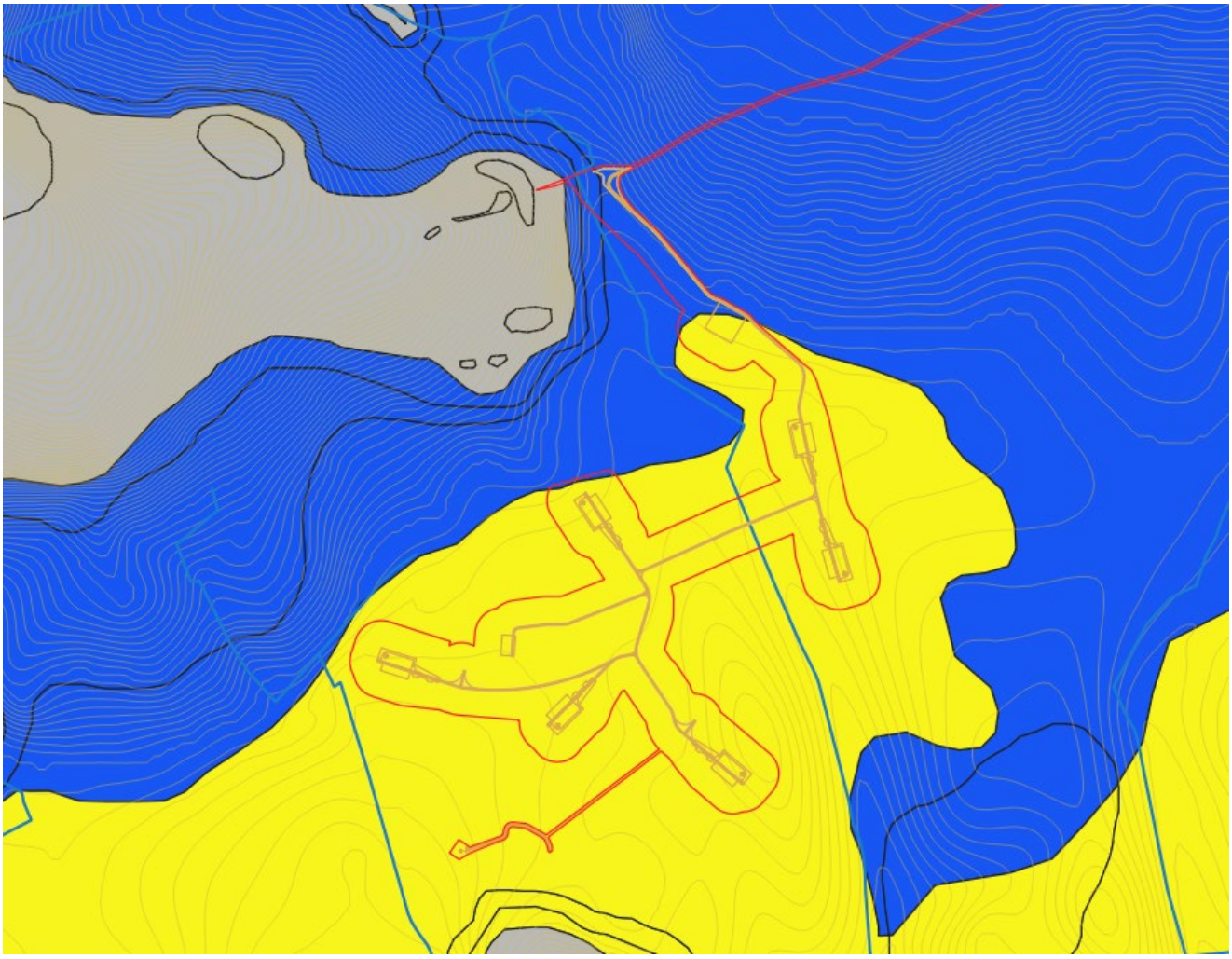


Figure 2-3: Subsoil Permeability

3. FLOOD RISK ASSESSMENT METHODOLOGY

The FRA Guidelines and its Technical Appendices outline the requirements for a Site-Specific Flood Risk Assessment. The FRA Guideline requires to:

- Avoid development in areas at risk of flooding,
- substitute less vulnerable uses, where avoidance s not possible, and
- mitigate and manage the risk, where avoidance and substitution are not possible.

The key principles of the FRA Guidelines are to apply the **Sequential Approach** to the planning process. Figure 3-1 of this report describes the mechanism of the sequential approach for use in the planning process.

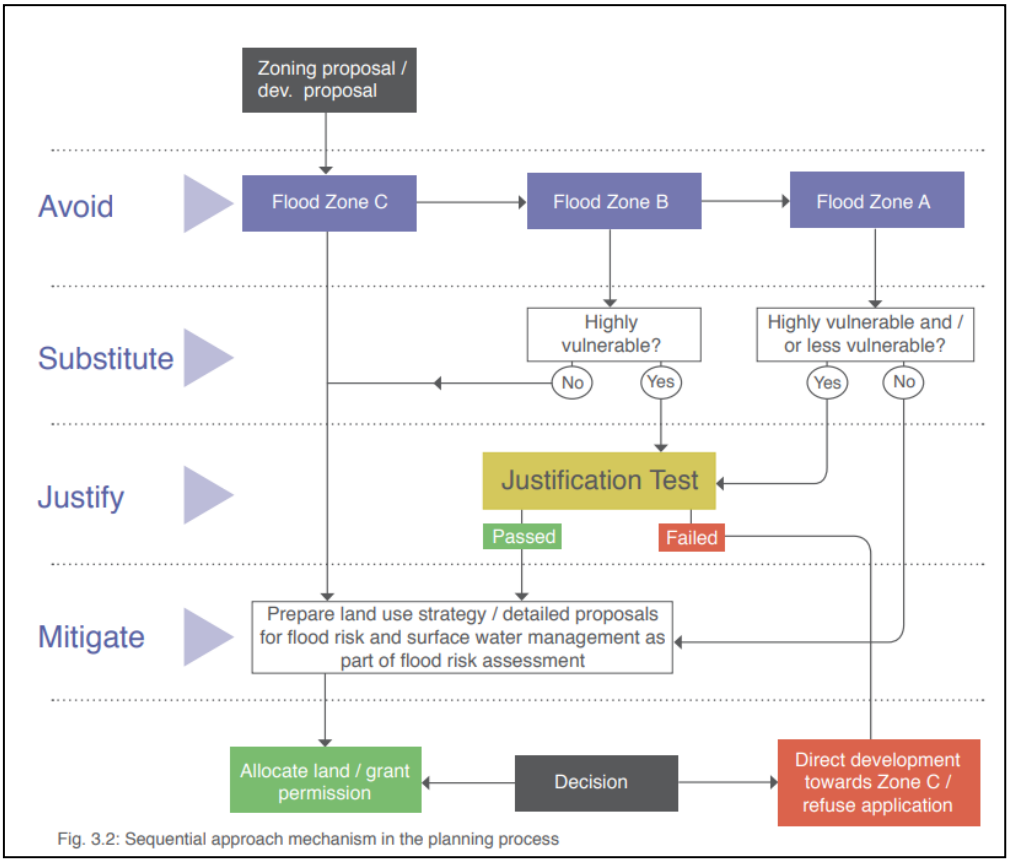


Figure 3-1: Sequential Approach Mechanism[1]

[1] Figure 3.2 of the FRA Guidelines

3.1 Source-Pathway-Receptor Model

The assessment of flood risk requires a thorough understanding of the sources of flood water (e.g. high sea levels, intense or prolonged rainfall leading to runoff and increased flow in rivers and sewers), the pathways by which the flood water reaches those receptors (e.g. river channels, river and coastal floodplains, drains, sewers and overland flow) and the people and assets affected by flooding (known as the receptors).

The Source-Pathway-Receptor (S-P-R) Model has become widely used to assess and inform the management of environmental risks. This is illustrated in Figure 3-2.

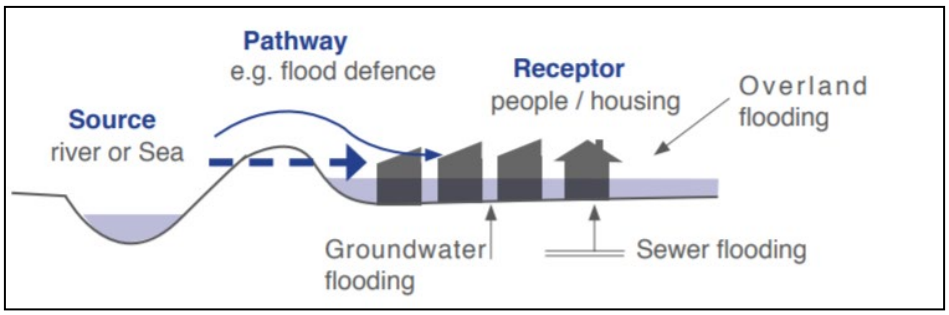


Figure 3-2: Source-Pathway- Receptor Model[2]

3.2 Likelihood of Flooding and Definition of Flood Zones

The FRA Guidelines define the likelihood of flooding as the percentage probability of a flood of a given magnitude occurring or being exceeded in any given year. The general misconception is that 1 in 100 year event will occur only once in 100 years. Likelihood of flooding is expressed as a return period or annual exceedance probability (AEP).

Flood Zones are graphical areas within which the likelihood of flooding is in a particular range. They are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning. These flood zones are split into three categories in the FRA Guidelines.

- **Flood Zone A** – where the probability of flooding from rivers and the sea is high (greater than 1% AEP for river flooding or 0.5% AEP for coastal flooding);
- **Flood Zone B** – where the probability of flooding from rivers and the sea is moderate (between 0.1% AEP and 1% AEP for river flooding and between 0.1% AEP and 0.5% AEP for coastal flooding); and
- **Flood Zone C** – where the probability of flooding from rivers and the sea is low (less than 0.1% AEP for both river and coastal flooding).

[2] Source: Fig2.2 Appendix A of the FRA Guidelines

3.3 Classification of the Proposed Development and Justification Test

The FRA Guidelines categorises all types of development as either:

- Highly Vulnerable (garda, ambulances, schools, hospitals, dwelling houses, student halls…)
- Less Vulnerable (buildings used for: retail leisure, warehousing, commercial, industrial, and non-residential institutions,…)
- Water Compatible (flood control infrastructure, docks, marinas, amenity open spaces,...)

Full list of types of development and related vulnerability class is provided in Table 3.1 of the FRA Guidelines. Uses which are not listed in the table should be considered on their own merits.

The Sequential Approach restricts development types to occur within the flood zone appropriate to their vulnerability class. Table 3-1 identifies the types of development that would be appropriate for each flood zone and those that would be required to meet the Justification Test.

Table 3-1: Matrix of Vulnerability Versus Flood Zone[1]

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

The Justification Test has been prepared to rigorously assess the appropriateness of developments that are being considered in areas of moderate or high flood risk. The test comprised the following two processes:

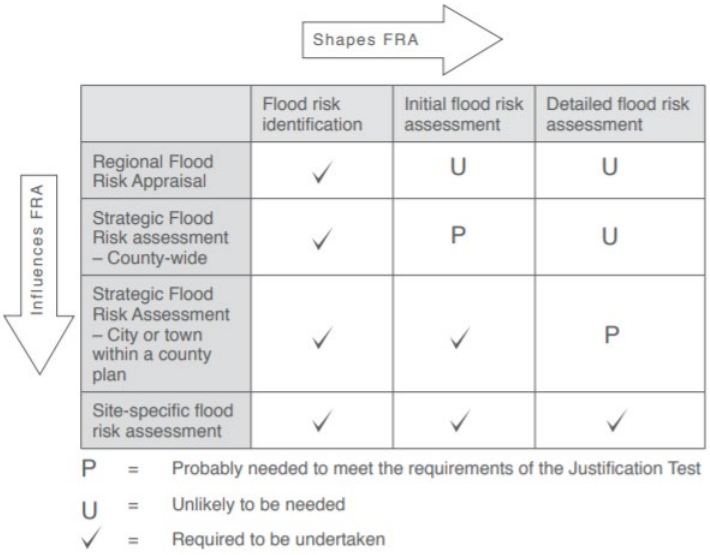
- The first is the Plan-making Justification Test and is used at the plan preparation and adoption stage where it is intended to zone or otherwise designate land which is at moderate or high risk of flooding.
- The second is the Development Management Justification Test and is used at the planning application 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.

3.4 Flood Risk Assessment Stages

The FRA Guidelines outline that a staged approach should be adopted when carrying out an FRA. These stages are:

- Stage 1 Flood Risk Identification,
- Stage 2 Initial Flood Risk Assessment,
- Stage 3 Detailed Flood Risk Assessment.

A SSFRA comprises of Stages 1, 2 and 3 according to the Figure 3-3:



	Flood risk identification	Initial flood risk assessment	Detailed flood risk assessment
Regional Flood Risk Appraisal	✓	U	U
Strategic Flood Risk assessment – County-wide	✓	P	U
Strategic Flood Risk Assessment – City or town within a county plan	✓	✓	P
Site-specific flood risk assessment	✓	✓	✓

P = Probably needed to meet the requirements of the Justification Test
U = Unlikely to be needed
✓ = Required to be undertaken

Figure 3-3: Flood risk assessment stages required per scale of study undertaken[3]

Stage 1: Flood risk identification – to identify whether there may be any flooding or surface water management issues relating to the proposed development site that may warrant further investigations. Flood risk identification stage uses existing information to identify whether there may be any flooding or surface water management issues related to the site. Flood risks identified in this stage are then addressed in Stage 2.

Stage 2: Initial flood risk assessment – to confirm sources of flooding that may affect the development site, to appraise the adequacy of existing information and to determine what surveys and modelling approach is appropriate to match the spatial resolution required and complexity of the flood risk issues. This stage involves the review of data addressed in Stage 1. Data where the flood risk at the site is recognized as being low is screened out and it is not further addressed, data which recognized the flood risk on the site to be medium or high is further analyzed.

Stage 3: Detailed flood risk assessment – to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development, of its potential impacts on flood risk elsewhere and of the effectiveness of any proposed mitigation measures. This will typically involve use of an existing or construction of a hydraulic model across a wide enough area to appreciate the catchment wide impacts and hydrological process involved.

[3] Source: Appendix A of FRA Guidelines, Table A3.

4. FLOOD RISK IDENTIFICATION

This section provides information whether there may be any flooding or surface water management issues relating to the proposed development site that may warrant further investigations. Flood risk identification uses existing and recorded information to identify whether there may be any flooding or surface water management issues related to the site.

4.1 Fluvial flooding

4.1.1 PFRA Maps

The Preliminary flood risk assessment (PFRA) is a national screening exercise undertaken in 2011 by the OPW to identify area of a potential flood risk. The country was divided into 420 no. map tiles for purposes of disseminating the output of the PFRA. These maps indicate the extent of the predicted 1% AEP (annual exceedance probability) fluvial and pluvial flooding.

The Oakfront Stream floods within the site boundary for 1% AEP (Flood Zone A) storm event as shown on Figure 4-1.

It must be noted that indicated extent of flooding illustrated on these maps was developed using a low resolution digital terrain model and illustrated flood extents are intended to be indicative only. The flood extents mapped on the PFRA maps are not intended to be used on a site specific basis.

4.1.2 CFRAM Study

The preliminary flood risk assessment completed in 2011 identified areas that need further assessment, or AFA (Area for Further Assessment), to determine their risk of flooding. This further detailed assessment has been completed as part of the CFRAM Study. The maps are in effect an updated version of PFRA Maps produced in 2011.

The subject site is within UoM River Basin 18, Blackwater (Munster).

The proposed development site is located in an area that was not included in CFRAM Study.

4.1.3 Local Area Plan 2017

In accordance with best practice, Cork CC has arranged for the preparation of indicative flood risk mapping on a county wide basis. The indicative mapping is being made available as a resource, only to be used to identify potential flood risks at an early stage.

The subject site is within Flood Zone A and B as shown on Figure 4-2.

4.1.4 Benefiting Lands

The proposed planning boundary is within a 'Drainage Districts'. Drainage districts are described by the OPW as lands that might benefit from the implementation of arterial (major) drainage schemes and areas that may subject to flooding or poor drainage.

Local authorities are charged with responsibility to maintain Drainage Districts.

Figure 4-1: PFRA Maps and Historic Flooding

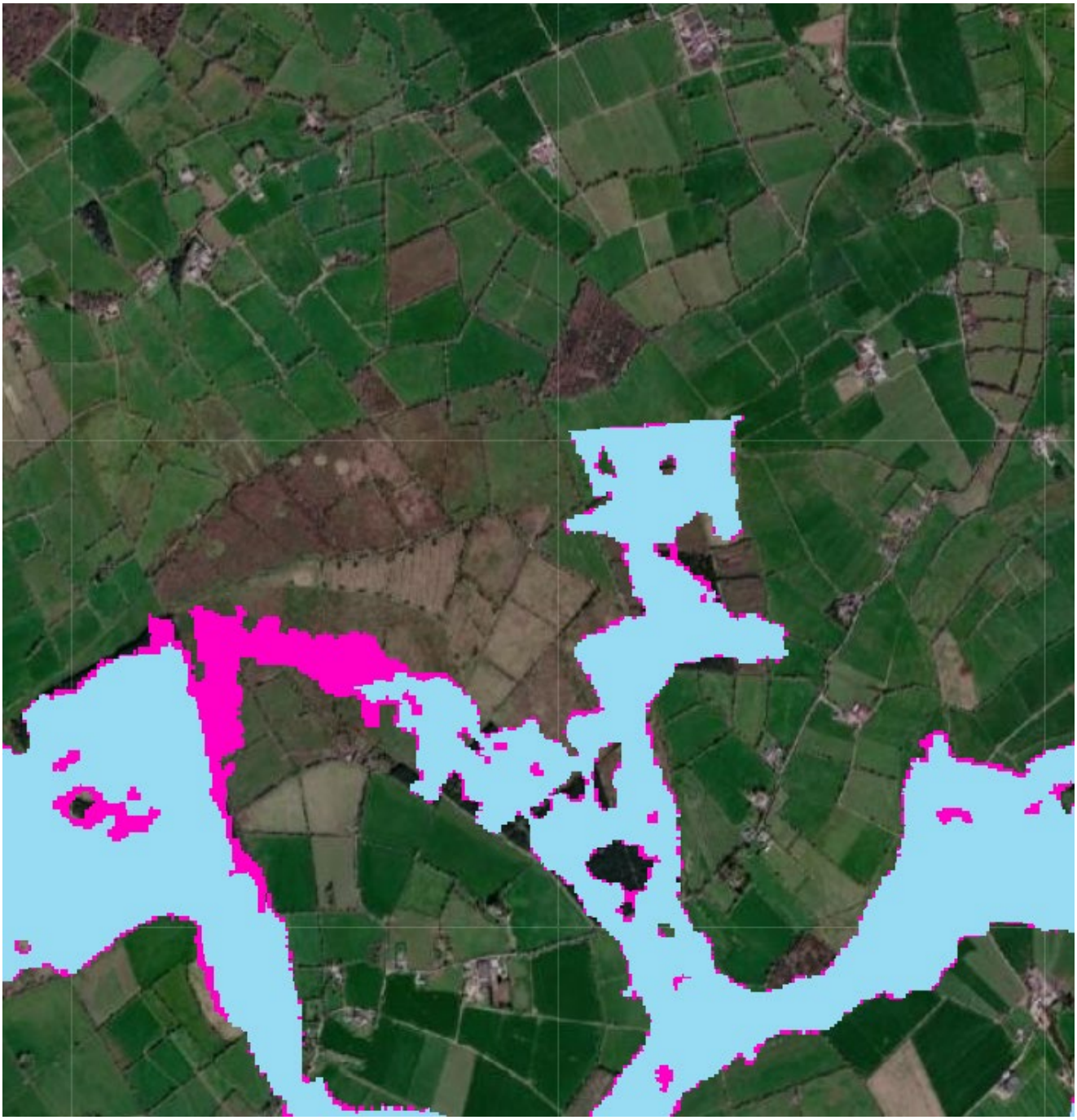


Figure 4-2: Local Area Plan 2017 – Flood Zones

4.2 Pluvial flooding

Pluvial, or surface water, flooding is the result of rainfall-generated flows that arise before run-off can enter a watercourse or sewer. It is usually associated with high intensity rainfall.

There are few isolated and ponded areas subject to localised waterlogging after periods of prolonged rainfall as shown on Figure 4-1.

There is no urban drainage infrastructure in the immediate vicinity of the site. There are no significant or restrictive hydraulic infrastructures located in the vicinity of the site.

4.3 Coastal flooding

The site of the proposed development is not located in a tidally influenced area.

4.4 Groundwater flooding

According to the GSI data, the subject site is at low risk of groundwater flooding.

4.5 Historical flooding

Various sources of flood information were reviewed to establish any recorded flood history at, or adjacent to the site. According to the OPW data base there are no recorded flood incidents or recuring flooding within the site.

There are no recorded flood incidents within 2km buffer zone from the subject site. There is one recurring flood incidents within 2km buffer. The flood incident is shown on Figure 4-1 and listed below:

- Annagh Bogs, Churchtown Recurring (Flood ID 2381)

An internet search was conducted to identify any further instances of flooding proximal to the sites. No additional information regarding flooding was found.

4.6 Site inspection

A site walkover was carried out in August and November 2020, and April 2021 to establish the pattern of existing drainage and to record existing hydrology features relevant to the proposed development.

The site visit in August 2020 took place following a wet period. It was noted that lands outside and to the south of the site boundary were poorly drained and subject to some pluvial flooding as shown on Figure 4-3. Water depth were up to 0.1m. Flooded area is indicated with yellow start on Figure 4-3.

Figure 4-3: Southern Part of the Site – August 2020

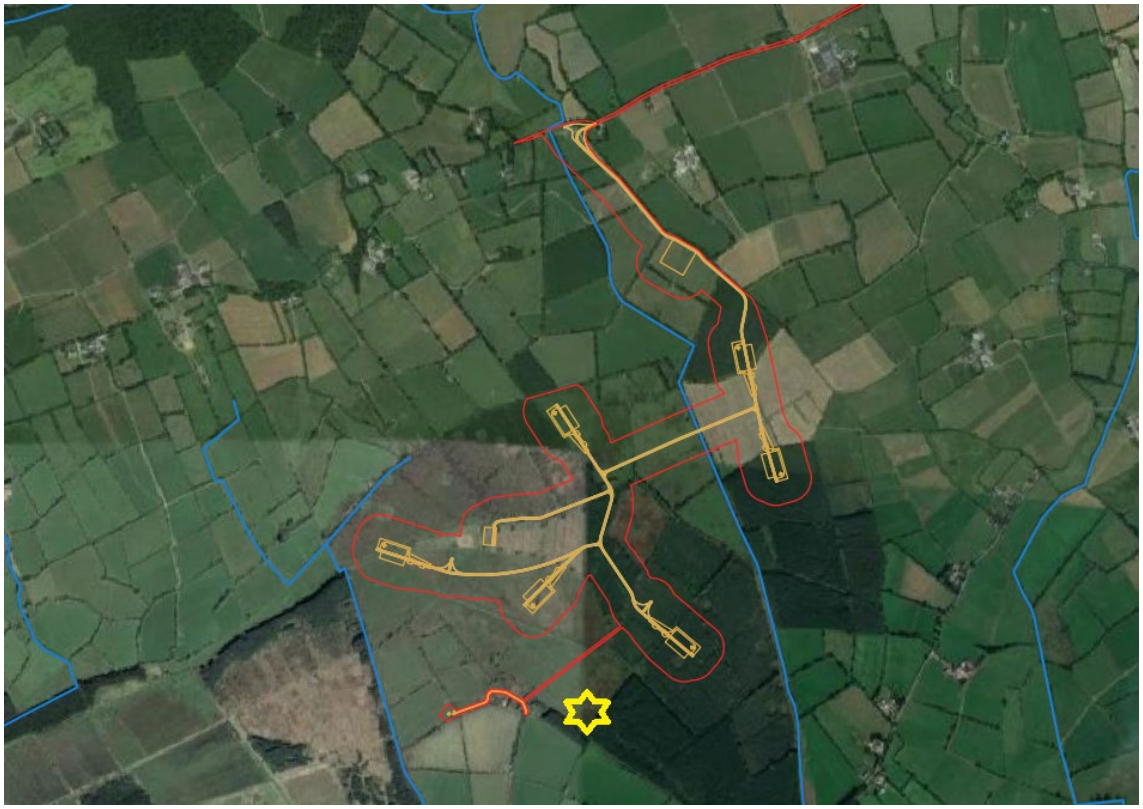


Figure 4-4: Location of Noted Pluvial Flooding – August 2020

4.7 Summary and Source-Pathway- Receptor Model

To initially identify potential flood risks for the existing site and surrounding area, a number of available sources were consulted. Summary of Stage 1 is provided in Table 4-1:

Table 4-1: Review of available data

Source	Detail	Confidence	Comment	Flood Risk?
PFRA	Low	Low	Flood maps indicated that the proposed development is within Flood Zone A.	Yes
LAP 2017	Medium	Medium	Flood maps indicated that the proposed development is within Flood Zone A.	Yes
CFRAM Study	High	High	The subject site is not within the study area.	No
Historic Flooding	High	High	No flood events recorded within the site or adjacent to it.	No
Groundwater flooding	Medium	Medium	The subject site is at low risk of groundwater flooding.	No
Pluvial flooding	High	High	Based on topography data and site inspection, the southern part of the site boundary is identified as being vulnerable to pluvial flooding.	Yes

According to Table 4-1 the proposed development is at risk of fluvial flooding. A Source-pathway-receptor model is provided in Table 4-3.

Table 4-2: Source – Pathway – Receptor Model

Source of Flooding	Pathway	Receptor
Fluvial	Bank overtopping	Lands
Pluvial	Overland flow	Lands

Following the Stage 1 Flood risk identification, it has been determined that the subject site is at the fluvial and pluvial risk of flooding. Based on that, the assessment should proceed straight to flood risk assessment.

5. FLOOD RISK ASSESSMENT

5.1 Hydrology

No suitable historical flow data or hydrometric gauging station data is available from the OPW or EPA for the Oakfront Stream catchment area from which an estimation of design flow can be extrapolated or correlated.

Utilising the OPW Flood Studies Update web portal, the catchment area of the Oakfront River was delineated. Assessment of the existing upstream catchment area indicates a rural catchment area, with no significant urban development within the catchment area.

As the catchment area is less than 25 km^2, FSU method is not suitable for this exercise.

Given the small size of the catchment areas of the field drainage channels and the Oakfront River, the FSU Web portal is not considered appropriate to estimate the median or mean flow. The mean annual flow, Q_{BAR} (m^3 /s), is therefore estimated by utilising any of the three multiple parameter regression equations detailed in the Flood Studies Report (FSR) and Flood Studies Supplementary Reports (FSSR), Flood Estimation in Small and Urbanised developed as part of the Flood Studies Update (FSU) Programme, and the Institute of Hydrology Report (IH) No. 124 'Flood Estimation for Small Catchments' regression equation. These equations are listed below:

$$Q_{bar\ Rural} = 0.00066 \times Area^{0.92} \times SAAR^{1.22} \times SOIL^{2} \quad \text{(FSSR)}$$

$$Q_{bar\ Rural} = 0.00108 \times Area^{0.89} \times SAAR^{1.17} \times SOIL^{2.17} \quad \text{(IH124)}$$

$$Q_{med\ Rural} = (2.0951 \times 10^{-5}) * (AREA^{0.9245}) * (SAAR^{1.2695}) * (BFI^{-0.9030}) * (FARL^{2.3163}) * (S_{1085}^{0.2513}) \quad \text{(FSU-SC)}$$

To assist in the estimation of potential flood risk to the proposed development, this section provides flow estimates for the 1% and 0.1% AEP flood events expected along the watercourses within the study area.

5.1.1 Catchment Characteristics and Flow Estimation

The physical characteristics of the catchment influence the hydrology, this including catchment size, soil type, steepness and the average annual rainfall. The Catchment delineation is presented in Figure 5-1, while Table 5-1 outlines the parameters calculated for the river catchments. The catchment area was determined at two locations, upstream and downstream of the site, and further extrapolated along between these two points.

Hydraulic flow capacity will be determined at the boundaries of the reach, and at the extrapolated locations.

The Oakfront Stream is analysed at four locations as marked at the Figure 5-1.

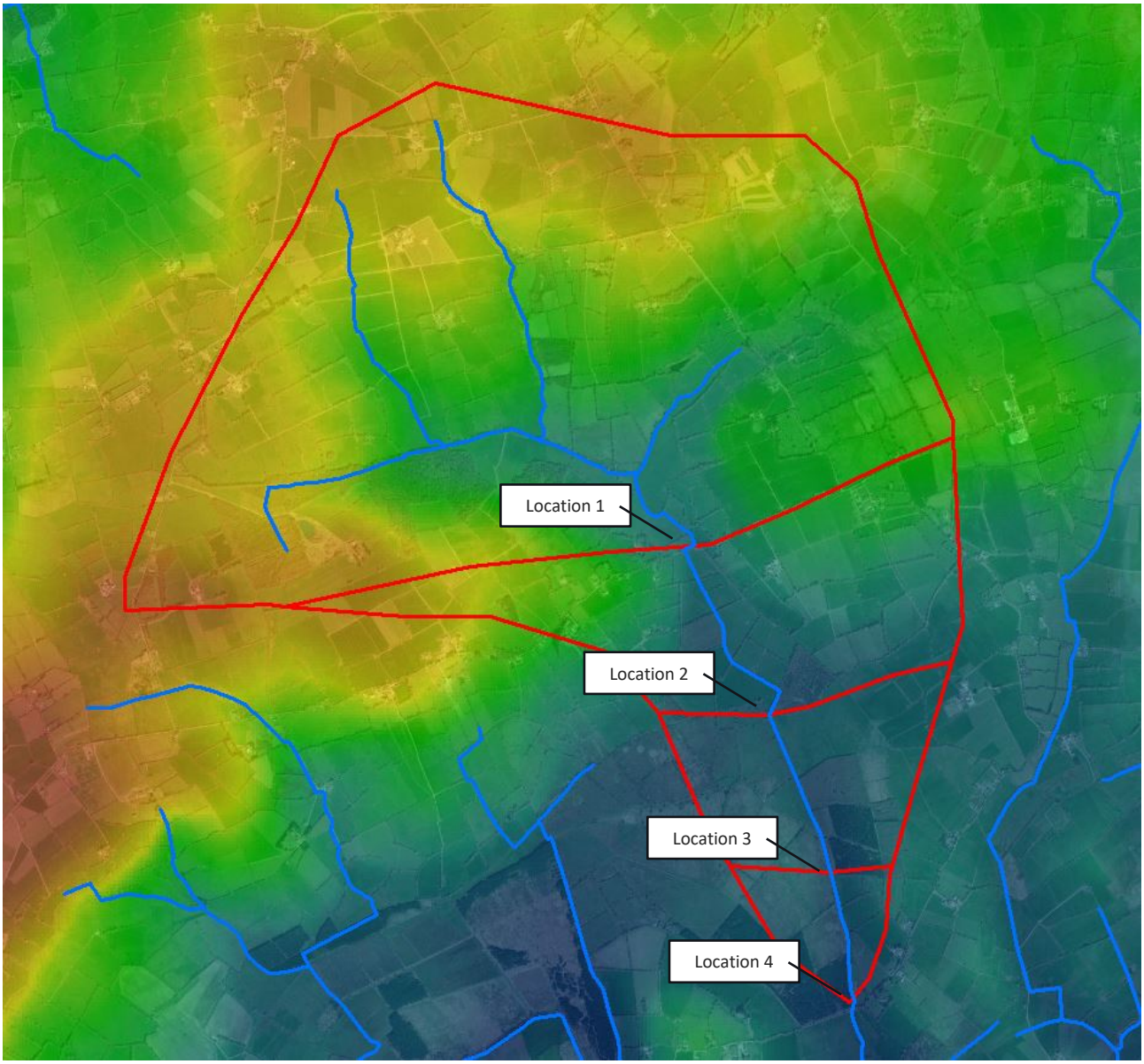


Figure 5-1 Watercourse Catchment Area

Table 5-1: Catchment Characteristics (FSU web portal)

Catchment Descriptor	Location 1	Location 4
Area	7.94	11.56
SAAR	951	954
SOIL	0.4	0.4
BFI SOIL	0.4563	0.3746
FARL	1	1
S1085	15.73	8.59
URBEXT	0	0

5.1.2 Growth Curve

The return period flows 'Q_T' are estimated using the index flood method and multiplying the annual maximum flow by the appropriate growth factor 'XT' using the FSR (1975) national growth curve for Ireland, as shown in Figure 5-2 below:

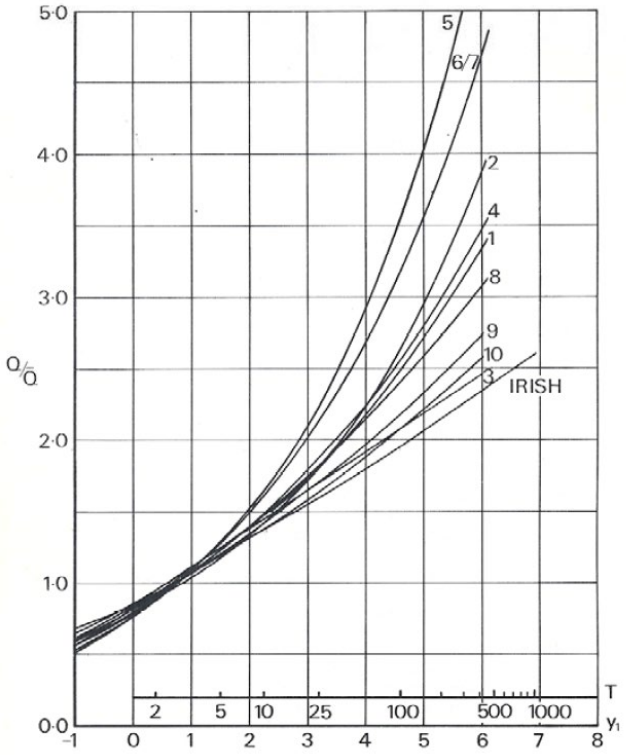


Figure 5-2: Regional Growth Curves

For flood return periods 2, 5, 10, 20, 50, 100 and 1000 years the growth factors determined from Figure 5-2 are listed in Table 5-3 below:

Table 5-2: Growth Curves

AEP %	Growth Factor
2	0.95
5	1.20
10	1.37
100	1.96
1000	2.59

5.1.3 Design peak flows

The peak flows for 1% AEP and 0.1% are presented in Table 5-2. For a conservative approach, a Factorial Standard of Error (FSE) has been applied to the hydrology to increase the confidence in the final flows. FSE for FSSR6 is 1.5, for IH124 it is 1.65 and for FSU-SC it is 1.69. The peak flows are present in Table 5-3:

Table 5-3: The Peak Flow (m^3/s)

Equation	FSSR 6		IH124		FSU-SC	
Location	Q_{100}	Q_{1000}	Q_{100}	Q_{1000}	Q_{100}	Q_{1000}
Location 1	3.37	4.36	2.99	3.88	6.83	8.85
Location 4	4.78	6.19	4.20	5.54	9.96	12.91

Table 5-4: Design Flow (m^3/s)

Equation	FSSR 6		IH124		FSU-SC	
Location	Q_{100}	Q_{1000}	Q_{100}	Q_{1000}	Q_{100}	Q_{1000}
Location 1	5.05	6.55	4.94	6.40	11.55	14.96
Location 4	7.16	9.28	6.93	8.98	16.84	21.82

The peak flows estimated with FSU-SC equation are almost 70% higher than peak flows determined by FSSR6 and IH124 equation. Given that the FSU-SC equation needs further testing according to the Flood Studies Update WP4.2 Flood Estimation in Small and Urban Catchments, the peak flows determined using that equation will not be used in this assessment.

FSSR6 equation provides slightly higher values than IH124. To keep a conservative approach, FSSR6 equation will be used in this assessment. The peak flow values determined at Location 1 and Location 4 will be extrapolated based on the catchment area to determine the peak flow at Location 2 and Location 3.

Table 5-5 Design Flow – Extrapolation (m^3/s)

Equation	FSSR 6		Area
Location	Q_{100}	Q_{1000}	km^2
Location 1	5.05	6.55	7.94
Location 2	6.28	6.93	10.14
Location 3	6.93	8.99	11.19
Location 4	7.16	9.28	11.56

6. HYDRAULIC CAPACITY ASSESSMENT

To assess flood risk at the site, a flow capacity of the Oakfront Stream is undertaken. A cross sectional and geometry survey of the channel was undertaken during the site inspection at the locations illustrated in Figure 6-1.

The hydraulic capacity of the drainage channels was assessed at each surveyed cross-sectional location. Manning's equation was used to calculate the flow capacity of the channel. Manning's equation can be expressed as the following:

$H_f = Q^2n^2 / A^2R^{4/3}$

The head loss due to friction, H_f, can be expressed as the slope of the water surface (in this case it is assumed to be same as the slope of the bed of the stream). The equation is thus rearranged:

$Q = AR^{2/3} S^{1/2} / n$

Where:

Q = Flow Capacity of Channel

A = Minimum Cross Sectional Area of Channel

R = Hydraulic Radius = Area / Wetted Perimeter

S = Slope of bed of channel between subsequent cross-sections

n = Manning's Roughness Coefficient for the channel.

The choice of Manning's Roughness Coefficient has a significant effect on the overall hydraulic capacity of a watercourse channel. Manning's Roughness Coefficients are applied to each cross-sectional location. Table 6-1 below lists recommended Manning's Roughness Coefficients for varying channel vegetation growth situations.

Table 6-1: Manning's 'n' Roughness Coefficients

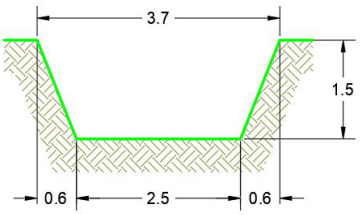
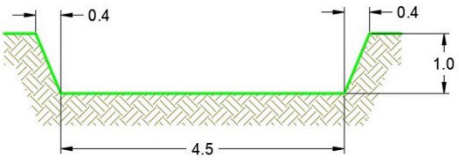
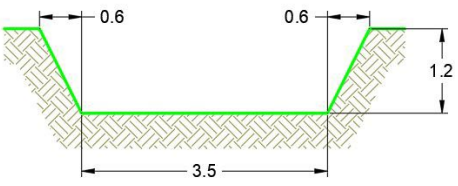
Type of Channel and Description	Minimum	Normal	Maximum
Natural Streams	**Recommended Manning's 'n'**		
Clean, straight, full, no rifts or deep pools	0.025	0.030	0.030
Same as above, but more stones and weeds	0.030	0.035	0.040
Clean, winding, some pools and shoals	0.033	0.040	0.045
Same as above, but weeds and stones	0.035	0.045	0.050
Same as above, lower stages, more ineffective Slopes and sections, overgrowth, brush, weeds	0.040	0.048	0.055
Clean, winding, some pools and shoals but more stones	0.045	0.050	0.060
Sluggish reaches, weedy, brush	0.050	0.070	0.080
Very weedy reaches, deep pools, or floodways	0.070	0.100	0.150

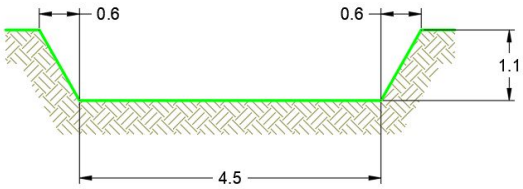
The Manning's 'n' value has been determined to be 0.030 based on the stream characteristics as shown in Figure 6-1 below. The average slope along the assessed reach is 0.005 m/m.

Figure 6-1: The Oakfront Stream – Location 2 Looking Upstream

Table 6-2 below summaries the flow capacity of the drainage watercourse channel at each surveyed location. The above hydraulic analysis demonstrates that the Oakfront Stream has enough capacity to cater 1% AEP flows at analysed locations.

Table 6-2: Hydraulic Capacity

Section	Flow Capacity (m^3/s)	Cross section
Location 1	9.06	
Location 2	8.29	
Location 3	9.46	

Section	Flow Capacity (m^3/s)	Cross section
Location 4	10.11	

7. CONCLUSION

PFRA maps and LAP 2017 maps show that the proposed development is vulnerable to fluvial flooding. Both maps were developed as a high level assessment. These maps are not reliable but gives sufficient response if a detailed flood risk assessment is required.

No suitable historical flow data or hydrometric gauging station data is available from the OPW or EPA for the Oakfront Stream catchment area from which an estimation of design flow can be extrapolated or correlated.

Given the small size of the catchment areas of the field drainage channels and the Oakfront River, the FSU Web portal is not considered appropriate to estimate the median or mean flow. The mean annual flow, Q_{BAR} (m^3 /s), was estimated by utilising regression equations.

FSSR6 equation provided slightly higher values than IH124 equation. To keep a conservative approach, FSSR6 equation was used in this assessment.

Hydraulic capacity assessment has been carried out in Section 6. The capacity was determined at 4 locations determined as part of the site inspection.

It was determined that the Oakfront Stream does not overtop at these locations for extreme flood events (1%AEP and 0.1%AEP).

It is proposed to construct a single span bridge over the Oakfront Stream. The proposed crossing will be designed to convey 1% AEP MRFS flows with 300mm freeboard elevation.

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX 10.3

Surface Water Management Plan

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED ANNAGH WIND FARM

SURFACE WATER MANAGEMENT PLAN

Prepared for: EMPower

EMPower

Date: November 2021

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1. INTRODUCTION

This Surface Water Management Plan shall be read in conjunction with the Annagh Wind Farm EIAR. The Surface Water Management Plan for the construction stage of the project shall be finalised in accordance with this plan following the appointment of the contractor for the works.

1.1 Existing Environment

The proposed wind farm site is situated within Awbeg (Buttevant)_SC_010 sub-catchment as defined by the WFD and shown on Figure 10 2 of the EIAR. This sub-catchment is part of the Blackwater Munster (ID 18) catchment.

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

The average annual rainfall in period 1981-2010 in the area of the wind farm site is 1,002 mm. M5-60 at development location is 16.9 mm according to the Met Éireann rainfall data. This is the predicted rainfall depth in a sixty minute storm with an annual exceedance probability of 20%.

1.2 Daily Preparation during the Implementation of the Surface Water Management Plan

An Environmental Clerk of Works (ECOW) appointed by the contractor will conduct regular meetings with the Construction Management Team to discuss the phasing of construction and drainage as the work progresses. The focus of these meetings will be on establishing an operational drainage system in advance of the progression of the works.

Particular regard will be taken of daily weather conditions and long-range forecasts. The ECOW will have the authority to suspend the works if weather conditions are deemed too extreme for the effective protection of receiving watercourses. Mitigation measures to protect receiving watercourses will be put in place as directed by the ECOW in response to extreme forecasts.

1.3 Personnel Qualifications and Key Contacts

All those carrying out work on site must have a Fás/Solas Safe Pass Card. All works must be supervised by a competent supervisor. Workers must be adequately trained in the tasks they are required to carry out. The key contact names and contact details will be supplied to all personnel entering the site. All site staff will be informed of the emergency procedures for the site.

2. POTENTIAL IMPACTS

2.1 Construction Stage Impacts

During the construction period, the development has the potential to lead to impacts on hydrology and water quality unless appropriate mitigation is applied.

Tree felling, new site access roads, turbine hard-standing areas, the on-site substation and other new, hard surfaces have the potential to contribute to an increase in runoff, release of sediments, hydrocarbons, and pollutants in the watercourses.

During construction, the transport of both dissolved and sediment-bound nutrients from soil to water could deleteriously affect water quality downstream, in the absence of mitigation measures.

A detailed description of the potential construction stage impacts on hydrology and water quality can be found in Chapter 10 of the EIAR.

2.2 Operational Phase Impacts

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

During the operation stage, small quantities of oil will be used in cooling the transformers associated with the facility. There is therefore a potential for small oil spills.

The significance of the effect of the potential for small oil spills into the receiving waters is not significant.

2.3 Decommissioning Stage Impacts

The foundations will be covered over and allowed to re-vegetate naturally. Leaving the turbine foundations in situ is considered a more environmentally sensible option as to remove the reinforced concrete associated with each turbine would result in environmental nuisances such as noise and vibration and dust.

It is proposed that the internal site access tracks and turbine hard standings will be left in place. The access tracks will continue to be used for forestry and agriculture access. Turbine hardstandings will be covered over with topsoil and left to revegetate naturally.

It is expected that the temporary accommodation works along the TDR will not be required for the decommissioning phase as turbine components can be broken up on site and removed using standard HGVs.

Grid connection infrastructure including substations and ancillary electrical equipment will form part of the national grid and will be left in situ.

A detailed decommissioning plan will be agreed in advance of construction with Cork County Council.

It is not expected that decommission phase of the project will have negative impact on hydrology and water quality. A detailed description of the potential decommissioning stage impacts on hydrology and water quality can be found in Chapter 10 of the EIAR.

3. DRAINAGE OF WIND FARM DURING THE CONSTRUCTION AND OPERATION PHASES

The proposed surface water drainage system utilises sustainable drainage devices and methods where appropriate. The proposed layout of the drainage system is provided in Appendix 1.

Where required, on the upslope side of new sections of access track and hardstanding areas, overland flows will be intercepted in channels. The flow will then be discharged diffusely over vegetated areas. The roadside drains will therefore only carry the site access track runoff. This will ensure that there will be no mixing of 'clean' and 'dirty' water as shown on Figure 3-1, and will avoid a large concentration of flows. Thus, erosion risks will be reduced and the quantity of water requiring treatment will be minimised.

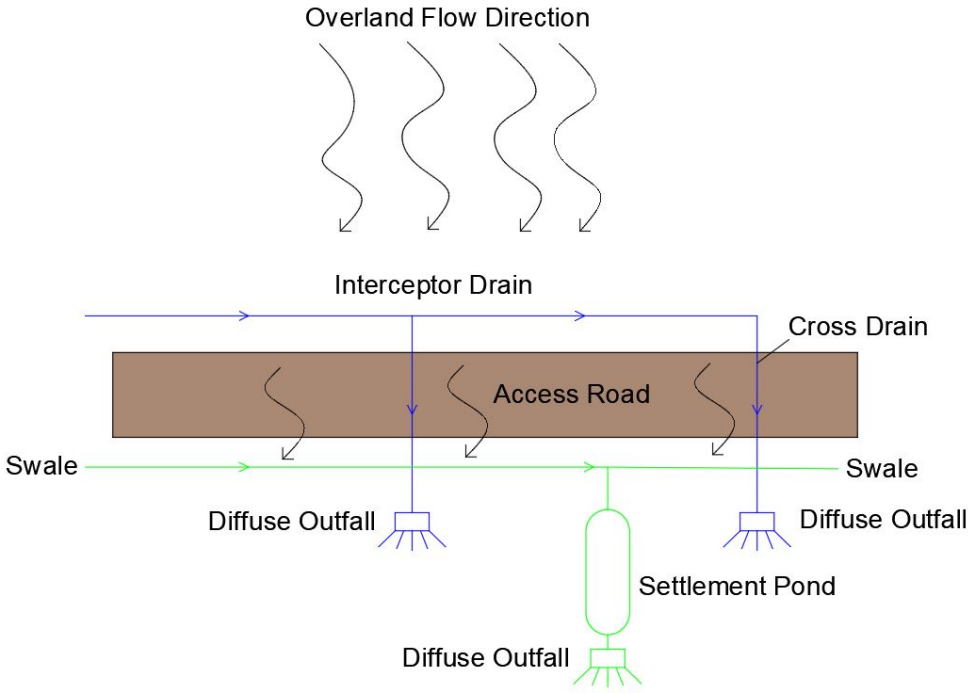


Figure 3-1: Drainage Design Principles

The main components of the proposed drainage network are:

- Interceptor Drains,
- Swales,
- Cross Drains,
- Settlement Ponds.

The surface water drainage is designed to capture surface water run-off from the roads and other hardstanding areas in swales and discharge into settlement ponds specifically constructed for managing surface water runoff generated from the wind farm infrastructure. After passing through the settlement pond, surface run-off will be permitted to spread across the adjacent lands. This treated water will ultimately percolate to groundwater or travel over ground and be assimilated into the existing drainage network. There will be no direct discharges from the wind farm to any existing natural watercourse.

The internal access tracks will be constructed using unbound aggregate materials such that they will permit some degree of infiltration and reduce the volume of runoff generated.

Temporary settlement ponds will be established during construction works in areas of high construction activity and groundworks. Location of the settlement ponds is shown on drainage layout provided in Appendix 1 of this report. Preliminary design of settlement ponds is included in Appendix 3. The locations of temporary settlement ponds will be adjacent to significant earthworks, as close as possible to the source of sediment while maintaining a minimum 50m buffer distance from existing watercourses. These additional temporary ponds will be decommissioned and reinstated on completion of the construction works. The settlement ponds will also provide containment capacity in the event of a spill or leak on the installed infrastructure and the outflow can be closed off to contain any potential pollutants within the settlement ponds. In the event of contaminated runoff being contained in a settlement pond, the incident will be reported as set out in Section 4.7, samples taken of the contaminated liquid for classification, as required, and the liquid pumped out of the pond using a suitable vacuum truck and disposed of at a licensed waste facility off-site.

The surface water management system will be visually inspected on a daily basis during construction works by the ECOW (or equivalent appointed person) to ensure that it is working optimally. The frequency of inspection will be increased at settlement ponds adjacent to areas where earthworks are being carried out. Where issues arise, construction works will be stopped immediately, and the source of the issue will be investigated. Records of all maintenance and monitoring activities associated with the surface water network will be retained by the Contractor on-site, including results of any discharge testing requirements.

The Contractor will implement temporary control measures such as silt fences, silt bags, temporary settlement tanks, as required. These are further explained in section below.

The works programme for the initial construction stage of the proposed development will take account of weather forecasts and predicted rainfall in particular. Large excavations and movements of subsoil or vegetation stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

The drainage system outlined below provides for a multi-stage treatment train of the discharges from the development, as recommended in the SUDS manual:

- grassed swales removing some of the sediment borne contaminants,
- settlement ponds providing retention and treatment of discharges,
- diffuse outflow from settlement ponds providing for further retention and settlement of suspended solids by reducing the velocities of flows and increasing the flow path of discharges,
- continuation of flows by natural flow paths over vegetated areas before entering the watercourse, providing further retention and treatment of discharges.

Interceptor Drains

Interceptor drains will be installed in parallel of the main earthworks activities to minimise the effects of collected water on the stripped/exposed soils once earthworks commence. These drainage ditches will be installed on the upgradient boundary of the areas affected by the access track earthworks operations and installed in parallel of the main track construction operations commencing.

They will generally follow the natural flow of the ground. The interceptor drains will intercept any storm water surface runoff and collect it to the existing low points in the ground, allowing the clean water flows to be transferred independently through the works without mixing with the construction drainage. Collected runoff will be discharged over the roads via cross drains. It will then be directed to areas where it can be redistributed over the ground. The overland flow will then discharge diffusely on the downslope side over vegetated areas within the site boundary.

Swales

Swales along access tracks will be installed in parallel of the main construction phase. Swales will provide additional storage of storm water where located along gradient. The swales will be 0.3 m in depth with a bottom width of 0.5 m and side slopes of 1 in 3. A grassed swale is shown on Figure 3-2.

The swales will be constructed in accordance with CIRIA C698 Site Handbook for the Construction of SUDS in conjunction with CIRIA C753 The SuDS Manual.

At slopes greater than 2%, check dams will be required in the swales and interceptor drains to slow down the velocities of flows, prevent erosion occurring and provide settlement opportunity. Check dams will be constructed from course gravel/ crushed rock. This is further described below.

Figure 3-2: Grassed swale along access track

Settlement Ponds

Settlement ponds will be put in place as construction progresses across the site. Settlement ponds will have a diffuse stone filled outflow which will encourage the diffuse spread of flows overland and back into natural drains down slope of the settlement ponds. Drainage stone will be placed at the inlet to the ponds to filter the flows before they enter the ponds.

After passing through the settlement ponds, the concentration of suspended solids in the surface water run-off due to the excavations will be reduced.

The following will apply to construction of settlement ponds at the site:

- Pond depths generally to be excavated to less than 2m;
- Side slopes to be shallow, nominally at a 1 in 3 side slope (maximum); and
- Material excavated from the settlement pond should be compacted around the edge of the pond.

The settlement pond design is based on primary settling out of suspended solids from aqueous suspension. The theory behind the design of the settlement ponds is the application of Stoke's Law. The settlement ponds will be designed to provide sufficient retention time and a low velocity environment to allow suspended solids of a very small particle size to fall out of suspension prior to allowing the water to outfall to the receiving environment. Event mean concentration of suspended solids is 2582 mg/l according to CIRIA B14 , Section 6.1.3. Table 6.1. Flow rates for storm events will be maintained at or below greenfield run-off rates.

Settlement ponds will be installed concurrently with the formation of the road and will be fenced off for safety. They will be located as close to the source of sediment as possible and maintain a buffer of 50m from existing watercourses. Machine access will be required at settlement ponds to remove accumulated sediment.

Further sediment pond control measures include:

- Settlement pond maintenance and/or cleaning will not take place during periods of extended heavy rain;
- Settlement ponds will, where practicable, be constructed on even ground and not on sloping ground and where possible will discharge into vegetation areas to aid dispersion; and
- Settlement ponds will be monitored closely over the construction timeframe to ensure that they are operating effectively.

In the event of an emergency, the settlement ponds will provide a temporary holding area for any accidental spills on site as it will be possible to block off the outflow from these ponds for a limited period. Erosion control and retention facilities, including settlement ponds will be regularly maintained during the construction phase.

The drainage system will remain operational and will be utilised for the decommissioning phase to treat any surface water from exposed areas as a result of decommissioning at the site. During the decommissioning of the turbine base, hardstanding areas and access tracks will remain in place and be covered with local soil/topsoil to minimise disturbance to soils.

Swale draining to settlement pond is shown on Figure 3-3.

Figure 3-3: Swale draining to Settlement pond

Check Dams

At slopes greater than 2%, check dams will be required in the swales and interceptor drains to slow down the velocities of flows and prevent erosion occurring, as shown in Figure 3-4. These check dams will be in stone of minimum size 37.5 mm and will be laid at a spacing of between 10 and 30 m dependent on the slope.

All check dams, etc will be checked at least once weekly via a walkover survey during the full period of construction. All excess silts will be removed as per Soil Management Plan provided in the CEMP. Where check dams have become fully blocked with silt, they will be replaced.

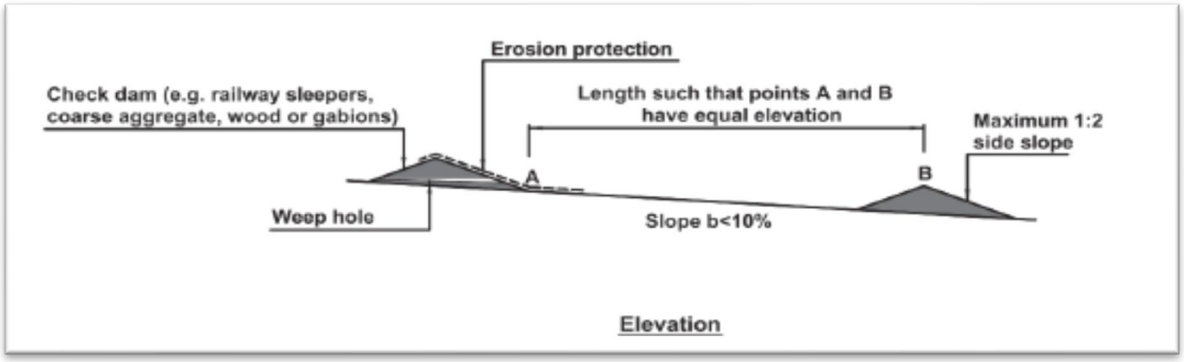


Figure 3-4: Check Dam Detail

Silt Traps and Silt Fences

Silt traps will be provided in swales which will consist of geotextile staked across the swale at regular intervals. The geotextile will be weighed down on the upstream side with clean filter stone to provide further filtration and stability to the silt trap, as shown in Figure 3-5 to Figure 3-7.

Silt fencing will be kept on site and erected as required during construction to provide further protection to prevent the ingress of silt into the watercourses. The silt fencing will be kept in place until the natural vegetation has been re-established.

Figure 3-5: Silt trap across grassed swale

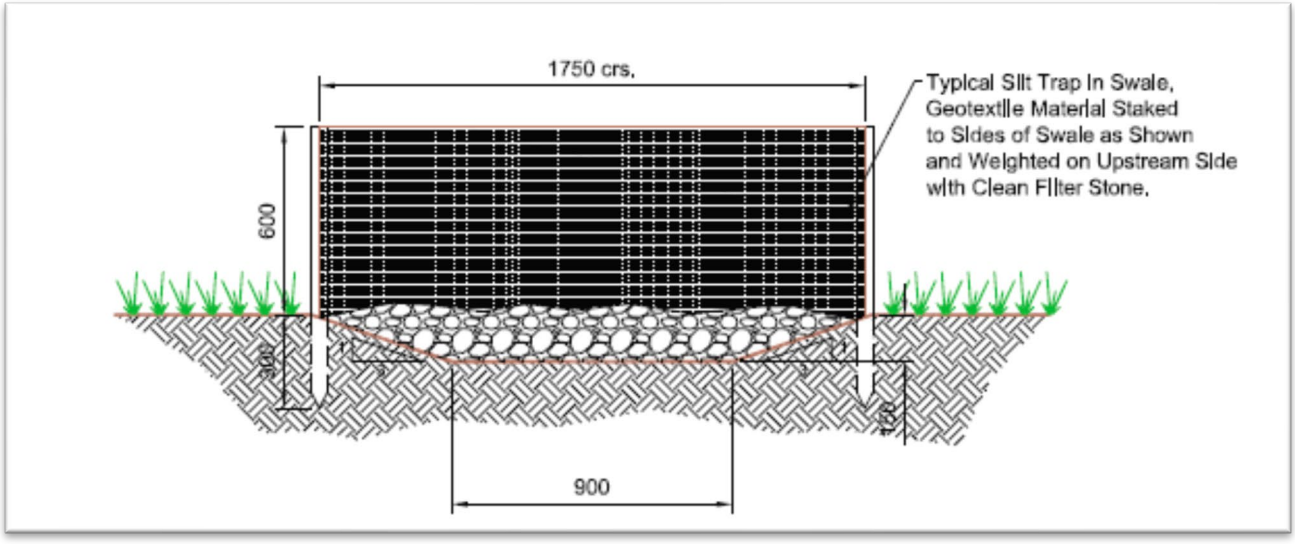


Figure 3-6: Trap Details

Figure 3-7: Silt Fence

Drainage of Turbine Bases and Hardstanding

The excavations for turbines will be pumped into the site drainage system (including settlement ponds), which will be constructed at site clearance stage, in advance of excavations for the turbine bases.

As discussed above, the new turbine hard-standing areas will be drained via shallow swales with suitably designed settlement ponds. The settlement ponds will remain in place following the construction period.

If cross-drains are required to convey the drainage across the hardstanding area, the diameters will be suitably designed in advance.

Drainage of Temporary site compounds

The compound will be set back a minimum of 50m from streams. Drains around the hard-standing areas of the site compounds will be in the form of shallow grassed swales to minimise the disturbance to sub-soils.

Concrete washout will be carried out in a dedicated area of the temporary compounds or at a designated washout pit on site. Only the washing of chutes will be permitted. Chutes will be washed out at the designated area with a settlement pond provided to receive all run-off.

Portaloos and/ or containerised toilets and welfare units with storage tanks will be used to provide toilet facilities for site personnel during construction. The sanitary waste will be removed from site by a licensed waste disposal contractor. All portaloo units located on site during the construction phase will be operated and maintained in accordance with the manufacturer's instructions, and will be serviced under contract with the supplier.

All such units will be removed off-site following completion of the construction phase. Potable water will be brought onsite in bottles.

Temporary petrol and oil interceptors will be installed at the site compounds and at all locations dedicated for plant repairs/storage of fuel/temporary generator installation. Surface water run-off from the compound will be directed through a Class 1 Full Retention Oil Interceptor before discharge to the surface water drainage system for the site. This surface water drain flows to a settlement pond before final discharge over land. A trained and dedicated environmental and fuel spill emergency response team will be set up on site before commencement of construction on-site. An example of Oil Interceptor Class 1 is provided in the Appendix 2.

Drainage of Substation

The permitted on-site substation will be drained using shallow swales, with a suitably designed settlement pond. At the upslope side of the sub-station overland flows will be intercepted in channels and discharged diffusely over vegetated areas.

In operation stage, the substation drainage will consist of an underground surface water pipe system. This system will include a number of surface water manholes, rain water pipes for the compound building roof, Class 1 Full Retention Oil Separator, an oil sensitive bund dewatering system, attenuation tank, ACO drains and filter drains. The system will discharge overland limited to the greenfield runoff.

In accordance with SuDs best practice, it is proposed to include a rainwater harvesting tank within the surface water system which will comprise of a filter, an underground tank and a pump. The system allows rainwater to run down the roof and into the guttering and downpipes in the normal way before passing through the filter, which removes any leaves and debris. Rainwater is then stored in the underground tank for reuse. Potable water will be brought onsite in bottles.

A foul system is proposed within the station to cater for the wastewater generated in the welfare facilities of the control building. The foul system will consist of an underground pipe network, foul manholes and a 9m3 full retention foul effluent storage tank. The tank will have an associated high level alarm which will be connected to the control building. A foul holding tank to be maintained and emptied quarterly is the most preferable means of treating and disposing of foul waste from the site. The licensed contractor charged to empty and dispose of the waste will be the holder of a valid waste collection permit. It is not proposed to treat wastewater onsite.

Drainage of Cable Trenches

Cables running throughout the wind farm site will be installed in trenches adjacent to site access tracks, where possible. Cable trenches will be excavated using a mechanical excavator and the excavated materials placed in small bunds adjacent to the trenches for back filling, as shown in Figure 3-8.

The seed bank is to be retained for placing back as the top layer of backfill to the trench, to aid successful restoration of vegetation in disturbed areas.

Cable trenches will be excavated during dry periods where possible, in short sections and left open for minimal periods, to avoid acting as a conduit for surface water flows.

Figure 3-8: Backfill over cable trench

Procedure for Dewatering of Excavations

Standing water, which could arise in excavations, has the potential to contain an increased concentration of suspended solids as a result of the disturbance to soils. Water in the excavations for turbines will be pumped into the site drainage system which will be constructed at site clearance stage, in advance of excavations for the turbine bases. Pumped water will be treated via settlement ponds. There will be no direct discharge to the existing drainage network.

Drainage of Stockpiled Material

During the construction period, the excavated material will be used to reinstate the turbine bases. All excavations will be constructed and backfilled as quickly as possible. Excavation will stop during or immediately after heavy rainfall.

Excavation will precede the turbine base construction, cable trench and access track construction. Soil will be excavated and replaced with granular fill where required. Excavation will be carried out from access tracks where possible in order to reduce the compaction of topsoil.

During the construction period, spoil heaps from the excavations for the turbine bases will be stored temporarily. These temporary spoil heaps will be covered if required and surrounded by silt fences to filter sediment from the surface water run-off from excavated material. The silt fences will be inspected weekly and after rainfall events by ECOW.

It shall be noted that any stockpiling will be short-term and temporary and will occur only within the site boundary as the construction proceeds. The site drainage system will be put in place prior to excavation, therefore the discharge routes from any temporary stockpiling will be via the site drainage system. A minimum buffer of 50m will be provided between temporary stockpiles and the nearest watercourse.

Wash Down from Concrete Trucks and Cement Mixers

Only ready-mixed concrete will be used during the construction phase, with all concrete being delivered from local batching plants in sealed concrete delivery trucks. The use of ready-mixed concrete will eliminate any potential environmental risks of onsite batching.

Concrete washout will be carried out in a dedicated area of the temporary compounds. The small volume of water that will be generated from washing of the concrete trucks chute will be directed into a temporary lined impermeable containment area as shown in Figure 3-9, or a concrete wash unit.

Regular inspections of the wash down areas and associated settlement ponds will be carried out and adequate records kept.

The settlement ponds will be lined using a 1mm LLDPE impermeable liner. A sump will be provided at this location which will collect the wash water from the concrete trucks. The excavated material will be kept on site for reinstatement following the construction period.

Figure 3-9: Lined Settlement Pond for Concrete Washout Facility

During construction, wash water and any solids in the sump will be removed periodically to an appropriate licensed facility. The sump can be emptied daily if required. Following construction, any solids, the liner, and any remaining wash water in the sump will all be removed to an appropriate licensed facility for disposal. The sump will then be reinstated.

Watercourse Crossings

There is one stream crossings required for the proposed new internal access road network. This crossing location is shown on Figure 10-5 of the EIAR. It is proposed to install one single-span bridge. The crossing structures will be installed with a minimum 300mm freeboard elevation for 1% AEP MRFS flows (annual exceedance probability, medium range future scenario).

Existing stream crossings will be protected using silt fencing. Minor drains such as manmade agricultural and field drains will be crossed using suitably designed pipe culverts.

4. MITIGATION MEASURES

4.1 Mitigation Measures for Pollution Control to Protect Water Quality in Downstream Receptors

All personnel working on site will be trained in pollution incident control response. An emergency response procedure is prepared herein which will ensure that appropriate information will be available on site outlining the spillage response procedure and a contingency plan to contain silt.

Silt Protection Controls (SPCs) are proposed at the location of watercourse crossings and where haul roads pass close to watercourses, silt fencing will be used to protect the streams.

Silt traps will also be provided at outfalls from roadside swales. Silt traps will be kept upstream of outfalls to allow a buffer zone to the outfall. Additional silt fencing will be kept on site in case of an emergency break out of silt laden run-off.

Settlement ponds will be put in place in advance as construction progresses across the site. The settlement ponds with a diffuse outflow detail will mitigate any increase in runoff and treat suspended solids in the surface water runoff. Erosion control and retention facilities, including settlement ponds will be regularly maintained during the construction phase.

All stockpile material will be bunded adequately and protected from heavy rainfall to reduce silt runoff, where necessary.

Drains around hardstanding areas will be shallow to minimize the disturbance to sub-soils.

Suitably sized cross-drains will be provided for drainage crossings to convey flows from agricultural drains and forestry drains across the access tracks, to prevent a risk of clogging.

Tracks will be capped as soon as practicably possible to cover exposed subsoils and as such reduce the concentration of suspended solids in the run-off.

All open water bodies adjacent to proposed construction areas will be protected by fencing, including the proposed settlement ponds.

Additional protection will be provided in the form of silt fencing downslope where required and at existing stream crossings during construction, to further ensure that there is no impact from the development to streams and rivers crossing the site.

Where haul roads pass close to watercourses, silt fencing will be used to protect the streams. Silt traps will also be provided at outfalls from roadside swales. Silt traps will be kept upstream of outfalls to allow a buffer zone to the outfall.

Refuelling of plant during construction will be carried out at the temporary compounds, which will be located a minimum of 50m from any watercourse. The station will be fully equipped for a spill response and a specially trained and dedicated environmental and emergency spill response team will be appointed before commencement on site. In addition to the above, onsite re-fuelling of machinery will be carried out 50m from watercourses using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site or at the designated refuelling area and will be towed by a 4x4 jeep to designated re-fuelling areas near to where machinery is located but at distances of greater than 50m from watercourses.

Drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site.

Concrete washout will be carried out in a dedicated area of the temporary compounds. Only the washing of chutes will be permitted. Chutes will be washed out at the designated area with a settlement pond provided to receive all run-off. During construction concrete will be kept out of all watercourses and drains.

Any diesel, fuel or hydraulic oils stored at the temporary site compounds will be bunded. The bund capacity will be sufficient to contain 110% of the tank's maximum capacity.

Vehicles entering the site will be in good working order, free from leakage of fuel or hydraulic fluid.

A wheel wash will be provided at the site entrance draining to a silt trap to avoid any silt laden run-off flowing on to the public road and entering roadside drains.

Portaloos and/or containerised toilets and welfare units will be used to provide toilet facilities for site personnel during construction. Sanitary waste will be removed from site via a licenced waste disposal contractor.

Silt fencing will be erected at the location of stream crossings along the cable route.

4.2 Construction Stage Mitigation Measures

Long range weather forecasts will be examined, and the construction phases planned taking cognisance of expected weather conditions. Regular meetings will be held to re-assess construction phases with weather conditions as the project progresses.

Regular meetings will be held between the ECOW appointed by the contractor and the contractor's Project Manager. The planning of traffic routes through the site will be agreed in advance, in order to plan appropriate construction drainage management.

The proposed mitigation measures are listed in Chapter 10 of EIAR.

A detailed water quality monitoring programme will be undertaken during the construction phase of the proposed development, in addition to the visual inspections outlined above, so as to ensure the effective implementation of the proposed mitigation measures. A water quality monitoring plan is detailed in Section 4.6.

4.3 Operational Phase Mitigation Measures

It is not anticipated that the operation of the wind farm will result in significant impacts on the hydrological regime or water quality of the area, as there will be no further disturbance of soils post-construction, and only a minimum of traffic movement.

Oil used in transformers (at the substation and within each turbine) and storage of oils in tanks at the substation could leak during the operational phase and impact on groundwater quality.

The substation transformer and oil storage tanks will be in a concrete bunded capable of holding 110% of the oil in the transformer and storage tanks. Turbine transformers are located within the turbines, so any leaks would be contained.

Visual inspections will be continued during the operational period until satisfactory vegetation is established on site at intervals to be agreed with Local Authority/IFI.

It is not anticipated that the maintenance period will involve any significant impacts on the hydrological regime of the area. The maintenance of the development will incorporate effective maintenance of the drainage system. Visual inspections will be undertaken during the maintenance period in accordance with maintenance schedule in CIRIA C753. The maintenance regime will include inspecting the following:

- Drains, cross-drains and culverts for any blockages,
- Outfalls to existing field drains and watercourses,
- Existing roadside swales for any obstructions,
- Swales,
- Progress of the re-establishment of vegetation.

The maintenance regime will also include implementing appropriate remedial measures as required after the above inspections and testing the water quality at the outfalls at appropriate intervals.

4.4 Decommissioning Stage and Mitigation Measures

As in the construction phase silt protection controls would again be put in place. The drainage system will remain operational during the decommissioning phase and will serve to treat any sediment laden surface water runoff due to a renewed disturbance of soils. Revegetation following the backfilling of hardstanding areas will be monitored. If it is deemed necessary, erosion control matting will be used to assist in the re-establishment of vegetation.

4.5 Mitigation Measure for Flooding

The swales will serve to reduce velocities in the surface water runoff draining from the access tracks and hardstanding areas and will provide retention of the flows. This will also mitigate any increase in the risk of flooding.

No construction personnel, operation or maintenance personnel will be permitted on site during extreme flood events. Landowners will carry on their normal activities in the vicinity of the development and will take the usual precautionary measures as far as practicable during flood events.

4.6 Water Quality Monitoring Plan

A monitoring programme will be established to ensure that the water quality is maintained. This programme will ensure that designed measures are working to ensure water quality is not affected. The details of this programme are outlined below.

Daily visual inspections of drains and outfalls will be performed during the construction period to ensure suspended solids are not entering the streams and rivers of the site, to identify any obstructions to channels, and to allow for appropriate maintenance of the drainage regime. If excessive suspended solids are noted, construction work will be stopped, and remediation measures will be put in place immediately.

Visual inspections will be continued during the operational period until vegetation is established on site at intervals to be agreed with Local Authority/IFI.

A detailed water quality monitoring programme will be undertaken during the construction phase of the proposed development, in addition to the visual inspections outlined above, so as to ensure the effective implementation of the proposed mitigation measures. Field measurements and grab samples will be taken at suitable locations, which will be decided prior to the construction phase commencing. The field measurements will be recorded at the site and will include measurement of the following parameters, electrical conductivity (µs/cm), pH, temperature (ºC), suspended solids (mg/l) and dissolved oxygen (mg/l). The field measurements will be taken on a weekly basis during the site clearance and earthworks stage of the construction period. An ECOW will compare the results with the pre work levels and ensure that designed mitigation measures are working. An ECOW will propose new mitigation measures if results exceed pre work levels.

4.7 Emergency Silt Control and Spillage Response Procedures

All personnel working on site will be trained in pollution incident control response. An emergency response plan will be prepared which will ensure that appropriate information will be available on site outlining the spillage response procedure and a contingency plan to contain silt. A regular review of forecasts of heavy rainfall is required and a contingency plan will be prepared for before and after such events. A record will be kept of daily visual examinations of watercourses which receive flows from the permitted development, during and for an agreed period after the construction phase. Procedures for particular accidental spillages, from leaking or damaged fuel lines or a break-out of silt are outlined below.

Oils, Fuels and Site Vehicles

Construction vehicles will be refuelled off-site, wherever possible. This will primarily be the case for road vehicles such as vans and trucks. Refuelling of mobile plant during construction will be carried out at the temporary compound. Any additional fuel containers, other than the fuel bowser, used for smaller equipment (such as generators, lights etc.) will be stored within additional secondary containment e.g. bund for static tanks or drip trays for smaller mobile containers. Taps/nozzles for fuels and storage containers for oils will be fitted with locks to ensure their use is controlled. Only designated trained and competent operatives will be authorised to refuel plant on site.

All tank and drum storage areas shall, as a minimum, be bunded, either locally or remotely, to a volume not less than the greater of the following:

a. 110% of the capacity of the largest tank or drum within the bunded area; or
b. 25% of the total volume of substance which could be stored within the bunded area.

On-site refuelling of non-mobile machinery (such as cranes, excavators, dozers, dumpers etc.) will be carried out using a mobile double skinned fuel bowser typical of that shown in Figure 4-1. Refuelling will be carried out at least 50m from any watercourse. The fuel bowser, typically a double-axle custom-built refuelling trailer, will be re-filled off-site, where possible, or at either of the two construction compounds and will be towed as required within the site by a 4x4 vehicle to where machinery is located. It is not practical or preferable for most heavy construction vehicles to travel back to the refuelling point in the construction compound given the size of the proposed wind farm site. The 4x4 vehicle will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level impermeable area in either of the construction compounds when not in use.

The station will be fully equipped for a spill response and a specially trained and dedicated environmental and emergency spill response team will be appointed before commencement on site.

Figure 4-1: Typical Mobile Fuel Bowser

Accidental spillage from leaking or damaged fuel lines

Emergency spill kits with oil boom and absorbent materials will be kept on-site in the event of an accidental spill. Spill kits will be kept in construction compound, the 4x4 vehicle transporting the fuel bowser and smaller spill control kits will be kept in all construction machinery. All construction personnel will be notified of where the spill kits are located as part of the site induction and will be trained on the site procedures for dealing with spills.

In the event of a leak or a spill in the field, the spill kits will be used to contain and absorb the pollutant and prevent any further potential contamination. The absorbed pollutants and contaminated materials will be placed into leak proof containers and transferred to a suitable waste container for hazardous materials in the construction compound. Where a leak has occurred from machinery, the equipment will not be permitted to be used further until the issue has been resolved.

The ECOW (or equivalent appointed person) will be notified of any spills on-site and will determine the requirement to notify the authorities.

Typically, the following procedures will be followed in the event of an incident:

- Works will stop immediately where safe to do so,
- The ECOW (or equivalent appointed person) will be contacted,
- The size of the incident will be assessed and determined if it can be controlled by site staff or if emergency services are required to attend,
- The appropriate enforcing authority will be contacted,
- The ECOW (or equivalent appointed person) will investigate after the incident,
- The findings will be sent to the appropriate authority; and
- An action plan will be prepared to set out any modifications to working practices required to prevent a recurrence.

Accidental break out of silt

Following an accidental break out of silt, emergency measures will be put in place. During the construction period an emergency facility will be provided with sand bags to block off the outlet in the sedimentation ponds to prevent discharge from the sedimentation ponds in the event of a break out of the silt.

Additional silt fencing will be available on site for use in emergencies.

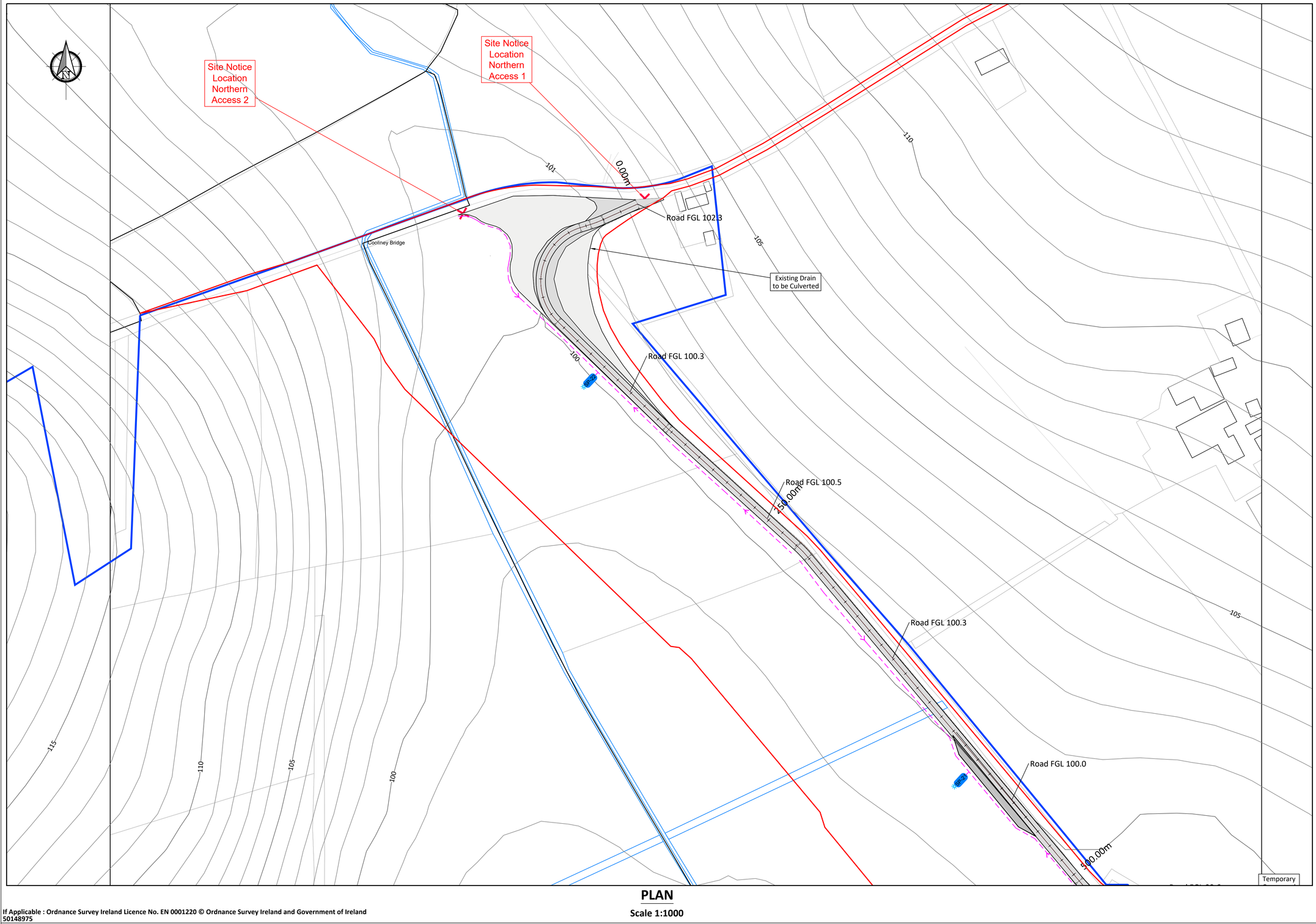
The ECOW will be contacted if there is an accidental spillage or break out of silt on the site.

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 1

Proposed Drainage Layout



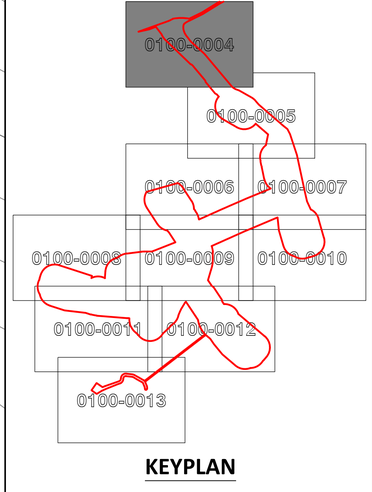
PLAN

Scale 1:1000

Legend

- Planning Boundary
- Property Boundary
- Proposed Wind Farm Access Track
- Existing Road To Be Upgraded
- Passing Bays
- Turning Areas
- Turbine And Hardstanding Areas
- Private Electrical Network Cable Route
- Indicative Buried Grid Connection Cable Route
- Temporary Compound Area
- Substation Compound
- Indicative Location of Roadside Swale
- Cross Drain
- Indicative Interceptor Ditch With Diffuse Outflow
- Stilling Pond With Diffuse Outflow
- Roadside Drain
- Interceptor Ditch
- Diverted Drain
- Culvert
- Sight Lines
- 0.00m Road Chainage
- Wayleave
- Temporary hard standing for the construction phase only, to be used for oversized vehicles associated with turbine component deliveries. To be fenced off when not in use. To be fully reinstated following the construction phase of the project.

Refer to drawings P2359-0100-0014 to P2359-0100-0019 for all 1:500 turbine and hardstand layouts.



KEYPLAN

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Scale 1:1000

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Rev.	Description	App By	Date
A	PLANNING	JH	24.11.21

PROJECT	ANNAGH WIND FARM EIAR
CLIENT	EMPOWER
SHEET	1:1000 SITE LAYOUT SHEET 1 OF 10

Date 24.11.21	Project number P2359	Scale (@ A1) 1:1000	
Drawn by POR	Drawing Number P2359-0100-0004		Rev A
Checked by TB			

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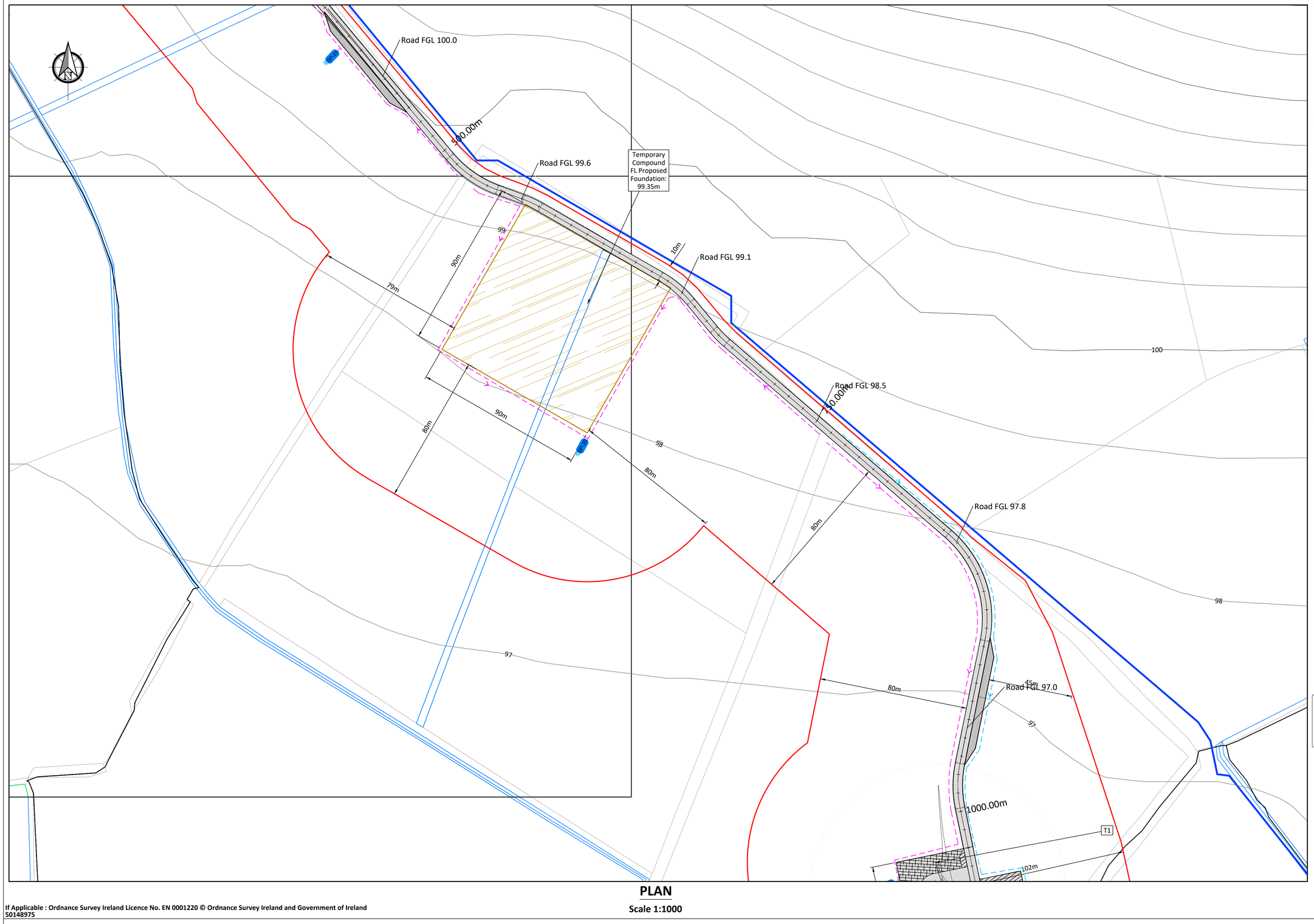
Wednesday 24 November 2021



PLAN

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Rev.	Description	App By	Date
A	PLANNING	JH	24.11.21

PROJECT	ANNAGH WIND FARM EIAR
CLIENT	EMPOWER
SHEET	1:1000 SITE LAYOUT SHEET 2 OF 10
Date	24.11.21
Project number	P2359
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Rev	A
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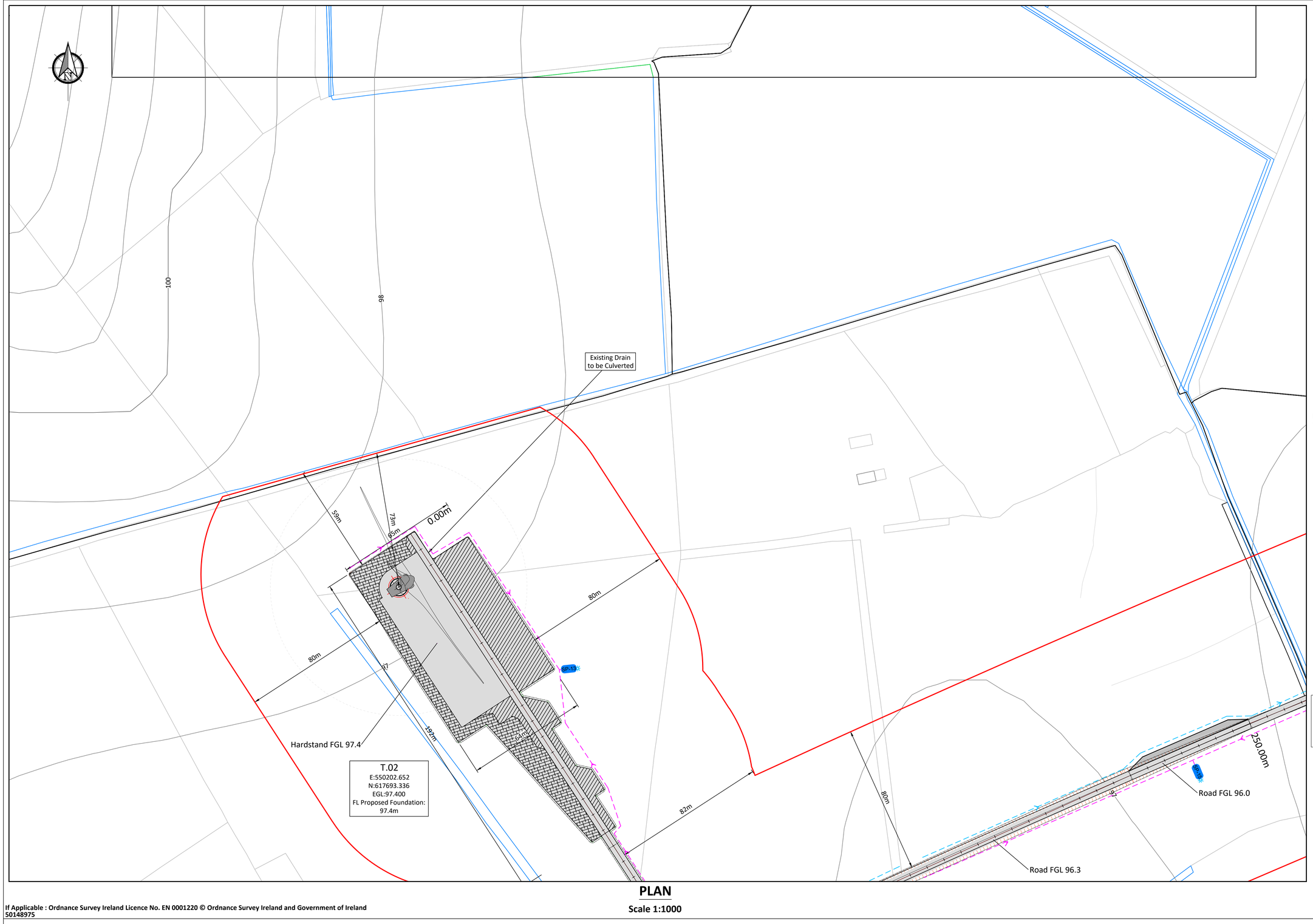
Wednesday 24 November 2021



PLAN

Scale 1:1000

Legend

- Planning Boundary
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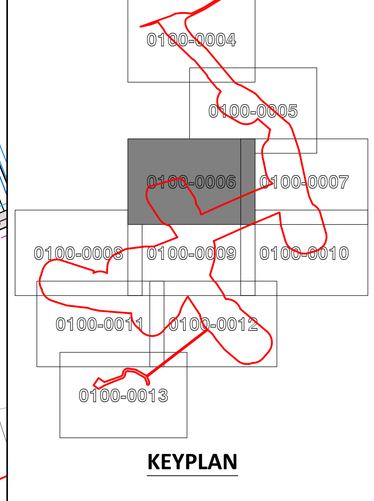
Refer to drawings P2359-0100-0014 to P2359-0100-0019 for all 1:500 turbine and hardstand layouts.



KEYPLAN

0m 10m 20m 30m 40m 50m 60m 70m 80m 90m 100m

Scale 1:1000

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Rev.	Description	App By	Date
A	PLANNING	JH	24.11.21

PROJECT	ANNAGH WIND FARM EIAR
CLIENT	EMPOWER
SHEET	1:1000 SITE LAYOUT SHEET 3 OF 10
Date	24.11.21
Project number	P2359
Scale (@ A1)	1:1000
Drawn by	POR
Drawing Number	P2359-0100-0006
Rev	A
Checked by	TB

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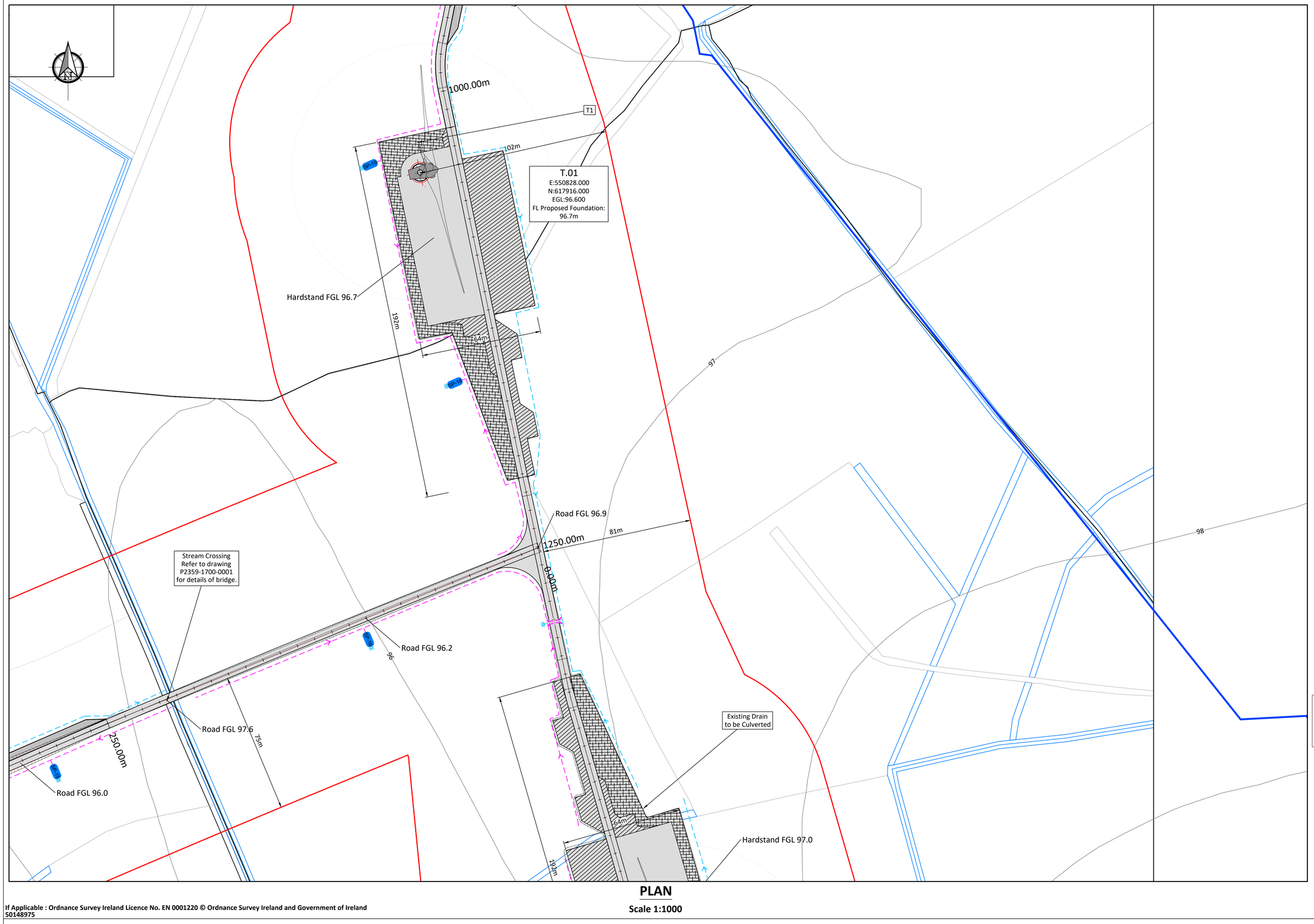
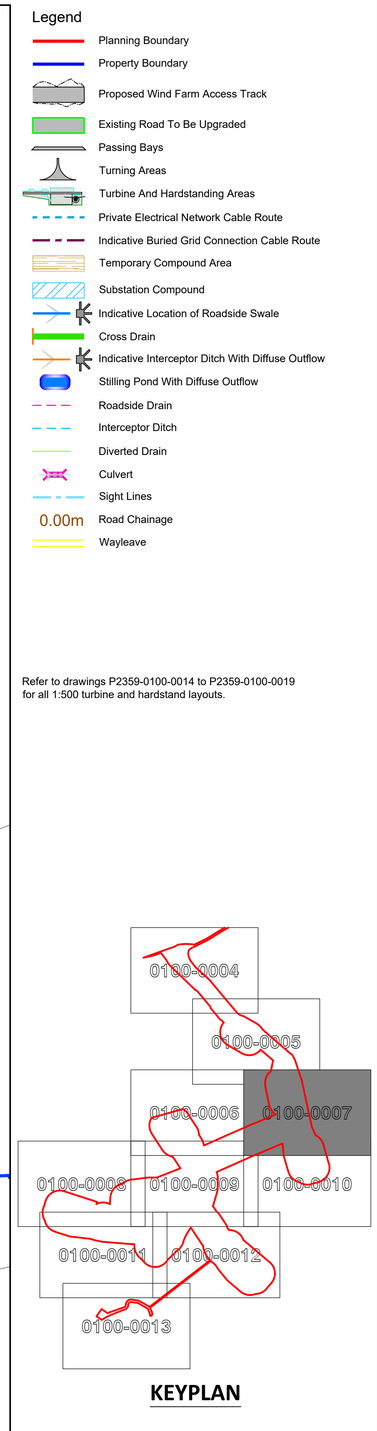
Wednesday 24 November 2021



PLAN

Scale 1:1000



Refer to drawings P2359-0100-0014 to P2359-0100-0019
for all 1:500 turbine and hardstand layouts.

KEYPLAN

0m 10m 20m 30m 40m 50m 60m 70m 80m 90m 100m

Scale 1:1000

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Rev.	Description	App By	Date
A	PLANNING	JH	24.11.21

PROJECT	ANNAGH WIND FARM EIAR
CLIENT	EMPOWER
SHEET	1:1000 SITE LAYOUT SHEET 4 OF 10
Date	24.11.21
Project number	P2359
Scale (@ A1)	1:1000
Drawn by	POR
Checked by	TB
Drawing Number	P2359-0100-0007
Rev	A

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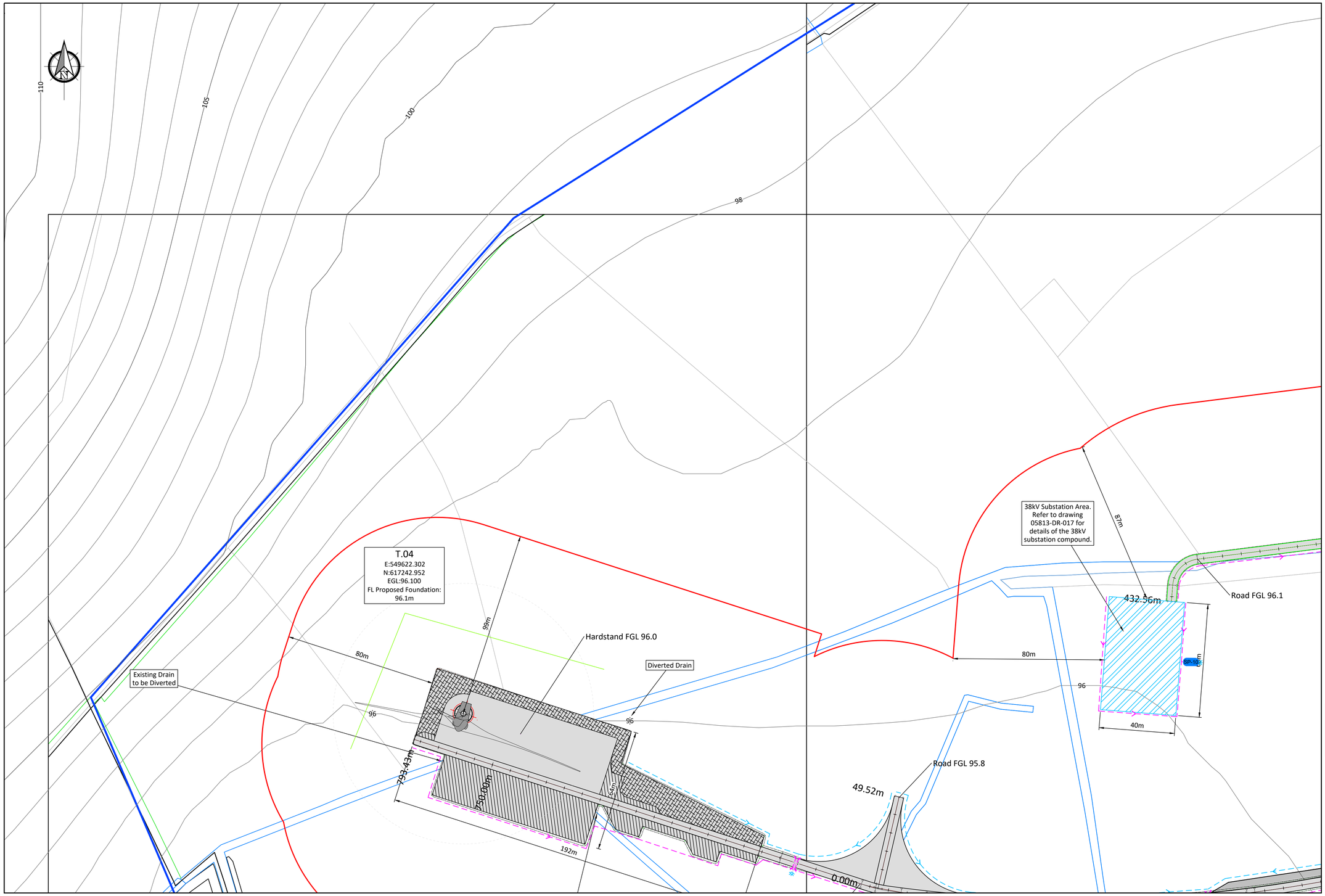
Wednesday 24 November 2021



PLAN

Scale 1:1000

Legend

- Planning Boundary
- Property Boundary
- Proposed Wind Farm Access Track
- Existing Road To Be Upgraded
- Passing Bays
- Turning Areas
- Turbine And Hardstanding Areas
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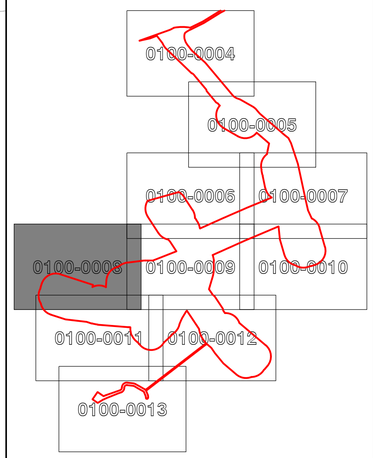
- 0.00m Road Chainage
- Wayleave

Refer to drawings P2359-0100-0014 to P2359-0100-0019 for all 1:500 turbine and hardstand layouts.



KEYPLAN

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Rev.	Description	App By	Date
A	PLANNING	JH	24.11.21

PROJECT	ANNAGH WIND FARM EIAR
CLIENT	EMPOWER
SHEET	1:1000 SITE LAYOUT SHEET 5 OF 10
Date	24.11.21
Project number	P2359
Scale (@ A1)	1:1000
Drawn by	POR
Checked by	TB
Drawing Number	P2359-0100-0008
Rev	A

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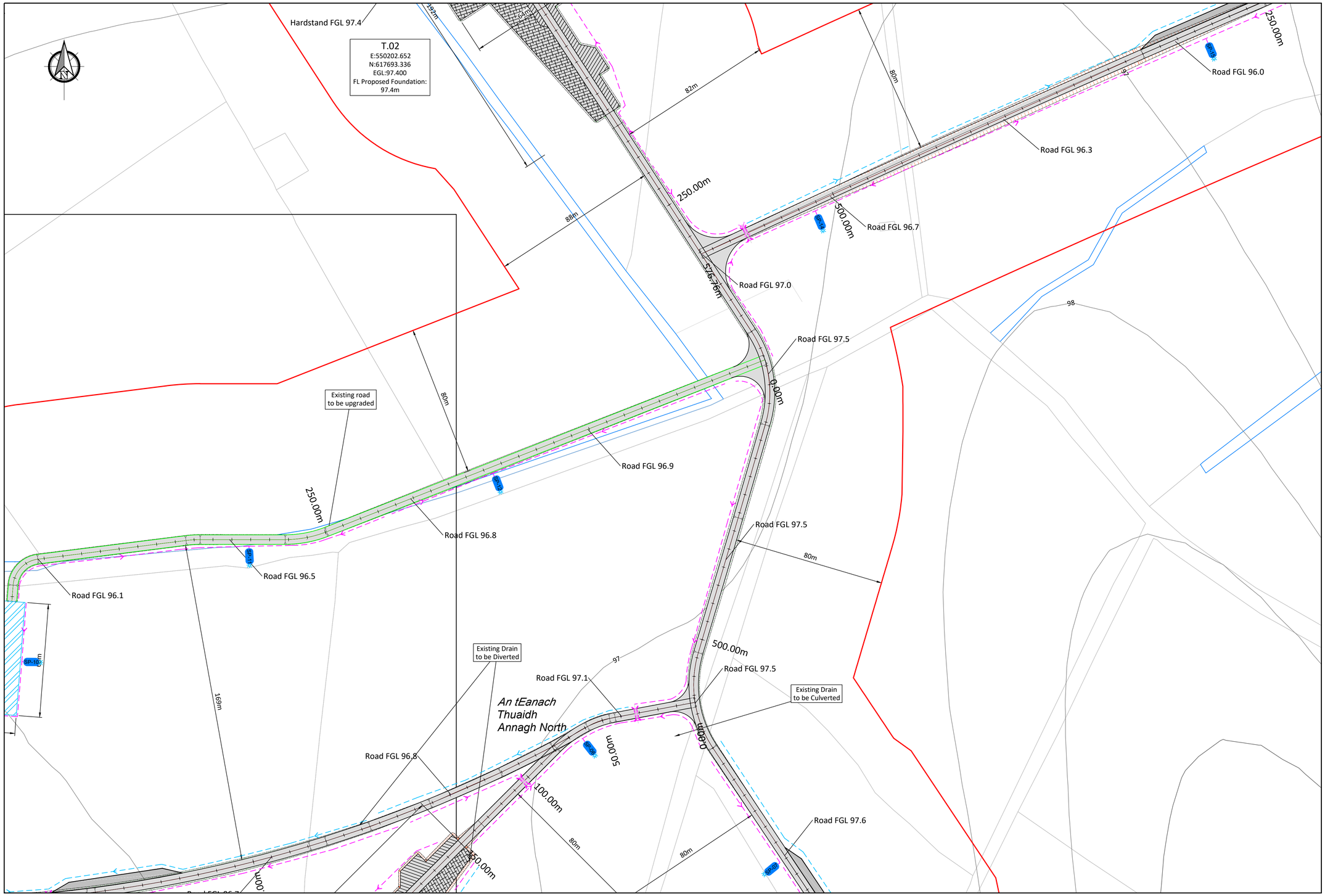
Wednesday 24 November 2021



PLAN

Scale 1:1000

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Legend

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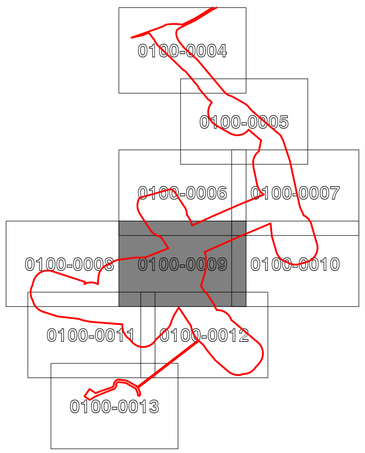
Refer to drawings P2359-0100-0014 to P2359-0100-0019 for all 1:500 turbine and hardstand layouts.



KEYPLAN

0m 10m 20m 30m 40m 50m 60m 70m 80m 90m 100m

Scale 1:1000

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Rev.	Description	App By	Date
A	PLANNING	JH	24.11.21

PROJECT	ANNAGH WIND FARM EIAR
CLIENT	EMPOWER
SHEET	1:1000 SITE LAYOUT SHEET 6 OF 10
Date	24.11.21
Project number	P2359
Scale (@ A1)	1:1000
Drawn by	POR
Checked by	TB
Drawing Number	P2359-0100-0009
Rev	A

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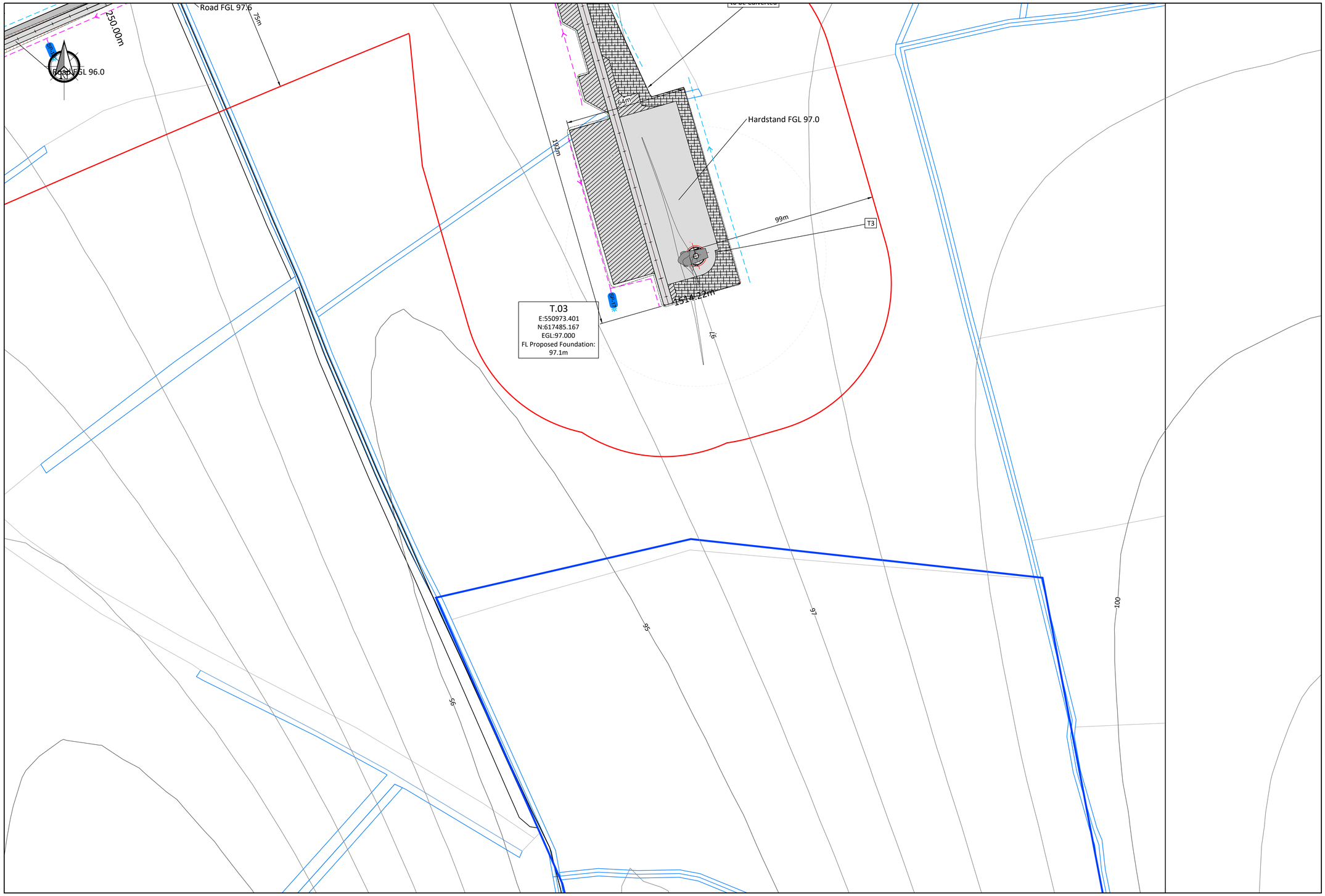
Wednesday 24 November 2021



PLAN

Scale 1:1000

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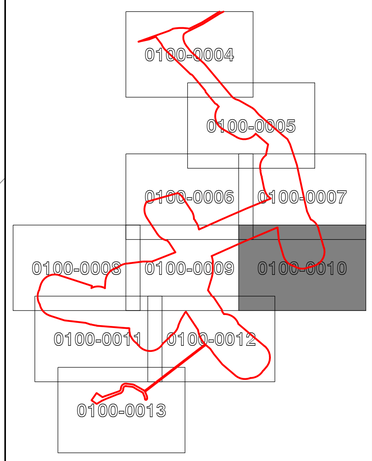
Refer to drawings P2359-0100-0014 to P2359-0100-0019 for all 1:500 turbine and hardstand layouts.



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Rev.	Description	App By	Date
A	PLANNING	JH	24.11.21

PROJECT	ANNAGH WIND FARM EIAR
CLIENT	EMPOWER
SHEET	1:1000 SITE LAYOUT SHEET 7 OF 10

Date 24.11.21	Project number P2359	Scale (@ A1) 1:1000	
Drawn by POR	Drawing Number P2359-0100-0010		Rev A
Checked by TB			

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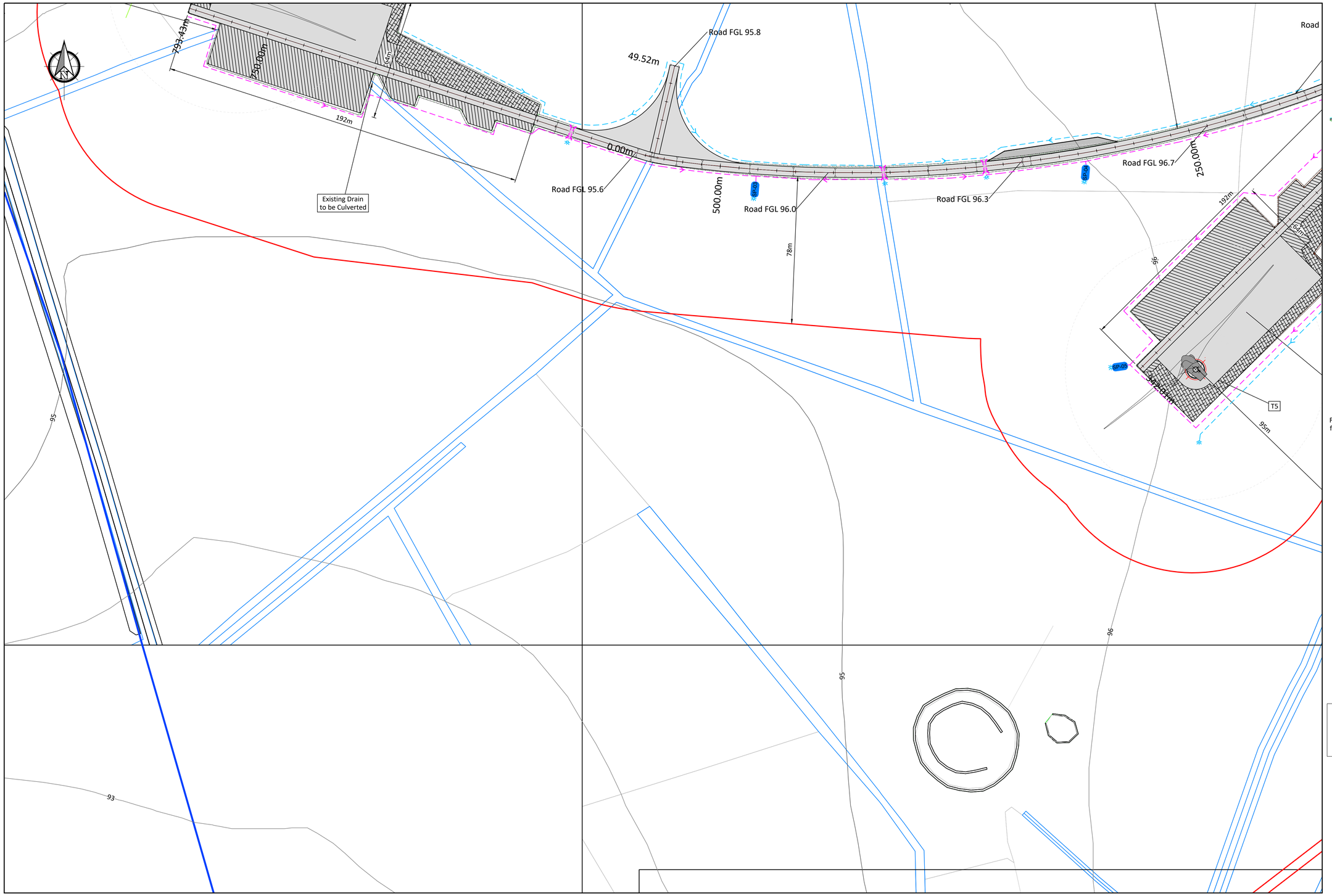

PLAN

Scale 1:1000

Refer to drawings P2359-0100-0014 to P2359-0100-0019 for all 1:500 turbine and hardstand layouts.

KEYPLAN

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Scale 1:1000

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Rev.	Description	App By	Date
A	PLANNING	JH	24.11.21

PROJECT	ANNAGH WIND FARM EIAR
CLIENT	EMPOWER
SHEET	1:1000 SITE LAYOUT SHEET 8 OF 10

Date 24.11.21	Project number P2359	Scale (@ A1) 1:1000	
Drawn by POR	Drawing Number P2359-0100-0011		Rev A
Checked by TB			

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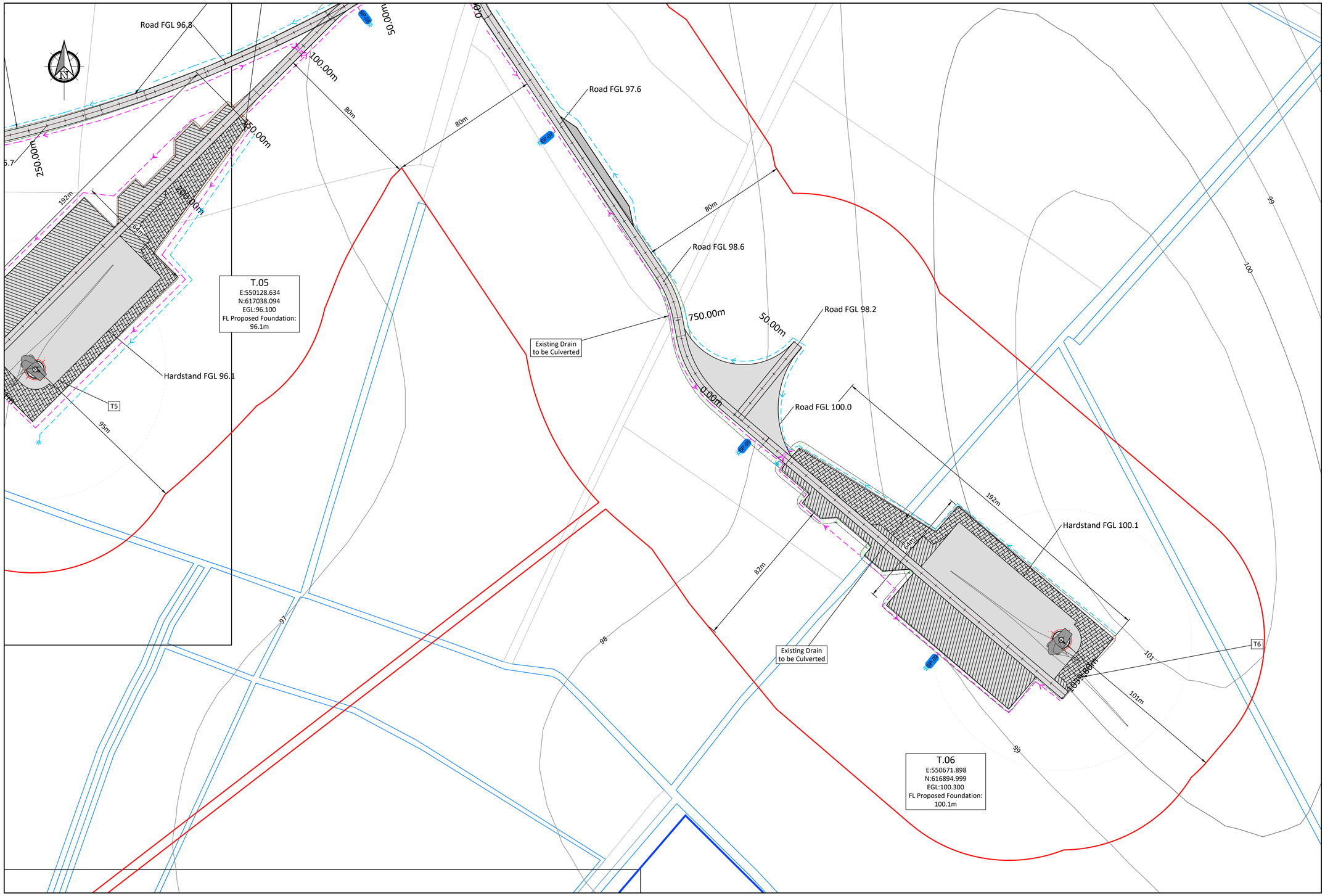

PLAN

Scale 1:1000

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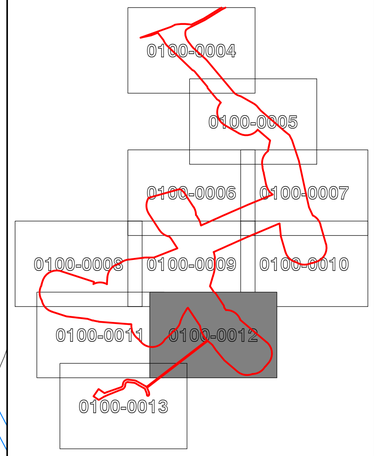
Refer to drawings P2359-0100-0014 to P2359-0100-0019 for all 1:500 turbine and hardstand layouts.



KEYPLAN

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Rev.	Description	App By	Date
A	PLANNING	JH	24.11.21

PROJECT	ANNAGH WIND FARM EIAR
CLIENT	EMPOWER
SHEET	1:1000 SITE LAYOUT SHEET 9 OF 10
Date	24.11.21
Project number	P2359
Scale (@ A1)	1:1000
Drawn by	POR
Checked by	TB
Drawing Number	P2359-0100-0012
Rev	A

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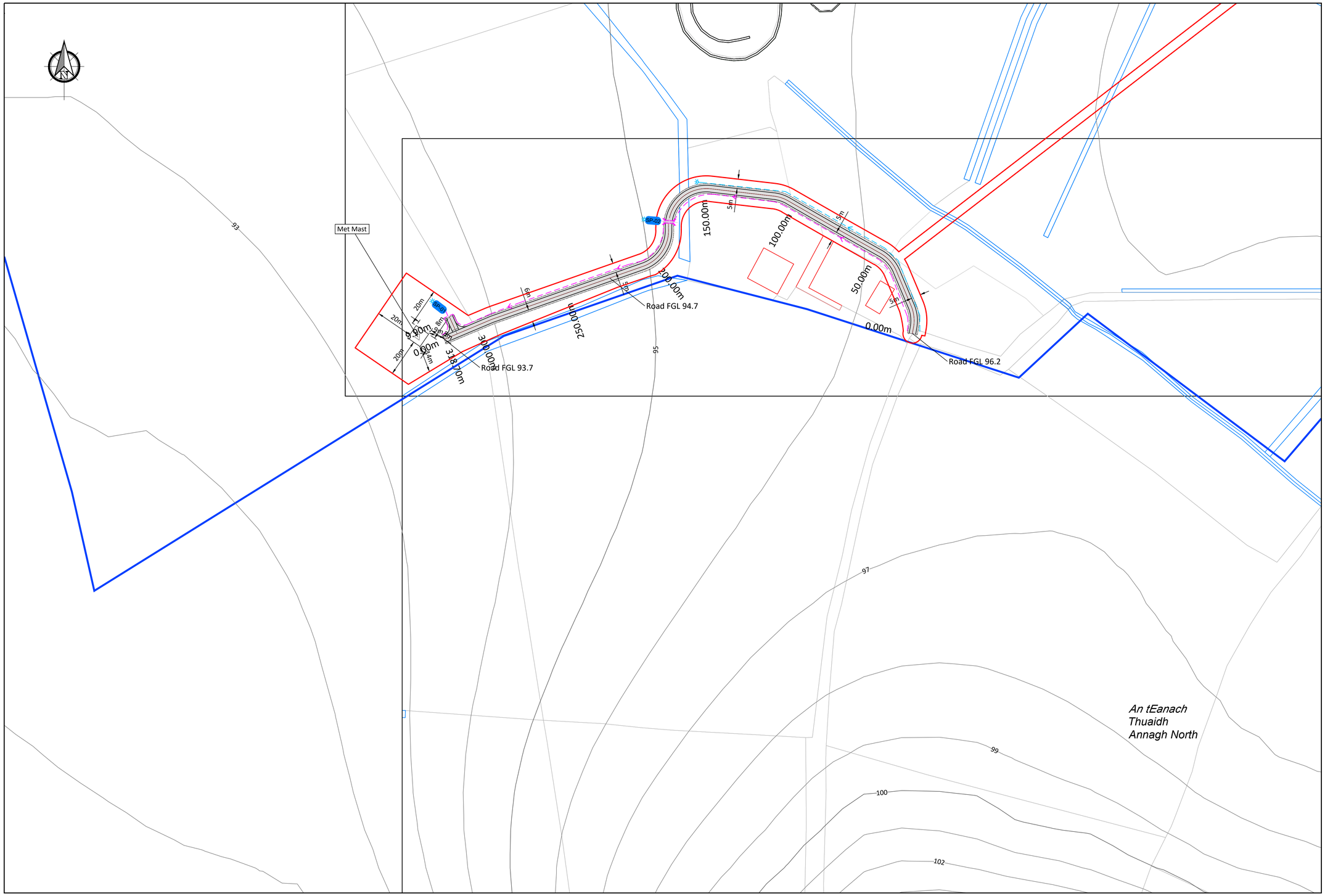
Wednesday 24 November 2021



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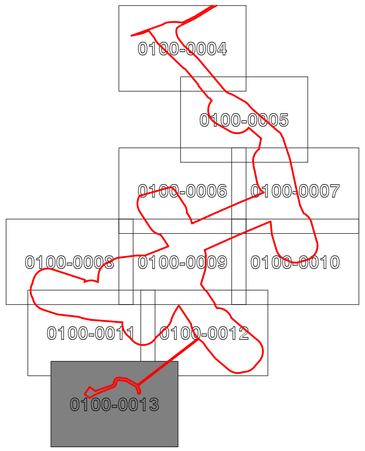

KEYPLAN

0m 10m 20m 30m 40m 50m 60m 70m 80m 90m 100m

Scale 1:1000

PLAN

Scale 1:1000

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Rev.	Description	App By	Date
A	PLANNING	JH	24.11.21

PROJECT	ANNAGH WIND FARM EIAR
CLIENT	EMPOWER
SHEET	1:1000 SITE LAYOUT SHEET 10 OF 10
Date	24.11.21
Project number	P2359
Scale (@ A1)	1:1000
Drawn by	POR
Drawing Number	P2359-0100-0013
Rev	A
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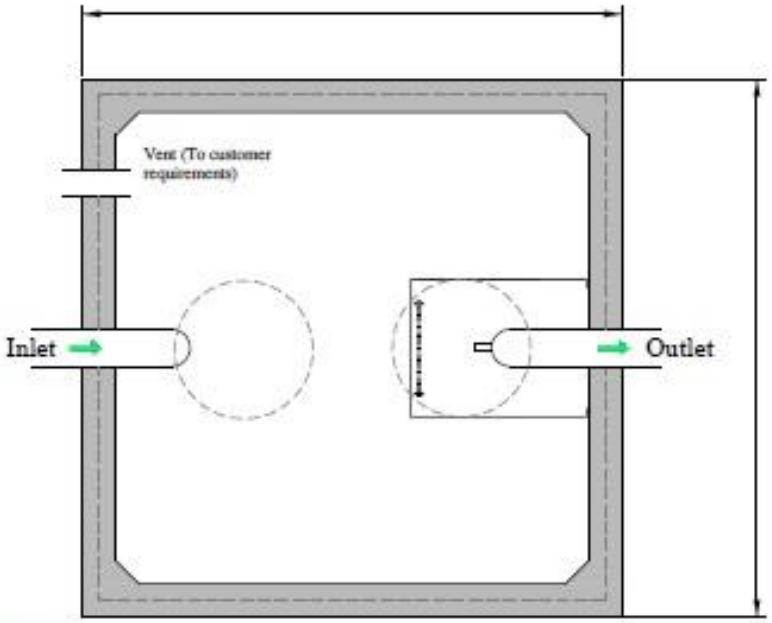
APPENDIX 2

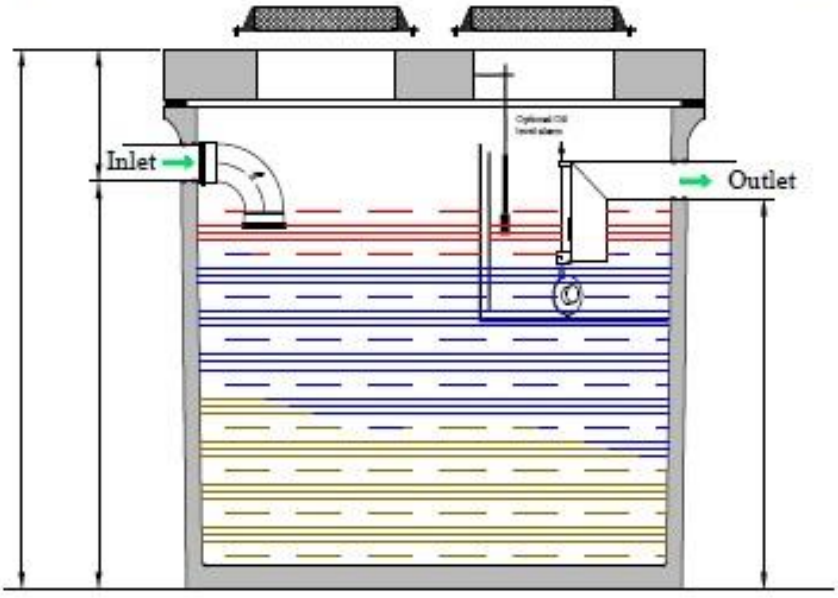
Class 1 Oil Interceptor – example

Full Retention Interceptor Class 1



All the tanks must be placed on a perfectly level and firm suitable base.
Typical layout, variations as required per customer.

An anti-syphon vent is required for long run outflows



MOLLOY
PRECAST
Environmental Solutions
Clara Road, Tullamore, Co. Offaly, Ireland
Tel: 057 9326000 Info@molloyprecast.com
Fax: 057 9326060 www.molloyprecast.com

Note: Observe all safety regulations in regard to excavation and lifting requirements. Never leave opening uncovered or unattended at any time.
Note: Specify any specific requirements prior to ordering. All civil works by customer.
Note: Do not scale from this drawing. Only for illustration purposes.

Tank Type: C Full Retention Interceptor	**Title:**
Tank Size:	Full Retention Interceptors
Height:	**Date:**
Volume:	**Drg. No.:**
Weight:	**Drawn By:**

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APPENDIX 3

Preliminary Design of Settlement Ponds

	Area		Inflow (Rational Equation)	CIRIA 648			
Pond ID	Contriburing Area (m2)	Imp.Contributing Area (m2)	Inflow (m3/s)	Retention time (h)	Pond Volume Required (m3)	Depth (m)	Top Area (m2)
SP1	527	237	0.001	2	9.59	1.5	6.4
SP2	611	275	0.002	2	11.12	1.5	7.4
SP3	11154	5019	0.028	2	202.94	1.5	135.3
SP4	1454	654	0.004	2	26.45	1.5	17.6
SP5	10193	4587	0.026	2	185.46	1.5	123.6
SP6	2804	1262	0.007	2	51.02	1.5	34.0
SP7	1188	535	0.003	2	21.62	1.5	14.4
SP8	3878	1745	0.010	2	70.56	1.5	47.0
SP9	7240	3258	0.018	2	131.73	1.5	87.8
SP10	2417	1088	0.006	2	43.98	1.5	29.3
SP11	1088	490	0.003	2	19.80	1.5	13.2
SP12	1366	615	0.003	2	24.85	1.5	16.6
SP13	9614	4326	0.024	2	174.92	1.5	116.6
SP14	1845	830	0.005	2	33.57	1.5	22.4
SP15	2094	942	0.005	2	38.10	1.5	25.4
SP16	4310	1940	0.011	2	78.42	1.5	52.3
SP17	6962	3133	0.018	2	126.67	1.5	84.4
SP18	8336	3751	0.021	2	151.67	1.5	101.1
SP19	2409	1084	0.006	2	43.83	1.5	29.2
SP20	12302	5536	0.031	2	223.83	1.5	149.2
SP21	5240	2358	0.013	2	95.34	1.5	63.6
SP22	8270	3722	0.021	2	150.47	1.5	100.3

Notes:

- *For tracks and hardstanding areas impervious factor of 0.45 is applied,*
- *Rainfall Intensity for 1-in-10 year return period storm of 60 minutes duration supplied by Met Eireann.*
- *A safety factor of 1.2 is applied.*
- *Q10 flow derived using the Modified Rational method Q=2.78 x (Rainfall Intensity) x (Contributing Impervious Area(factored).)*

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APPENDIX 11.1

Shading Analysis Report

ENERGY PRODUCTION ASSESSMENT FOR PV PLANT IN THE REPUBLIC OF IRELAND

A REPORT FOR EMP ENERGY LIMITED

CLIENT	EMP ENERGY LIMITED
DOCUMENT NO.	BRIW005-R-1
REVISION	B
ISSUE DATE	24/09/2021
STATUS	Final
PREPARED BY	Stefan Mau
CHECKED BY	Martin Laing
APPROVED BY	Nicolas Chouleur

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

DISCLAIMER

This report has been prepared and is issued by Everoze Partners Limited ("Everoze") to the named Client on the title page in accordance with the email proposal 'RE Solar Shading Impact from Annagh Wind Farm' dated 10/08/2021, which governs how and by whom this report should be read and used.

ABBREVIATIONS

AC	Alternate Current
CCTV	Closed-Circuit Television
DC	Direct Current
DIF	Diffuse Horizontal Irradiation
GCR	Ground Coverage Ratio
GHI	Global Horizontal Irradiation
GTI	Global Tilted (Inclined) Irradiation
IAM	Incidence Angle Modifier
IEC	International Electrotechnical Commission
LID	Light-Induced Degradation
LeTID	Light and elevated Temperature Induced Degradation
NREL	National Renewable Energy Laboratory
O&M	Operation & Maintenance
PR	Performance Ratio
PV	Photovoltaic
PVGIS	Photovoltaic Geographical Information System
STC	Standard Test Conditions
TMY	Typical Meteorological Year

VERSION HISTORY

A	Initial version	16/09/2021
B	Update following client comments	24/09/2021

1. EXECUTIVE SUMMARY

This report is delivered to EMP Energy Limited (the "Client") by Everoze Partners Limited in connection with a request to perform a pre-planning Energy Production Assessment (EPA) of a ground mounted PV plant located 6km to the south-west of Charleville, Republic of Ireland (the "Project"), with an assumed power capacity of 33,244 kWp.

The purpose of this assessment is to estimate the energy production of the plant and its associated Performance Ratio (PR) assuming the re-designed planning layout of close-by wind turbines (Annagh wind farm). As a result, Everoze's EPA intends to provide an estimation of the energy generation impact that the wind turbines will have on the Project due to shading. The study is based on meteorological data from different databases and simulations using the latest recognized methodologies and tools, along with Everoze's experience of PV plants.

This is not considered a bankable assessment.

From the resource assessment and simulations undertaken by Everoze the predicted independent energy figures are given in Table 1 below.

Results	GHI (kWh/m²/ Year)	GTI (kWh/m²/ Year)	PR Year 1 (%)	Full load hours P50 (kWh/ kWp)	1-year Production P50 (MWh)	1-year Production P90 (MWh)	10-year Production P90 (MWh)
Without turbines	937.7	1,064.9	84.37%	898.5	29,870	27,005	27,890
6 turbines oriented south-west (Annagh wind farm)	937.7	1,064.9	84.13%	895.9	29,783	26,927	27,809
Difference	0	0	- 0.24	- 2.6	- 87	- 78	- 81
Percentage difference (%)	0	0	- 0.24	- 0.29	- 0.29	- 0.29	- 0.29

TABLE 1: EVEROZE FIGURES FOR THE ENERGY ASSESSMENT

Everoze recommends using a 0.4% degradation figure per year for this project as a P50 evaluation. The uncertainty analysis includes a degradation uncertainty factor.

Everoze's experience in ground mounted solar PV projects in the Republic of Ireland has provided uncertainty in relation to the accuracy of SolarGIS long term irradiation. Based on data from current onsite measured irradiation from pyranometers for other similar projects, Everoze has observed a 3-7% uplift in measured irradiation compared to SolarGIS. Furthermore, SolarGIS Prospect which is much more economic has continually provided irradiation figures very close to the SolarGIS TMY purchased data. For the purposes of this assessment, Everoze has performed the analysis using SolarGIS Prospect data and obtaining the uncertainty in interannual variability from nearby solar PV locations. In order to get a more accurate representation of onsite solar irradiation, Everoze would recommend an onsite measurement campaign.

2. INTRODUCTION

2.1 CONTEXT AND PURPOSE

The purpose of this energy production assessment is to predict the energy production of the solar PV plant and its estimated Performance Ratio (PR) assuming the re-designed planning layout of close-by wind turbines (Annagh wind farm). As a result, Everoze's EPA intends to provide an estimation of the energy generation impact that the wind turbines will have on the Project due to shading. The study is based on meteorological data from different databases and simulations under the latest recognized methodologies and tools, together with Everoze experience.

2.2 OVERVIEW OF THE PROJECT

Table 2 below provides the main characteristics of the Project covered in this report. The location of the project within the Republic of Ireland is shown in Figure 1.

Project	
Coordinates (Lat/Long)	52.310°N, 8.737°W
Mounting structure	Ground-mounted, fixed structure
Modules	Longi LR4-72HpH-450M (assumed)
Module technology	Mono-cSI Half-Cell PERC
Modules capacity (DC)	450Wp
Inverters	SUN2000-185KTL-H1 (assumed)
Inverters capacity (AC)	175kVA
DC/AC ratio	1.42 (assumed)
MV transformer	LV-MW-transformer (assumed)
Modules configuration	Landscape
String configuration	25 modules (assumed)
Tilt (°)	25°
Azimuth (0°=South)	0°

TABLE 2: MAIN CHARACTERISTICS OF THE PROJECT

FIGURE 1: LOCATION OF THE PROJECT (SOURCE: GOOGLE EARTH)

3. RESOURCE

3.1 AVAILABLE DATASETS

For the estimation of irradiation and temperature for the Project SolarGIS Prospect was considered.

3.1.1 SolarGIS - Prospect

SolarGIS - Prospect [3] is a high-resolution climate database operated by Solargis s.r.o. Primary data layers include solar irradiation, air temperature and terrain (elevation, horizon). SolarGIS - Prospect provides monthly data for a 25-years period from 1994 to 2018 over Europe. Solar irradiation is calculated from the following satellite and atmospheric data: Meteosat PRIME satellite (© EUMETSAT, Germany) 1994 - 2015, 15-minute or 30-minute values for Europe, MACC-II/CAMS (© ECMWF, UK) 2003 - 2015, GFS, CFSR (© NOAA, USA), 1994 – 2015 and MERRA-2 (© NASA, USA), 1994 – 2002 for atmospheric data.

3.2 SELECTION OF THE SOLAR DATA SOURCE

3.2.1 Selected dataset

The selected meteorological dataset for the considered site is SolarGIS Prospect. . According to independent reviews, SolarGIS [5] and [6] it is considered the most accurate data source. It is also the dataset with the most up-to-date data available.

Table 3 below presents the datasets for GHI, Direct Horizontal Irradiation (DIF) and temperature from the SolarGIS Prospect dataset. It slightly differs from the long-term average.

Data source	GHI (kWh/m²) (1994-2021)	DIF (kWh/m²) (1994-2021)	Temperature (°C) (1994-2021)
January	22.4	15.3	5.5
February	37.5	24.6	5.6
March	72.4	45.5	6.5
April	109.8	65.1	8.3
May	138.5	81.9	10.9
June	140.2	84.4	13.4
July	129.7	86.0	14.8
August	112.9	73.3	14.6
September	80.6	52.3	13.0
October	49.8	33.0	10.4
November	26.5	17.7	7.5
December	17.4	12.1	5.9
Year	**937.7**	**591.3**	**9.7**

TABLE 3: TMY DATA FROM SOLARGIS FOR GHI, DIF AND TEMPERATURE

Everoze's experience in ground mounted solar PV projects in the Republic of Ireland has provided uncertainty in relation to the accuracy of SolarGIS long term irradiation. Based on data from current onsite measured irradiation from

pyranometers for other similar projects, Everoze has observed a 3-7% uplift in measured irradiation compared to SolarGIS. Furthermore, SolarGIS Prospect which is much more economic has continually provided irradiation figures very close to the SolarGIS TMY purchased data. For the purposes of this assessment, Everoze has performed the analysis using SolarGIS Prospect data and obtaining the uncertainty in interannual variability from nearby solar PV locations. In order to get a more accurate representation of onsite solar irradiation, Everoze would recommend an onsite measurement campaign.

4. PREDICTED LOSSES

4.1 METHODOLOGY

For the purpose of assessing the energy delivered by a PV plant, Everoze uses the industry standard tool PVsyst (version 7.2.4), combined with extensive experience of analysing PV plants.

The losses that are applied between the raw energy delivered on the module plane and the AC electricity at the network delivery point are described below.

Shading: The PV modules are affected by shading. Shading has two effects, one on the direct irradiation received by the plant and one on the diffuse irradiation. The orientation of the PV modules and their mode of connection has a direct effect on this loss. It can be divided in two categories:

- The long-range shading (horizon) is due to the effect of the terrain surrounding the PV plant, such as mountains or hills.
- The nearby shading is due to objects affecting the PV plant locally. This can be trees, buildings, containers on site, and mostly row-to-row shading.

Global incident below threshold: For simulation hours when the incident irradiance (GlobInc parameter) value is below a given threshold, PVsyst does not perform the simulation. Up to now this (little) loss was included in the Near Shading or IAM loss contribution.

Reflection losses: Incidence angle modifier (IAM) losses account for radiation reflected from the front glass when the light is not striking the module perpendicularly.

Irradiance losses: The efficiency of PV modules varies with the irradiance. The rated power of the PV modules is given at Standard Test Conditions (STC) (1,000W/m², 25°C, AM 1.5). Since the irradiance reaching the PV modules varies from 0 to 1,200W/m² maximum, the losses when there is a deviation from the STC conditions should be taken into account.

Temperature losses: The rated power of the PV modules is given at STC conditions. When the temperature increases above the STC temperature of 25°C (due to ambient temperature, but also the modules being heated by irradiance), the power of the module decreases.

Soiling losses: This loss is due to the accumulation of dirt on the surface of the PV modules resulting in less irradiance reaching the cells. Soiling losses depend strongly on the site location, the environment (pollens, agricultural aerosols, pollution, bird nesting) and the rain levels. Soiling can be uniform (pollution) or heterogeneous. These losses can be mitigated by planning a regular cleaning of the modules.

Module quality losses: The PV modules do not match their rated capacity, being manufactured products. Depending on the tolerance for the classification of the module, a different power output can be expected.

First-year degradation: Light-Induced Degradation (LID) is a known phenomenon in the industry. The PV modules often degrade from the day they are installed. Independent tests on the PV modules can be undertaken to further determine the scale of these losses. The loss factor associated to LID is not the same for monocrystalline and polycrystalline modules (1.5%) and for n-type silicon cells (0.0%).

PERC cells are subject to a different degradation phenomenon from LID, known as LeTID (Light and elevated Temperature Induced Degradation). There is currently no standard to evaluate LeTID losses for PERC cells. According to literature, it is expected that LeTID will be similar to LID for standard cells with back-surface field but they should occur later. We recommend that the Client requests the module manufacturer to provide LeTiD test results from independent third-party prior to finalizing the module purchase agreement.

Mismatch: The PV modules combined on a string/inverter do not exhibit the exact same electrical characteristics (current/voltage). The mismatch between the modules creates a loss at the system level.

DC cable losses: The cables present ohmic losses due to the cable resistance on the DC cabling of the PV plant. These losses can be further determined by entering the results of cable losses calculations at STC as inputs in PVsyst.

Inverter losses: Different losses are experienced at the inverter level:

- Inverter efficiency.
- Overloaded inverter due to high DC/AC ratio (in certain conditions).
- Grid limitation and grid reactive power request.
- Inverter input DC voltage range.

AC cable losses: The cables present ohmic losses due to the cable resistance on the AC cabling of the PV plant. These losses can be further determined by entering the results of cable losses calculations at STC as inputs in PVsyst.

Transformer losses: The transformer losses are a combination of iron losses and ohmic losses. These can be estimated from the transformer datasheet.

Auxiliary consumption: The PV plant is using electricity for its own consumption. For instance, the CCTVs, the monitoring systems, the lights, the fence detectors and the inverters need energy to be powered and in operation.

Availability of the plant: The plant output energy is also limited by downtime due to different factors:

- The O&M availability, where the downtime is due to a component failure which is the responsibility of the O&M contractor, for instance: inverter, combiner box, or other components. A contractual availability figure is usually set in the Project's O&M contract.
- The network availability, where the downtime is due to the grid not being available or the grid characteristics (frequency, voltage) resulting in disconnection of the PV plant/inverters. Usually this downtime is excluded from the responsibility of the O&M contractor. However, the response time of the O&M contractor to reconnect the PV plant needs to be verified.

A summary of the general hypothesis and losses assumptions included in Everoze methodology is provided in Table 4 and Table 5.

Hypothesis	Comment
Weather data	From SolarGIS.
GHI (kWh/m²)	SolarGIS Prospect
GTI (kWh/m²)	From PVsyst
Transposition gain	Fraction of irradiation gained between GHI and GTI.

TABLE 4: COMMENTS ON GENERAL HYPOTHESES

Losses	Comment
Global incident below threshold	From PVsyst.
Shading horizon line	From Meteonorm 8.
Shading	From 3D model in PVsyst (see Appendix 1).
IAM	Default ASHRAE model value Bo=0.04 since the modules are equipped with anti-reflection coating
Soiling	Everoze experience, assuming one cleaning planned every 5 years.
Irradiance level	From PVsyst.
Temperature	From PVsyst, with wind figures from SolarGIS and the parameter Uc=29W/m²K.
Shading electrical	From PVsyst, assuming string shading.
Module quality	Positive tolerance of the modules based on datasheet.
First-year degradation	Everoze experience and literature. Adjusted with regards to the technology of the PV modules.

Losses	Comment
Mismatch	Everoze estimation.
DC cables	1% Everoze estimation
Inverter efficiency	From PVsyst.
Inverter other	From PVsyst and conditions for the project.
Transformer	0.1% Iron losses, 0.9% coppers losses, Everoze estimation
AC losses	1.5% Everoze estimation
Auto consumption	Everoze experience on other similar plants
Curtailment	Not assumed
Unavailability	1% Everoze estimation

TABLE 5: COMMENTS ON LOSSES ASSUMPTIONS

To determine the energy production at the metering point the Performance Ratio (PR) is then calculated.

The PR for a time period is defined in IEC 61724 as: $PR = \frac{Y_{fAC}}{Y_r}$

Where:

- Y_{fAC} is the AC system yield defined as the measured AC energy produced by the PV system in the considered period (kilowatt hours) divided by the rated power of the PV system. The definition of this rating is not specified in IEC 61724, but is defined here as DC power rating at STC conditions (1,000W/m2, cell temperature of 25°C, and AM 1.5 spectrum).
- Y_r is the plane-of-array insolation (kWh/m²) divided by the reference irradiance (1,000W/m²). Y_r is in units of time.

The PR is calculated using the combination of all the losses presented above.

4.2 CALCULATED LOSSES AND PERFORMANCE RATIO

Table 6, Table 7 and Table 8 below, present input data, breakdown of losses and performance results for the Project.

Hypothesis	Without turbines	6 turbines oriented south-west
Installed DC Power (kWp)	33,243.8	33,243.8
Azimuth (0°=South)	25	25
Tilt Angle	0	0
GHI (kWh/m²)	937.7	937.7
GTI (kWh/m²)	1,065	1,065
Transposition gain	13.6%	13.6%

TABLE 6: SUMMARY OF MAIN INPUT DATA

Losses	Without turbines	6 turbines oriented south-west
GTI below threshold	0.11%	0.11%
Far shading	0.00%	0.00%
Near shading	2.80%	2.91%
IAM	2.52%	2.51%
Soiling	1.00%	1.00%
Irradiance level	1.67%	1.67%
Temperature	-0.14%	-0.15%
Electrical shading	0.60%	0.78%
Module quality	-0.28%	-0.28%
First-year degradation	2.00%	2.00%
Mismatch	0.70%	0.70%
DC cables	0.47%	0.47%
Inverter efficiency	1.61%	1.61%
Inverter other	1.01%	1.01%
LV/MV-Transformer	0.82%	0.82%
AC losses	0.64%	0.64%
Auxiliary consumption	0.30%	0.30%
Other (e.g. HV transfo, export line)	0.00%	0.00%
Downtime	1.00%	1.00%

TABLE 7: BREAKDOWN OF LOSSES

Results	PR – First year (%)	P50 – First year (MWh)	Full load hours P50 – First year (kWh/kWp)
Without turbines	84.37%	29,870	898.5
6 turbines oriented south-west (Annagh wind farm)	84.13%	29,783	895.9
Difference	- 0.24	- 87	- 2.6
Percentage difference (%)	- 0.24	- 0.29	- 0.29

TABLE 8: MAIN RESULTS

4.3 LONG-TERM DEGRADATION

The performance of a PV plant is subject to different degradation factors. It is known that solar PV modules have a power output degradation and this phenomenon significantly contributes to the system level degradation of the plant. The Balance of System (BoS) degradation should be considered as well during the life of the project.

The literature on the degradation of PV modules and PV systems is quite extensive and research is continuously ongoing on this hot topic. A wide range of degradation estimates are found in the literature, usually in the range of 0% to 1.1%. The most widely recognised research publication is the NREL paper [7] which is referenced by many (and it is understood an update to this paper is ongoing). It presents a wide distribution of degradation from 0.1% per year to more than 3% per year, with a median value of 0.5% per year and an average figure of 0.8%/year.

Assuming this project uses crystalline silicon modules, Everoze recommends for this Project a 0.4% degradation figure per year as a P50 evaluation. The uncertainty analysis presents a degradation uncertainty factor. This assumption should be verified during plant operation.

5. UNCERTAINTIES ANALYSIS

The uncertainties which are applicable to the assessment for the case ´without turbines´ here are summarized in Table 9 below:

- **Uncertainty on the data source**: This is the uncertainty on the data selected for the analysis. This uncertainty has been further reduced with a long-term satellite data set correlated with on-site ground measurements.
- **Inter-annual variability**: This reflects the year-to-year variation of the solar resource, GHI. It is the standard deviation of the annual sum of GHI over the period 1994 to 2020. This uncertainty is reduced when considering the average annual production over longer period of 10 years by dividing the annual figure by the square root of the number of years (10 in this case).
- **Transposition**: Based on the spread of results obtained when undertaking a number of different transpositions.
- **Simulation**: The uncertainty of the simulation and defined losses.
- **Degradation**: As discussed above, the degradation of the PV plant is widely discussed and is not a fixed figure but rather inherently an uncertain figure, hence the inclusion of an associated uncertainty figure.

Table 9 below presents a breakdown of the uncertainties for the 1-year and 10-year energy predictions.

Parameter	Uncertainty (%) 1 year	Uncertainty (MWh) 1 year	Uncertainty (%) 10 year	Uncertainty (MWh) 10 year
Uncertainty on the source data	3.50%	1045.4	3.50%	1045.4
Interannual variability	5.70%	1702.6	1.80%	538.4
Transposition uncertainty	0.00%	0.0	0.00%	0.0
Simulation (losses) uncertainty	3.00%	896.1	3.00%	896.1
Degradation	1.50%	448.0	1.50%	448.0
Total uncertainty	**7.48%**	**2,235.0**	**5.17%**	**1,544.8**

TABLE 9: UNCERTAINTIES BREAKDOWN – 1-YEAR AND 10-YEARS

The associated probabilities of exceedance (P90, P75 and P50) for the future 1-year and 10-year energy production are given in Table 10 below.

Project	Probability of exceedance	Future 1-year production (MWh/annum)	Future 10-year production (MWh/annum)
´Without turbines´	P90	27,005	27,890
	P75	28,362	28,828
	P50	29,870	29,870

TABLE 10: PROBABILITIES OF EXCEEDANCE FOR 1-YEAR AND 10-YEAR PRODUCTION

6. REFERENCES

[1] PVGIS 5: http://re.jrc.ec.europa.eu/pvg_tools/en/tools.html

[2] SolarGIS: https://solargis.info/

[3] pvPlanner: https://solargis.info/pvplanner

[4] Meteonorm: http://www.meteonorm.com/

[5] Pierre Ineichen: Long Term Satellite Global, Beam and Diffuse Irradiance Validation, Energy Procedia, Volume 48, 2014, Pages 1586–1596

[6] Pierre Ineichen: Five Satellite products deriving beam and global irradiance validation on data from 23 ground stations, University of Geneva, February 2011

[7] Jordan, Kurtz, Compendium of photovoltaic degradation rates, 2016

APPENDIX 1: 3D shading model

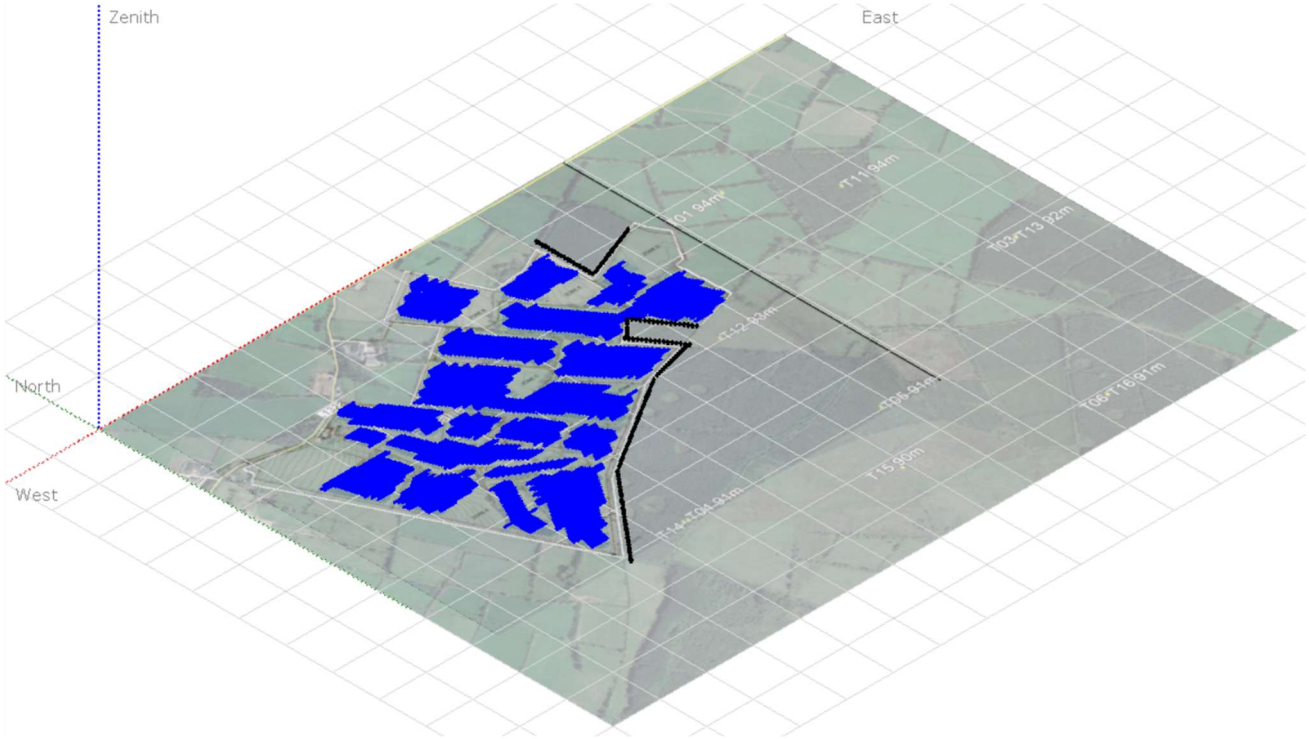

FIGURE 2: 3D SHADING MODEL ´WITHOUT TURBINES´

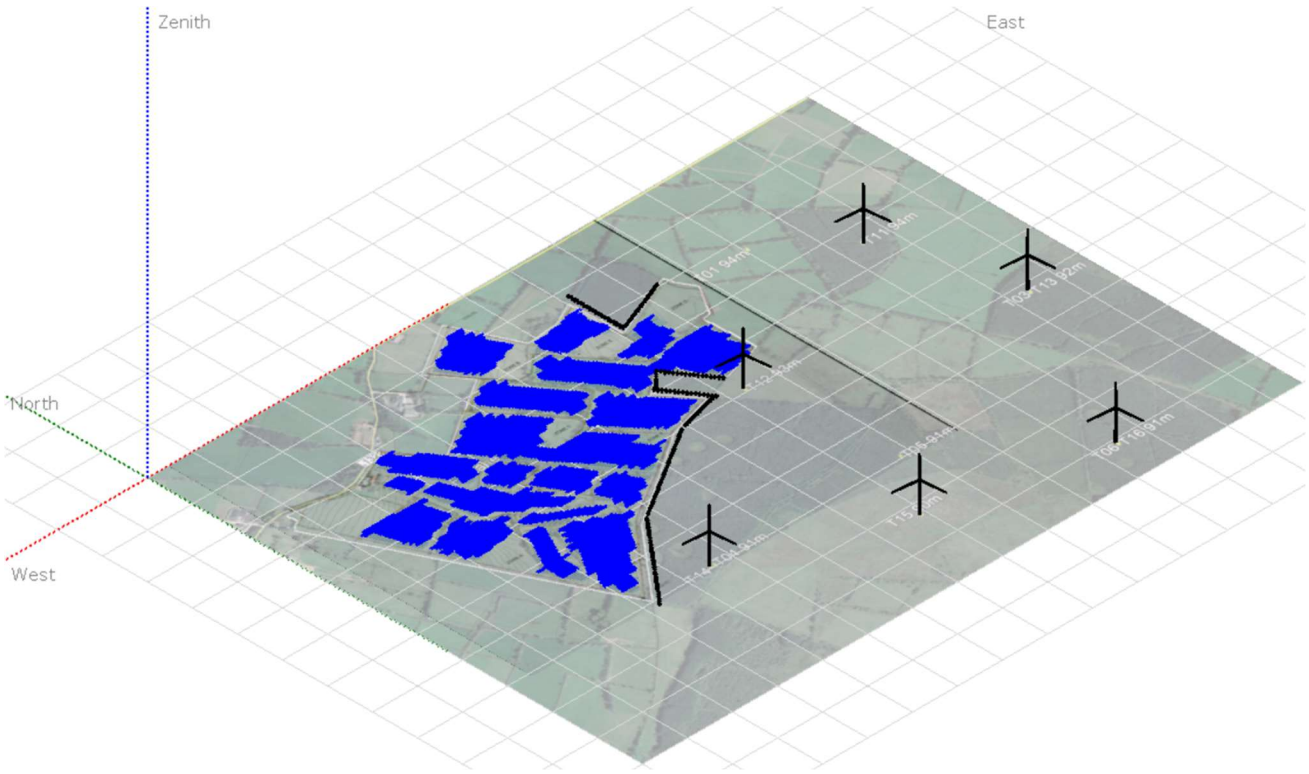

FIGURE 3: 3D SHADING MODEL ´6 TURBINES ORIENTED SOUTH-WEST´

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APPENDIX 12.1

Shadow Flicker Modelling Input Data

ReceptorID	X Coordinate (ITM)	Y Coordinate (ITM)	Façade ID	Façade Centre - Offset from X Coordinate (m)	Façade Centre - Offset from Y Coordinate (m)	Façade Width (m)	Façade Height (m)	Façade Centre Height Above Ground (m)	Direction from North (°)
1	550246	616015	1-1	-9	0	12	2	1.1	271
			1-2	0	5	20	2	1.1	1
			1-3	9	0	12	2	1.1	91
			1-4	0	-5	20	2	1.1	181
2	550187	616079	2-1	0	4	17	2	1.1	357
			2-2	8	0	9	2	1.1	87
			2-3	0	-4	17	2	1.1	177
			2-4	-8	0	9	2	1.1	267
3	551204	616311	3-1	-9	10	8	2	1.1	318
			3-2	2	2	28	2	1.1	48
			3-3	9	-10	8	2	1.1	138
			3-4	-2	-2	28	2	1.1	228
4	549942	615917	4-1	0	3	9	2	1.1	358
			4-2	4	0	7	2	1.1	88
			4-3	0	-3	9	2	1.1	178
			4-4	-4	0	7	2	1.1	268
5	549915	615806	5-1	-3	0	10	2	1.1	278
			5-2	0	4	8	2	1.1	8
			5-3	3	0	10	2	1.1	98
			5-4	0	-4	8	2	1.1	188
6	550512	616206	6-1	0	7	11	2	1.1	359
			6-2	5	0	16	2	1.1	89
			6-3	0	-7	11	2	1.1	179
			6-4	-5	0	16	2	1.1	269
7	550503	616033	7-1	-2	5	15	2	1.1	334
			7-2	6	3	12	2	1.1	64
			7-3	2	-5	15	2	1.1	154
			7-4	-6	-3	12	2	1.1	244
8	550161	616057	8-1	0	5	9	2	1.1	358
			8-2	4	0	12	2	1.1	88
			8-3	0	-5	9	2	1.1	178
			8-4	-4	0	12	2	1.1	268
9	550050	615904	9-1	-4	1	9	2	1.1	290
			9-2	1	4	9	2	1.1	20
			9-3	4	-1	9	2	1.1	110
			9-4	-1	-4	9	2	1.1	200
10	550072	615899	10-1	-7	2	16	2	1.1	286
			10-2	2	7	15	2	1.1	16
			10-3	7	-2	16	2	1.1	106
			10-4	-2	-7	15	2	1.1	196
11	549910	615857	11-1	-4	1	17	2	1.1	284
			11-2	2	8	9	2	1.1	14
			11-3	4	-1	17	2	1.1	104
			11-4	-2	-8	9	2	1.1	194
12	550023	615907	12-1	-8	2	14	2	1.1	288
			12-2	2	6	18	2	1.1	18
			12-3	8	-2	14	2	1.1	108
			12-4	-2	-6	18	2	1.1	198
13	551256	616464	13-1	-4	4	22	2	1.1	318
			13-2	8	7	12	2	1.1	48
			13-3	4	-4	22	2	1.1	138
			13-4	-8	-7	12	2	1.1	228
14	550099	615910	14-1	0	2	7	2	1.1	359
			14-2	3	0	5	2	1.1	89
			14-3	0	-2	7	2	1.1	179
			14-4	-3	0	5	2	1.1	269
15	551317	616474	15-1	-3	2	15	2	1.1	307
			15-2	4	5	9	2	1.1	37
			15-3	3	-2	15	2	1.1	127
			15-4	-4	-5	9	2	1.1	217
16	551284	616537	16-1	-3	2	10	2	1.1	299
			16-2	2	4	9	2	1.1	29
			16-3	3	-2	10	2	1.1	119
			16-4	-2	-4	9	2	1.1	209

17	551354	616674	17-1	-2	1	9	2	1.1	294
			17-2	1	4	6	2	1.1	24
			17-3	2	-1	9	2	1.1	114
			17-4	-1	-4	6	2	1.1	204
18	549993	616018	18-1	0	3	18	2	1.1	358
			18-2	8	0	7	2	1.1	88
			18-3	0	-3	18	2	1.1	178
			18-4	-8	0	7	2	1.1	268
19	549939	615800	19-1	-5	1	8	2	1.1	283
			19-2	0	3	12	2	1.1	13
			19-3	5	-1	8	2	1.1	103
			19-4	0	-3	12	2	1.1	193
20	549468	618217	20-1	-1	1	8	2	1.1	322
			20-2	3	2	5	2	1.1	52
			20-3	1	-1	8	2	1.1	142
			20-4	-3	-2	5	2	1.1	232
21	548557	617899	21-1	-1	4	16	2	1.1	344
			21-2	7	2	10	2	1.1	74
			21-3	1	-4	16	2	1.1	164
			21-4	-7	-2	10	2	1.1	254
22	549030	618103	22-1	-1	4	9	2	1.1	343
			22-2	4	1	10	2	1.1	73
			22-3	1	-4	9	2	1.1	163
			22-4	-4	-1	10	2	1.1	253
23	548285	617846	23-1	0	4	10	2	1.1	352
			23-2	4	0	9	2	1.1	82
			23-3	0	-4	10	2	1.1	172
			23-4	-4	0	9	2	1.1	262
24	549542	618506	24-1	-3	4	23	2	1.1	320
			24-2	8	7	12	2	1.1	50
			24-3	3	-4	23	2	1.1	140
			24-4	-8	-7	12	2	1.1	230
25	549616	618216	25-1	-4	1	21	2	1.1	284
			25-2	2	10	10	2	1.1	14
			25-3	4	-1	21	2	1.1	104
			25-4	-2	-10	10	2	1.1	194
26	549438	618168	26-1	-2	2	14	2	1.1	317
			26-2	5	4	6	2	1.1	47
			26-3	2	-2	14	2	1.1	137
			26-4	-5	-4	6	2	1.1	227
27	548912	618087	27-1	-1	3	21	2	1.1	333
			27-2	9	4	7	2	1.1	63
			27-3	1	-3	21	2	1.1	153
			27-4	-9	-4	7	2	1.1	243
28	548956	617988	28-1	-2	2	14	2	1.1	321
			28-2	5	4	7	2	1.1	51
			28-3	2	-2	14	2	1.1	141
			28-4	-5	-4	7	2	1.1	231
29	548676	617949	29-1	-2	4	17	2	1.1	334
			29-2	7	3	11	2	1.1	64
			29-3	2	-4	17	2	1.1	154
			29-4	-7	-3	11	2	1.1	244
30	548514	617910	30-1	-2	6	8	2	1.1	340
			30-2	3	1	13	2	1.1	70
			30-3	2	-6	8	2	1.1	160
			30-4	-3	-1	13	2	1.1	250
31	548341	617847	31-1	0	2	7	2	1.1	344
			31-2	3	0	6	2	1.1	74
			31-3	0	-2	7	2	1.1	164
			31-4	-3	0	6	2	1.1	254
32	548265	617443	32-1	-3	4	17	2	1.1	317
			32-2	6	5	11	2	1.1	47
			32-3	3	-4	17	2	1.1	137
			32-4	-6	-5	11	2	1.1	227
33	548838	618104	33-1	-4	9	28	2	1.1	335
			33-2	12	5	20	2	1.1	65
			33-3	4	-9	28	2	1.1	155
			33-4	-12	-5	20	2	1.1	245

34	548203	617233	34-1	-4	1	18	2	1.1	292
			34-2	3	8	9	2	1.1	22
			34-3	4	-1	18	2	1.1	112
			34-4	-3	-8	9	2	1.1	202
35	551533	616816	35-1	-6	4	19	2	1.1	305
			35-2	5	7	16	2	1.1	35
			35-3	6	-4	19	2	1.1	125
			35-4	-5	-7	16	2	1.1	215
36	551791	617442	36-1	-4	3	16	2	1.1	306
			36-2	4	6	12	2	1.1	36
			36-3	4	-3	16	2	1.1	126
			36-4	-4	-6	12	2	1.1	216
37	551745	618625	37-1	-8	5	10	2	1.1	301
			37-2	2	4	20	2	1.1	31
			37-3	8	-5	10	2	1.1	121
			37-4	-2	-4	20	2	1.1	211
38	551891	618119	38-1	-3	0	15	2	1.1	280
			38-2	1	7	8	2	1.1	10
			38-3	3	0	15	2	1.1	100
			38-4	-1	-7	8	2	1.1	190
39	552050	618253	39-1	-7	0	15	2	1.1	274
			39-2	0	7	16	2	1.1	4
			39-3	7	0	15	2	1.1	94
			39-4	0	-7	16	2	1.1	184
40	551763	617403	40-1	-4	3	19	2	1.1	305
			40-2	5	7	11	2	1.1	35
			40-3	4	-3	19	2	1.1	125
			40-4	-5	-7	11	2	1.1	215
41	549760	618429	41-1	-1	4	13	2	1.1	337
			41-2	5	2	10	2	1.1	67
			41-3	1	-4	13	2	1.1	157
			41-4	-5	-2	10	2	1.1	247
42	549717	618492	42-1	-2	3	27	2	1.1	330
			42-2	11	6	9	2	1.1	60
			42-3	2	-3	27	2	1.1	150
			42-4	-11	-6	9	2	1.1	240
43	551819	617916	43-1	-1	7	13	2	1.1	347
			43-2	6	1	15	2	1.1	77
			43-3	1	-7	13	2	1.1	167
			43-4	-6	-1	15	2	1.1	257
44	551700	617316	44-1	-6	5	17	2	1.1	310
			44-2	5	6	18	2	1.1	40
			44-3	6	-5	17	2	1.1	130
			44-4	-5	-6	18	2	1.1	220
45	551564	617121	45-1	-3	2	18	2	1.1	311
			45-2	5	6	9	2	1.1	41
			45-3	3	-2	18	2	1.1	131
			45-4	-5	-6	9	2	1.1	221
46	551834	617480	46-1	-5	3	14	2	1.1	303
			46-2	3	5	12	2	1.1	33
			46-3	5	-3	14	2	1.1	123
			46-4	-3	-5	12	2	1.1	213
47	551938	618039	47-1	0	4	16	2	1.1	349
			47-2	7	1	10	2	1.1	79
			47-3	0	-4	16	2	1.1	169
			47-4	-7	-1	10	2	1.1	259
48	551902	618165	48-1	-5	1	17	2	1.1	283
			48-2	1	8	11	2	1.1	13
			48-3	5	-1	17	2	1.1	103
			48-4	-1	-8	11	2	1.1	193
49	551705	618617	49-1	-3	1	10	2	1.1	300
			49-2	2	4	7	2	1.1	30
			49-3	3	-1	10	2	1.1	120
			49-4	-2	-4	7	2	1.1	210
50	551963	618454	50-1	-3	11	12	2	1.1	341
			50-2	5	1	24	2	1.1	71
			50-3	3	-11	12	2	1.1	161
			50-4	-5	-1	24	2	1.1	251

51	552006	618171	51-1	-8	1	13	2	1.1	280
			51-2	1	6	17	2	1.1	10
			51-3	8	-1	13	2	1.1	100
			51-4	-1	-6	17	2	1.1	190
52	552248	618127	52-1	-7	0	16	2	1.1	275
			52-2	0	7	15	2	1.1	5
			52-3	7	0	16	2	1.1	95
			52-4	0	-7	15	2	1.1	185
53	552283	618133	53-1	-3	0	6	2	1.1	275
			53-2	0	2	8	2	1.1	5
			53-3	3	0	6	2	1.1	95
			53-4	0	-2	8	2	1.1	185
54	552203	617592	54-1	-3	5	11	2	1.1	329
			54-2	4	2	12	2	1.1	59
			54-3	3	-5	11	2	1.1	149
			54-4	-4	-2	12	2	1.1	239
55	551573	618719	55-1	-3	3	9	2	1.1	318
			55-2	3	3	10	2	1.1	48
			55-3	3	-3	9	2	1.1	138
			55-4	-3	-3	10	2	1.1	228
56	552268	618161	56-1	-6	0	11	2	1.1	274
			56-2	0	5	13	2	1.1	4
			56-3	6	0	11	2	1.1	94
			56-4	0	-5	13	2	1.1	184
57	550364	618674	57-1	-1	4	15	2	1.1	344
			57-2	7	2	10	2	1.1	74
			57-3	1	-4	15	2	1.1	164
			57-4	-7	-2	10	2	1.1	254
58	550042	618506	58-1	-6	0	15	2	1.1	274
			58-2	0	7	14	2	1.1	4
			58-3	6	0	15	2	1.1	94
			58-4	0	-7	14	2	1.1	184
59	549786	618550	59-1	-2	4	16	2	1.1	327
			59-2	6	4	10	2	1.1	57
			59-3	2	-4	16	2	1.1	147
			59-4	-6	-4	10	2	1.1	237
60	549848	618516	60-1	-1	3	13	2	1.1	341
			60-2	6	2	8	2	1.1	71
			60-3	1	-3	13	2	1.1	161
			60-4	-6	-2	8	2	1.1	251
61	551202	618886	61-1	-4	14	21	2	1.1	344
			61-2	10	2	30	2	1.1	74
			61-3	4	-14	21	2	1.1	164
			61-4	-10	-2	30	2	1.1	254
62	550903	618945	62-1	-2	6	13	2	1.1	342
			62-2	6	2	13	2	1.1	72
			62-3	2	-6	13	2	1.1	162
			62-4	-6	-2	13	2	1.1	252
63	550879	618940	63-1	-2	7	19	2	1.1	343
			63-2	9	2	16	2	1.1	73
			63-3	2	-7	19	2	1.1	163
			63-4	-9	-2	16	2	1.1	253
64	550649	618604	64-1	-2	5	11	2	1.1	334
			64-2	4	2	12	2	1.1	64
			64-3	2	-5	11	2	1.1	154
			64-4	-4	-2	12	2	1.1	244
65	550831	619302	65-1	-2	3	11	2	1.1	322
			65-2	4	3	8	2	1.1	52
			65-3	2	-3	11	2	1.1	142
			65-4	-4	-3	8	2	1.1	232
66	550681	619279	66-1	-10	8	14	2	1.1	310
			66-2	4	5	27	2	1.1	40
			66-3	10	-8	14	2	1.1	130
			66-4	-4	-5	27	2	1.1	220
67	551644	618620	67-1	-4	2	10	2	1.1	298
			67-2	2	4	11	2	1.1	28
			67-3	4	-2	10	2	1.1	118
			67-4	-2	-4	11	2	1.1	208

68	550595	619357	68-1	-1	7	15	2	1.1	347
			68-2	7	1	15	2	1.1	77
			68-3	1	-7	15	2	1.1	167
			68-4	-7	-1	15	2	1.1	257
69	551311	619147	69-1	-3	7	7	2	1.1	336
			69-2	3	1	16	2	1.1	66
			69-3	3	-7	7	2	1.1	156
			69-4	-3	-1	16	2	1.1	246
70	550516	618748	70-1	-2	3	20	2	1.1	329
			70-2	8	5	8	2	1.1	59
			70-3	2	-3	20	2	1.1	149
			70-4	-8	-5	8	2	1.1	239
71	549760	618491	71-1	-1	2	12	2	1.1	320
			71-2	4	3	6	2	1.1	50
			71-3	1	-2	12	2	1.1	140
			71-4	-4	-3	6	2	1.1	230
72	551826	618375	72-1	-2	4	21	2	1.1	335
			72-2	9	4	11	2	1.1	65
			72-3	2	-4	21	2	1.1	155
			72-4	-9	-4	11	2	1.1	245
73	551810	618364	73-1	-1	4	6	2	1.1	338
			73-2	2	1	10	2	1.1	68
			73-3	1	-4	6	2	1.1	158
			73-4	-2	-1	10	2	1.1	248
74	550984	618982	74-1	-1	3	9	2	1.1	340
			74-2	4	1	8	2	1.1	70
			74-3	1	-3	9	2	1.1	160
			74-4	-4	-1	8	2	1.1	250
75	551547	618843	75-1	0	8	10	2	1.1	356
			75-2	4	0	17	2	1.1	86
			75-3	0	-8	10	2	1.1	176
			75-4	-4	0	17	2	1.1	266

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING,
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& PLANNING

APPENDIX 12.2

Potential Shadow Flicker Times

Calculated Maximum Theoretical Shadow Time per Turbine

2021 Calculation Year
All Times In GMT/UTC

Turbine ID	Date	Start Time	End Time	Duration
1	01-Jan	09:53:56	10:31:48	00:37:52
1	01-Jan	11:21:59	11:35:17	00:13:18
1	01-Jan	15:13:31	16:21:34	01:08:03
1	02-Jan	09:54:39	10:32:00	00:37:22
1	02-Jan	11:24:16	11:33:57	00:09:41
1	02-Jan	15:14:26	16:22:33	01:08:07
1	03-Jan	09:55:23	10:32:10	00:36:47
1	03-Jan	11:28:45	11:30:24	00:01:39
1	03-Jan	15:15:24	16:23:58	01:08:34
1	04-Jan	09:56:10	10:32:17	00:36:07
1	04-Jan	15:16:25	16:25:30	01:09:06
1	05-Jan	09:56:59	10:32:21	00:35:23
1	05-Jan	15:17:23	16:26:56	01:09:33
1	06-Jan	09:57:49	10:32:22	00:34:32
1	06-Jan	15:18:25	16:28:24	01:09:59
1	07-Jan	09:58:43	10:35:55	00:37:12
1	07-Jan	15:19:33	16:29:59	01:10:27
1	08-Jan	09:59:40	10:35:44	00:36:05
1	08-Jan	15:20:48	16:31:27	01:10:39
1	09-Jan	08:52:25	08:58:55	00:06:29
1	09-Jan	10:00:40	10:35:56	00:35:16
1	09-Jan	15:22:14	16:32:50	01:10:36
1	10-Jan	08:50:09	09:01:58	00:11:49
1	10-Jan	10:01:44	10:35:38	00:33:54
1	10-Jan	15:23:54	16:34:10	01:10:16
1	11-Jan	08:48:44	09:04:09	00:15:26
1	11-Jan	10:02:53	10:35:14	00:32:21
1	11-Jan	15:26:02	16:35:53	01:09:51
1	12-Jan	08:47:38	09:05:59	00:18:21
1	12-Jan	10:04:08	10:34:41	00:30:33
1	12-Jan	15:28:30	16:37:26	01:08:56
1	13-Jan	08:46:45	09:07:37	00:20:52
1	13-Jan	10:05:30	10:33:58	00:28:29
1	13-Jan	15:33:18	16:38:50	01:05:32
1	14-Jan	08:45:46	09:09:05	00:23:19
1	14-Jan	10:07:02	10:33:02	00:26:01
1	14-Jan	15:34:02	16:40:06	01:06:05
1	15-Jan	08:44:47	09:10:25	00:25:38
1	15-Jan	10:08:47	10:31:46	00:22:59
1	15-Jan	15:34:48	16:41:17	01:06:29
1	16-Jan	08:43:46	09:11:40	00:27:53
1	16-Jan	10:10:52	10:29:56	00:19:04
1	16-Jan	15:35:38	16:42:22	01:06:44
1	17-Jan	08:42:52	09:12:48	00:29:57
1	17-Jan	10:13:36	10:26:18	00:12:43
1	17-Jan	15:36:32	16:43:23	01:06:50

Calculated Maximum Theoretical Shadow Time per Turbine

1	18-Jan	08:42:05	09:13:52	00:31:47
1	18-Jan	10:19:50	10:20:12	00:00:22
1	18-Jan	15:37:31	16:44:18	01:06:47
1	19-Jan	08:41:25	09:14:51	00:33:27
1	19-Jan	15:38:36	16:45:09	01:06:33
1	20-Jan	08:40:49	09:15:46	00:34:57
1	20-Jan	15:39:48	16:45:55	01:06:07
1	21-Jan	08:40:19	09:16:36	00:36:17
1	21-Jan	15:41:11	16:46:37	01:05:26
1	22-Jan	08:39:52	09:14:18	00:34:26
1	22-Jan	15:42:46	16:47:14	01:04:28
1	23-Jan	08:32:07	09:15:07	00:42:59
1	23-Jan	15:44:17	16:47:47	01:03:30
1	24-Jan	08:29:48	09:15:53	00:46:04
1	24-Jan	15:46:08	16:48:15	01:02:07
1	25-Jan	08:28:05	09:19:22	00:51:17
1	25-Jan	15:48:32	16:48:38	01:00:06
1	26-Jan	08:26:47	09:19:52	00:53:05
1	26-Jan	15:52:46	15:57:44	00:04:58
1	26-Jan	16:00:16	16:48:57	00:48:41
1	27-Jan	08:25:17	09:20:19	00:55:01
1	27-Jan	16:00:50	16:49:10	00:48:21
1	28-Jan	08:24:06	09:20:40	00:56:34
1	28-Jan	16:01:28	16:49:19	00:47:51
1	29-Jan	08:23:09	09:20:57	00:57:48
1	29-Jan	16:02:11	16:49:21	00:47:11
1	30-Jan	08:20:33	09:21:10	01:00:37
1	30-Jan	16:02:59	16:49:18	00:46:18
1	31-Jan	08:18:27	09:21:17	01:02:50
1	31-Jan	16:03:56	16:49:08	00:45:12
1	01-Feb	08:16:25	09:21:20	01:04:55
1	01-Feb	16:05:01	16:48:51	00:43:51
1	02-Feb	08:14:49	09:21:17	01:06:28
1	02-Feb	16:06:17	16:48:27	00:42:10
1	03-Feb	08:13:10	09:21:08	01:07:58
1	03-Feb	16:07:49	16:47:54	00:40:05
1	04-Feb	08:11:30	09:20:54	01:09:24
1	04-Feb	16:09:45	16:47:13	00:37:28
1	04-Feb	17:09:38	17:16:27	00:06:48
1	05-Feb	08:09:48	09:20:33	01:10:44
1	05-Feb	16:12:22	16:46:22	00:33:59
1	05-Feb	17:06:14	17:20:01	00:13:47
1	06-Feb	08:07:16	09:20:04	01:12:48
1	06-Feb	16:15:30	16:45:17	00:29:46
1	06-Feb	17:04:14	17:22:11	00:17:57
1	07-Feb	08:05:26	09:19:28	01:14:02
1	07-Feb	16:19:55	16:43:53	00:23:58
1	07-Feb	17:02:45	17:23:54	00:21:09
1	08-Feb	08:03:36	09:18:42	01:15:06
1	08-Feb	16:22:54	16:42:02	00:19:08

Calculated Maximum Theoretical Shadow Time per Turbine

1	08-Feb	17:01:35	17:26:03	00:24:27
1	09-Feb	08:01:58	09:17:46	01:15:48
1	09-Feb	16:27:48	16:39:17	00:11:29
1	09-Feb	17:00:39	17:27:39	00:26:59
1	10-Feb	08:00:44	09:16:38	01:15:53
1	10-Feb	16:59:54	17:28:54	00:29:00
1	11-Feb	07:59:47	09:15:12	01:15:26
1	11-Feb	16:59:18	17:30:12	00:30:54
1	12-Feb	07:59:01	09:13:24	01:14:22
1	12-Feb	16:58:50	17:31:21	00:32:30
1	13-Feb	07:58:26	09:11:25	01:12:59
1	13-Feb	16:58:30	17:32:16	00:33:46
1	14-Feb	07:58:01	09:09:06	01:11:05
1	14-Feb	16:58:17	17:32:59	00:34:43
1	15-Feb	07:57:44	08:51:14	00:53:31
1	15-Feb	08:52:54	09:05:28	00:12:34
1	15-Feb	16:58:11	17:33:34	00:35:23
1	16-Feb	07:57:35	08:49:26	00:51:51
1	16-Feb	16:58:09	17:33:58	00:35:49
1	17-Feb	07:57:35	08:47:12	00:49:37
1	17-Feb	16:57:54	17:34:14	00:36:20
1	18-Feb	07:57:43	08:43:38	00:45:54
1	18-Feb	16:57:45	17:34:22	00:36:36
1	19-Feb	07:58:01	08:37:49	00:39:48
1	19-Feb	16:57:41	17:34:21	00:36:40
1	20-Feb	07:58:30	08:35:49	00:37:19
1	20-Feb	16:57:44	17:34:13	00:36:28
1	21-Feb	07:59:11	08:32:52	00:33:41
1	21-Feb	16:57:54	17:33:56	00:36:01
1	22-Feb	08:00:07	08:30:56	00:30:48
1	22-Feb	16:58:12	17:33:30	00:35:18
1	22-Feb	17:40:27	17:51:21	00:10:54
1	23-Feb	08:01:25	08:29:23	00:27:58
1	23-Feb	16:58:39	17:32:55	00:34:17
1	23-Feb	17:37:29	17:54:02	00:16:32
1	24-Feb	07:35:21	07:44:54	00:09:33
1	24-Feb	08:03:18	08:27:32	00:24:14
1	24-Feb	16:59:15	17:32:11	00:32:56
1	24-Feb	17:35:29	17:55:53	00:20:24
1	25-Feb	07:32:01	07:47:54	00:15:54
1	25-Feb	08:06:44	08:25:09	00:18:26
1	25-Feb	17:00:03	17:31:15	00:31:12
1	25-Feb	17:33:56	17:57:44	00:23:47
1	26-Feb	07:29:50	07:49:45	00:19:55
1	26-Feb	08:09:43	08:21:14	00:11:31
1	26-Feb	17:01:05	17:30:06	00:29:01
1	26-Feb	17:32:42	17:59:04	00:26:22
1	27-Feb	07:27:08	07:51:02	00:23:54
1	27-Feb	17:02:27	17:28:46	00:26:19
1	27-Feb	17:31:43	18:01:00	00:29:17

Calculated Maximum Theoretical Shadow Time per Turbine

1	28-Feb	07:24:27	07:51:59	00:27:33
1	28-Feb	17:03:53	17:27:06	00:23:13
1	28-Feb	17:30:56	18:03:09	00:32:12
1	01-Mar	07:22:21	07:52:42	00:30:22
1	01-Mar	17:05:36	17:24:58	00:19:22
1	01-Mar	17:30:20	18:04:59	00:34:40
1	02-Mar	07:20:42	07:53:11	00:32:29
1	02-Mar	17:08:08	17:22:01	00:13:53
1	02-Mar	17:29:53	18:06:51	00:36:58
1	03-Mar	07:18:11	07:53:28	00:35:16
1	03-Mar	17:29:36	18:08:14	00:38:38
1	04-Mar	07:15:55	07:53:33	00:37:39
1	04-Mar	17:29:28	18:10:46	00:41:18
1	05-Mar	07:13:49	07:53:29	00:39:39
1	05-Mar	17:29:30	18:12:43	00:43:14
1	06-Mar	07:12:14	07:53:14	00:40:59
1	06-Mar	17:29:41	18:14:27	00:44:46
1	07-Mar	07:11:00	07:52:48	00:41:48
1	07-Mar	17:30:05	18:16:25	00:46:21
1	08-Mar	07:10:03	07:52:12	00:42:10
1	08-Mar	17:30:41	18:17:58	00:47:17
1	09-Mar	07:09:18	07:51:25	00:42:07
1	09-Mar	17:31:34	18:19:05	00:47:31
1	10-Mar	07:08:46	07:50:25	00:41:39
1	10-Mar	17:32:22	18:20:50	00:48:28
1	11-Mar	07:08:25	07:49:09	00:40:45
1	11-Mar	17:32:33	18:22:29	00:49:56
1	12-Mar	07:08:14	07:47:35	00:39:20
1	12-Mar	17:32:55	18:23:55	00:50:59
1	13-Mar	07:08:15	07:45:32	00:37:17
1	13-Mar	17:33:28	18:24:56	00:51:29
1	14-Mar	07:08:29	07:42:40	00:34:12
1	14-Mar	17:34:14	18:25:40	00:51:26
1	15-Mar	07:08:56	07:39:54	00:30:58
1	15-Mar	17:35:19	18:26:10	00:50:52
1	16-Mar	07:09:39	07:35:21	00:25:41
1	16-Mar	17:36:27	18:26:29	00:50:01
1	17-Mar	07:10:45	07:30:05	00:19:20
1	17-Mar	17:37:42	18:26:36	00:48:54
1	18-Mar	07:12:26	07:27:23	00:14:57
1	18-Mar	17:39:28	18:32:06	00:52:38
1	19-Mar	07:15:29	07:23:16	00:07:47
1	19-Mar	17:41:22	18:35:14	00:53:52
1	20-Mar	17:42:28	18:37:11	00:54:44
1	21-Mar	17:43:47	18:38:51	00:55:04
1	22-Mar	17:45:40	18:40:30	00:54:50
1	23-Mar	17:48:44	18:41:42	00:52:58
1	24-Mar	17:52:37	18:42:36	00:49:59
1	25-Mar	17:53:23	18:43:15	00:49:52
1	26-Mar	17:54:27	18:43:42	00:49:16

Calculated Maximum Theoretical Shadow Time per Turbine

1	27-Mar	17:55:56	18:43:59	00:48:04
1	28-Mar	17:57:42	18:44:07	00:46:25
1	29-Mar	18:00:16	18:44:06	00:43:50
1	30-Mar	18:04:15	18:43:57	00:39:43
1	31-Mar	18:04:03	18:43:40	00:39:37
1	01-Apr	18:03:59	18:43:16	00:39:16
1	02-Apr	18:04:04	18:42:44	00:38:39
1	03-Apr	18:04:18	18:42:03	00:37:45
1	04-Apr	18:04:41	18:41:15	00:36:33
1	05-Apr	18:05:15	18:40:17	00:35:01
1	06-Apr	18:06:02	18:39:08	00:33:07
1	07-Apr	18:07:03	18:37:48	00:30:45
1	08-Apr	18:08:25	18:36:17	00:27:52
1	08-Apr	19:02:26	19:10:21	00:07:55
1	09-Apr	18:10:17	18:34:29	00:24:12
1	09-Apr	18:58:57	19:13:18	00:14:21
1	10-Apr	18:11:59	18:32:14	00:20:14
1	10-Apr	18:56:45	19:15:03	00:18:17
1	11-Apr	18:14:28	18:29:14	00:14:45
1	11-Apr	18:55:08	19:16:41	00:21:33
1	12-Apr	18:20:05	18:23:06	00:03:01
1	12-Apr	18:53:51	19:17:48	00:23:57
1	13-Apr	18:52:50	19:18:35	00:25:44
1	14-Apr	18:52:03	19:19:06	00:27:03
1	15-Apr	18:51:26	19:19:25	00:27:58
1	16-Apr	18:51:00	19:19:33	00:28:33
1	17-Apr	18:50:44	19:19:32	00:28:48
1	18-Apr	18:50:37	19:19:22	00:28:45
1	19-Apr	18:50:39	19:19:03	00:28:24
1	20-Apr	18:50:51	19:18:36	00:27:45
1	21-Apr	18:51:14	19:17:59	00:26:46
1	22-Apr	18:51:49	19:17:14	00:25:25
1	23-Apr	18:52:27	19:16:18	00:23:51
1	24-Apr	18:53:18	19:15:09	00:21:51
1	25-Apr	18:54:28	19:13:47	00:19:19
1	25-Apr	19:29:10	19:36:53	00:07:44
1	26-Apr	18:56:08	19:12:03	00:15:54
1	26-Apr	19:25:17	19:40:28	00:15:11
1	27-Apr	18:58:23	19:09:38	00:11:15
1	27-Apr	19:22:55	19:42:34	00:19:39
1	28-Apr	19:21:07	19:44:12	00:23:05
1	29-Apr	19:19:41	19:45:55	00:26:13
1	30-Apr	19:18:31	19:47:13	00:28:42
1	01-May	19:17:32	19:48:44	00:31:12
1	02-May	19:16:42	19:50:51	00:34:08
1	03-May	19:16:01	19:52:25	00:36:23
1	04-May	19:15:28	19:54:08	00:38:40
1	05-May	19:15:01	19:55:37	00:40:36
1	06-May	19:14:40	19:56:49	00:42:09
1	07-May	19:14:24	19:58:51	00:44:26

Calculated Maximum Theoretical Shadow Time per Turbine

1	08-May	19:14:14	20:00:23	00:46:09
1	09-May	19:14:09	20:02:03	00:47:54
1	10-May	19:14:08	20:03:38	00:49:30
1	11-May	19:14:12	20:04:55	00:50:43
1	12-May	19:14:20	20:05:59	00:51:38
1	13-May	19:14:32	20:06:53	00:52:20
1	14-May	19:14:49	20:07:39	00:52:50
1	15-May	19:15:09	20:08:20	00:53:10
1	16-May	19:15:34	20:08:55	00:53:21
1	17-May	19:16:02	20:09:25	00:53:23
1	18-May	19:16:35	20:13:19	00:56:44
1	19-May	19:17:12	20:16:22	00:59:10
1	20-May	19:17:53	20:18:21	01:00:28
1	21-May	19:18:39	20:19:54	01:01:14
1	22-May	19:19:31	20:21:11	01:01:40
1	23-May	19:20:25	20:22:38	01:02:14
1	24-May	19:21:10	20:24:01	01:02:51
1	25-May	19:21:59	20:25:11	01:03:12
1	26-May	19:22:53	20:26:12	01:03:18
1	27-May	19:23:53	20:27:06	01:03:13
1	28-May	19:24:58	20:27:54	01:02:56
1	29-May	19:26:11	20:28:37	01:02:26
1	30-May	19:27:34	20:29:17	01:01:42
1	31-May	19:28:18	20:29:53	01:01:36
1	01-Jun	19:28:58	20:30:27	01:01:29
1	02-Jun	19:29:40	20:30:58	01:01:18
1	03-Jun	19:30:23	20:31:27	01:01:04
1	04-Jun	19:31:06	20:31:54	01:00:48
1	05-Jun	19:31:40	20:32:20	01:00:39
1	06-Jun	19:32:15	20:32:44	01:00:29
1	07-Jun	19:32:49	20:33:06	01:00:17
1	08-Jun	19:33:24	20:33:28	01:00:04
1	09-Jun	19:33:59	20:33:48	00:59:50
1	10-Jun	19:34:33	20:34:08	00:59:36
1	11-Jun	19:35:06	20:34:27	00:59:21
1	12-Jun	19:35:38	20:34:45	00:59:07
1	13-Jun	19:36:10	20:35:02	00:58:53
1	14-Jun	19:36:39	20:35:19	00:58:40
1	15-Jun	19:37:07	20:35:35	00:58:28
1	16-Jun	19:37:33	20:35:51	00:58:18
1	17-Jun	19:37:57	20:36:06	00:58:09
1	18-Jun	19:38:18	20:36:20	00:58:03
1	19-Jun	19:38:36	20:36:34	00:57:58
1	20-Jun	19:38:51	20:36:48	00:57:56
1	21-Jun	19:39:04	20:37:01	00:57:57
1	22-Jun	19:39:14	20:37:13	00:57:59
1	23-Jun	19:39:20	20:37:25	00:58:04
1	24-Jun	19:39:24	20:37:36	00:58:12
1	25-Jun	19:39:25	20:37:46	00:58:21
1	26-Jun	19:39:24	20:37:56	00:58:32

1	27-Jun	19:39:21	20:38:05	00:58:44
1	28-Jun	19:39:16	20:38:13	00:58:57
1	29-Jun	19:39:09	20:38:19	00:59:11
1	30-Jun	19:39:00	20:38:25	00:59:25
1	01-Jul	19:38:50	20:38:30	00:59:40
1	02-Jul	19:38:39	20:38:33	00:59:54
1	03-Jul	19:38:28	20:38:35	01:00:07
1	04-Jul	19:38:15	20:38:35	01:00:20
1	05-Jul	19:38:03	20:38:34	01:00:31
1	06-Jul	19:37:49	20:38:30	01:00:41
1	07-Jul	19:37:34	20:38:25	01:00:51
1	08-Jul	19:37:09	20:38:16	01:01:07
1	09-Jul	19:36:45	20:38:06	01:01:20
1	10-Jul	19:36:22	20:37:52	01:01:30
1	11-Jul	19:35:59	20:37:34	01:01:35
1	12-Jul	19:35:19	20:37:13	01:01:54
1	13-Jul	19:34:15	20:36:48	01:02:33
1	14-Jul	19:33:19	20:36:17	01:02:58
1	15-Jul	19:32:29	20:35:41	01:03:12
1	16-Jul	19:31:44	20:34:58	01:03:14
1	17-Jul	19:31:03	20:34:06	01:03:03
1	18-Jul	19:30:25	20:33:03	01:02:39
1	19-Jul	19:29:49	20:31:46	01:01:56
1	20-Jul	19:29:02	20:30:33	01:01:31
1	21-Jul	19:28:20	20:29:20	01:01:01
1	22-Jul	19:27:41	20:27:49	01:00:08
1	23-Jul	19:27:06	20:25:45	00:58:39
1	24-Jul	19:26:34	20:22:08	00:55:34
1	25-Jul	19:26:05	20:19:26	00:53:21
1	26-Jul	19:25:39	20:18:57	00:53:18
1	27-Jul	19:25:15	20:18:21	00:53:06
1	28-Jul	19:24:55	20:17:40	00:52:44
1	29-Jul	19:24:37	20:16:50	00:52:13
1	30-Jul	19:24:23	20:15:52	00:51:29
1	31-Jul	19:24:11	20:14:43	00:50:32
1	01-Aug	19:24:03	20:13:20	00:49:17
1	02-Aug	19:23:57	20:11:36	00:47:38
1	03-Aug	19:23:55	20:09:53	00:45:58
1	04-Aug	19:23:57	20:08:10	00:44:13
1	05-Aug	19:24:03	20:06:03	00:42:00
1	06-Aug	19:24:13	20:04:40	00:40:28
1	07-Aug	19:24:28	20:02:59	00:38:31
1	08-Aug	19:24:48	20:01:05	00:36:17
1	09-Aug	19:25:14	19:59:16	00:34:02
1	10-Aug	19:25:47	19:56:53	00:31:07
1	11-Aug	19:26:28	19:55:10	00:28:41
1	12-Aug	19:27:20	19:53:34	00:26:14
1	13-Aug	19:28:26	19:51:34	00:23:08
1	14-Aug	19:05:36	19:16:31	00:10:55
1	14-Aug	19:29:52	19:49:38	00:19:46

Calculated Maximum Theoretical Shadow Time per Turbine

1	15-Aug	19:02:59	19:18:37	00:15:37
1	15-Aug	19:31:50	19:47:13	00:15:24
1	16-Aug	19:00:55	19:19:59	00:19:04
1	16-Aug	19:35:08	19:43:27	00:08:19
1	17-Aug	18:59:21	19:20:59	00:21:39
1	18-Aug	18:58:04	19:21:44	00:23:40
1	19-Aug	18:57:01	19:22:16	00:25:15
1	20-Aug	18:55:59	19:22:36	00:26:37
1	21-Aug	18:55:08	19:22:46	00:27:38
1	22-Aug	18:54:27	19:22:46	00:28:20
1	23-Aug	18:53:54	19:22:38	00:28:43
1	24-Aug	18:53:30	19:22:20	00:28:50
1	25-Aug	18:53:14	19:21:52	00:28:38
1	26-Aug	18:53:07	19:21:15	00:28:09
1	27-Aug	18:53:08	19:20:27	00:27:19
1	28-Aug	18:53:20	19:19:27	00:26:07
1	29-Aug	18:53:43	19:18:13	00:24:30
1	30-Aug	18:15:20	18:27:33	00:12:13
1	30-Aug	18:54:20	19:16:39	00:22:19
1	31-Aug	18:11:51	18:30:24	00:18:33
1	31-Aug	18:55:15	19:14:38	00:19:22
1	01-Sep	18:09:22	18:32:15	00:22:52
1	01-Sep	18:56:38	19:12:22	00:15:44
1	02-Sep	18:06:59	18:33:35	00:26:35
1	02-Sep	18:58:53	19:09:28	00:10:35
1	03-Sep	18:04:53	18:34:34	00:29:41
1	04-Sep	18:03:09	18:35:21	00:32:12
1	05-Sep	18:01:40	18:35:56	00:34:16
1	06-Sep	18:00:25	18:36:20	00:35:56
1	07-Sep	17:59:19	18:36:35	00:37:15
1	08-Sep	17:58:24	18:36:40	00:38:16
1	09-Sep	17:57:36	18:36:37	00:39:01
1	10-Sep	17:56:57	18:36:27	00:39:29
1	11-Sep	17:56:25	18:36:08	00:39:43
1	12-Sep	17:54:28	18:35:42	00:41:14
1	13-Sep	17:50:01	18:35:08	00:45:07
1	14-Sep	17:47:18	18:34:25	00:47:07
1	15-Sep	17:44:59	18:33:34	00:48:35
1	16-Sep	17:43:03	18:32:34	00:49:31
1	17-Sep	17:41:28	18:31:23	00:49:55
1	18-Sep	17:40:09	18:29:59	00:49:51
1	19-Sep	17:34:37	18:28:21	00:53:44
1	20-Sep	17:31:27	18:26:23	00:54:55
1	21-Sep	17:29:09	18:23:56	00:54:46
1	22-Sep	17:27:19	18:21:45	00:54:26
1	23-Sep	17:25:34	18:18:56	00:53:22
1	24-Sep	06:58:12	07:09:04	00:10:52
1	24-Sep	17:22:52	18:14:29	00:51:37
1	25-Sep	06:55:15	07:12:00	00:16:45
1	25-Sep	17:20:38	18:09:48	00:49:10

Calculated Maximum Theoretical Shadow Time per Turbine

1	26-Sep	06:53:13	07:13:41	00:20:28
1	26-Sep	17:18:52	18:09:01	00:50:09
1	27-Sep	06:51:39	07:19:40	00:28:01
1	27-Sep	17:17:05	18:08:03	00:50:58
1	28-Sep	06:50:24	07:22:30	00:32:06
1	28-Sep	17:15:28	18:06:54	00:51:25
1	29-Sep	06:49:25	07:24:45	00:35:20
1	29-Sep	17:14:08	18:05:31	00:51:23
1	30-Sep	06:48:40	07:26:40	00:37:59
1	30-Sep	17:13:02	18:03:51	00:50:49
1	01-Oct	06:48:06	07:27:55	00:39:49
1	01-Oct	17:12:07	18:01:47	00:49:40
1	02-Oct	06:47:44	07:28:48	00:41:04
1	02-Oct	17:11:23	17:59:35	00:48:12
1	03-Oct	06:47:33	07:29:24	00:41:51
1	03-Oct	17:09:57	17:57:25	00:47:28
1	04-Oct	06:47:34	07:29:47	00:42:12
1	04-Oct	17:08:33	17:55:42	00:47:09
1	05-Oct	06:47:47	07:29:58	00:42:10
1	05-Oct	17:07:25	17:53:37	00:46:12
1	06-Oct	06:48:15	07:29:58	00:41:44
1	06-Oct	17:06:31	17:51:08	00:44:37
1	07-Oct	06:48:59	07:29:50	00:40:51
1	07-Oct	17:05:49	17:48:54	00:43:06
1	08-Oct	06:50:06	07:29:32	00:39:26
1	08-Oct	17:05:17	17:46:28	00:41:11
1	09-Oct	06:51:42	07:29:05	00:37:23
1	09-Oct	17:04:55	17:43:32	00:38:37
1	10-Oct	06:53:33	07:28:29	00:34:56
1	10-Oct	16:43:12	16:56:43	00:13:30
1	10-Oct	17:04:44	17:41:42	00:36:58
1	11-Oct	06:55:27	07:27:43	00:32:16
1	11-Oct	16:40:10	16:59:14	00:19:04
1	11-Oct	17:04:42	17:39:25	00:34:43
1	12-Oct	06:56:40	07:26:46	00:30:06
1	12-Oct	16:37:59	17:00:56	00:22:57
1	12-Oct	17:04:51	17:37:09	00:32:19
1	13-Oct	06:58:20	07:25:36	00:27:17
1	13-Oct	16:36:10	17:02:11	00:26:01
1	13-Oct	17:05:11	17:34:37	00:29:26
1	14-Oct	07:00:40	07:24:13	00:23:33
1	14-Oct	16:34:22	17:03:07	00:28:45
1	14-Oct	17:05:44	17:32:16	00:26:32
1	15-Oct	07:02:50	07:22:30	00:19:40
1	15-Oct	07:42:10	07:54:53	00:12:43
1	15-Oct	16:32:55	17:03:53	00:30:58
1	15-Oct	17:06:31	17:30:35	00:24:03
1	16-Oct	07:04:39	07:20:16	00:15:37
1	16-Oct	07:38:42	07:58:01	00:19:20
1	16-Oct	16:31:44	17:04:27	00:32:43

Calculated Maximum Theoretical Shadow Time per Turbine

1	16-Oct	17:07:38	17:28:26	00:20:48
1	17-Oct	07:07:41	07:16:49	00:09:09
1	17-Oct	07:35:15	07:59:55	00:24:40
1	17-Oct	16:30:45	17:04:51	00:34:06
1	17-Oct	17:09:12	17:26:15	00:17:04
1	18-Oct	07:33:07	08:01:23	00:28:16
1	18-Oct	16:29:57	17:05:07	00:35:09
1	18-Oct	17:11:36	17:23:27	00:11:52
1	19-Oct	07:31:33	08:02:32	00:30:59
1	19-Oct	16:29:19	17:05:14	00:35:55
1	20-Oct	07:30:20	08:04:21	00:34:02
1	20-Oct	16:28:50	17:05:15	00:36:25
1	21-Oct	07:29:23	08:06:54	00:37:31
1	21-Oct	16:28:29	17:05:09	00:36:39
1	22-Oct	07:28:40	08:08:34	00:39:55
1	22-Oct	16:28:17	17:04:56	00:36:39
1	23-Oct	07:28:08	08:14:20	00:46:12
1	23-Oct	16:28:11	17:04:36	00:36:26
1	24-Oct	07:27:47	08:17:32	00:49:45
1	24-Oct	16:28:11	17:04:10	00:35:59
1	25-Oct	07:27:35	08:19:31	00:51:56
1	25-Oct	16:28:06	17:03:37	00:35:31
1	26-Oct	07:27:33	08:21:08	00:53:34
1	26-Oct	08:22:36	08:35:33	00:12:57
1	26-Oct	16:28:01	17:02:57	00:34:56
1	27-Oct	07:27:41	08:38:54	01:11:13
1	27-Oct	16:28:04	17:02:09	00:34:05
1	28-Oct	07:27:59	08:41:04	01:13:05
1	28-Oct	16:28:15	17:01:11	00:32:56
1	29-Oct	07:28:27	08:42:56	01:14:29
1	29-Oct	16:28:36	17:00:03	00:31:27
1	30-Oct	07:29:07	08:44:39	01:15:32
1	30-Oct	16:29:05	16:58:41	00:29:36
1	31-Oct	07:30:01	08:46:01	01:16:01
1	31-Oct	15:58:54	16:07:01	00:08:07
1	31-Oct	16:29:44	16:57:29	00:27:45
1	01-Nov	07:31:11	08:47:09	01:15:58
1	01-Nov	15:54:08	16:10:29	00:16:21
1	01-Nov	16:30:35	16:56:01	00:25:26
1	02-Nov	07:32:45	08:48:05	01:15:20
1	02-Nov	15:50:34	16:12:36	00:22:03
1	02-Nov	16:31:40	16:54:10	00:22:30
1	03-Nov	07:34:38	08:48:53	01:14:15
1	03-Nov	15:47:31	16:14:12	00:26:41
1	03-Nov	16:33:03	16:52:17	00:19:14
1	04-Nov	07:36:27	08:49:33	01:13:06
1	04-Nov	15:43:10	16:15:28	00:32:18
1	04-Nov	16:34:51	16:50:29	00:15:37
1	05-Nov	07:38:53	08:50:07	01:11:14
1	05-Nov	15:40:32	16:16:30	00:35:58

Calculated Maximum Theoretical Shadow Time per Turbine

1	05-Nov	16:37:32	16:47:50	00:10:18
1	06-Nov	07:40:58	08:50:36	01:09:38
1	06-Nov	15:38:28	16:17:23	00:38:54
1	07-Nov	07:42:41	08:50:59	01:08:18
1	07-Nov	15:36:56	16:18:08	00:41:12
1	08-Nov	07:44:36	08:51:19	01:06:43
1	08-Nov	15:35:44	16:18:47	00:43:03
1	09-Nov	07:46:18	08:51:34	01:05:17
1	09-Nov	15:34:47	16:19:20	00:44:33
1	10-Nov	07:48:34	08:51:46	01:03:12
1	10-Nov	15:34:01	16:19:47	00:45:46
1	11-Nov	07:50:45	08:51:54	01:01:09
1	11-Nov	15:33:24	16:20:09	00:46:44
1	12-Nov	07:53:58	08:51:59	00:58:02
1	12-Nov	15:32:56	16:20:26	00:47:30
1	13-Nov	07:55:10	08:52:02	00:56:51
1	13-Nov	15:32:35	16:20:40	00:48:06
1	14-Nov	07:56:38	08:52:01	00:55:23
1	14-Nov	15:32:19	16:20:50	00:48:31
1	15-Nov	07:58:25	08:51:57	00:53:32
1	15-Nov	15:22:43	15:31:54	00:09:11
1	15-Nov	15:32:10	16:20:57	00:48:47
1	16-Nov	08:00:07	08:51:51	00:51:44
1	16-Nov	15:20:02	16:20:59	01:00:58
1	17-Nov	08:02:08	08:48:49	00:46:41
1	17-Nov	15:18:20	16:21:00	01:02:40
1	18-Nov	08:04:40	08:48:31	00:43:52
1	18-Nov	15:17:06	16:20:57	01:03:52
1	19-Nov	08:09:20	08:13:13	00:03:53
1	19-Nov	08:13:29	08:48:12	00:34:43
1	19-Nov	15:16:03	16:20:52	01:04:49
1	20-Nov	08:14:24	08:50:59	00:36:35
1	20-Nov	15:15:03	16:20:43	01:05:40
1	21-Nov	08:15:25	08:50:40	00:35:15
1	21-Nov	15:14:17	16:20:32	01:06:15
1	22-Nov	08:16:32	08:50:22	00:33:50
1	22-Nov	15:13:41	16:20:17	01:06:36
1	23-Nov	08:17:45	08:49:59	00:32:14
1	23-Nov	15:13:14	16:20:00	01:06:46
1	24-Nov	08:19:06	08:49:33	00:30:27
1	24-Nov	09:50:35	10:01:55	00:11:20
1	24-Nov	15:12:54	16:19:40	01:06:46
1	25-Nov	08:20:35	08:49:03	00:28:28
1	25-Nov	09:48:22	10:06:46	00:18:24
1	25-Nov	15:12:39	16:19:17	01:06:37
1	26-Nov	08:22:16	08:48:30	00:26:14
1	26-Nov	09:46:52	10:09:22	00:22:29
1	26-Nov	15:12:30	16:18:49	01:06:19
1	27-Nov	08:23:52	08:47:52	00:23:59
1	27-Nov	09:45:46	10:11:22	00:25:35

Calculated Maximum Theoretical Shadow Time per Turbine

1	27-Nov	15:12:26	16:18:18	01:05:52
1	28-Nov	08:25:37	08:47:09	00:21:32
1	28-Nov	09:44:55	10:13:02	00:28:07
1	28-Nov	15:11:05	16:17:42	01:06:37
1	29-Nov	08:27:11	08:46:18	00:19:07
1	29-Nov	09:44:15	10:14:29	00:30:14
1	29-Nov	15:07:48	16:16:59	01:09:11
1	30-Nov	08:28:57	08:45:18	00:16:21
1	30-Nov	09:43:44	10:15:48	00:32:04
1	30-Nov	15:06:13	16:16:08	01:09:55
1	01-Dec	08:31:00	08:44:01	00:13:00
1	01-Dec	09:43:20	10:16:59	00:33:39
1	01-Dec	15:05:02	16:15:20	01:10:18
1	02-Dec	08:33:40	08:42:08	00:08:28
1	02-Dec	09:43:03	10:18:05	00:35:02
1	02-Dec	15:04:13	16:14:46	01:10:33
1	03-Dec	09:42:51	10:19:06	00:36:16
1	03-Dec	15:03:40	16:14:12	01:10:32
1	04-Dec	09:42:43	10:19:43	00:36:59
1	04-Dec	15:03:16	16:13:32	01:10:16
1	05-Dec	09:42:40	10:17:02	00:34:22
1	05-Dec	15:03:01	16:12:45	01:09:44
1	06-Dec	09:42:40	10:17:53	00:35:13
1	06-Dec	15:02:51	16:12:15	01:09:23
1	07-Dec	09:42:43	10:18:42	00:35:59
1	07-Dec	15:02:47	16:11:40	01:08:53
1	08-Dec	09:42:50	10:19:29	00:36:39
1	08-Dec	15:02:39	16:10:59	01:08:20
1	09-Dec	09:42:59	10:20:14	00:37:15
1	09-Dec	11:12:48	11:22:00	00:09:12
1	09-Dec	15:02:36	16:10:40	01:08:04
1	10-Dec	09:43:11	10:20:57	00:37:46
1	10-Dec	11:11:21	11:24:20	00:12:59
1	10-Dec	15:02:38	16:10:37	01:07:59
1	11-Dec	09:43:25	10:21:39	00:38:14
1	11-Dec	11:10:29	11:26:07	00:15:38
1	11-Dec	15:02:44	16:10:34	01:07:51
1	12-Dec	09:43:41	10:22:19	00:38:38
1	12-Dec	11:09:55	11:28:08	00:18:13
1	12-Dec	15:02:53	16:10:33	01:07:40
1	13-Dec	09:43:59	10:22:58	00:38:59
1	13-Dec	11:09:34	11:29:46	00:20:12
1	13-Dec	15:03:05	16:10:33	01:07:28
1	14-Dec	09:44:18	10:23:36	00:39:18
1	14-Dec	11:09:22	11:31:08	00:21:46
1	14-Dec	15:03:20	16:10:35	01:07:15
1	15-Dec	09:44:40	10:24:12	00:39:33
1	15-Dec	11:09:18	11:32:18	00:23:00
1	15-Dec	15:03:38	16:10:39	01:07:02
1	16-Dec	09:45:02	10:24:48	00:39:46

Calculated Maximum Theoretical Shadow Time per Turbine

1	16-Dec	11:09:20	11:33:20	00:23:59
1	16-Dec	15:03:57	16:10:51	01:06:53
1	17-Dec	09:45:26	10:25:22	00:39:56
1	17-Dec	11:09:28	11:34:14	00:24:46
1	17-Dec	15:04:19	16:11:05	01:06:47
1	18-Dec	09:45:52	10:25:56	00:40:04
1	18-Dec	11:09:41	11:35:03	00:25:22
1	18-Dec	15:04:43	16:11:23	01:06:41
1	19-Dec	09:46:18	10:26:28	00:40:10
1	19-Dec	11:09:59	11:35:46	00:25:47
1	19-Dec	15:05:08	16:11:44	01:06:36
1	20-Dec	09:46:46	10:26:59	00:40:14
1	20-Dec	11:10:22	11:36:24	00:26:02
1	20-Dec	15:05:35	16:12:09	01:06:34
1	21-Dec	09:47:15	10:27:30	00:40:15
1	21-Dec	11:10:49	11:36:57	00:26:09
1	21-Dec	15:06:04	16:12:37	01:06:33
1	22-Dec	09:47:45	10:27:59	00:40:15
1	22-Dec	11:11:20	11:37:25	00:26:06
1	22-Dec	15:06:35	16:13:08	01:06:34
1	23-Dec	09:48:16	10:28:28	00:40:12
1	23-Dec	11:11:55	11:37:49	00:25:54
1	23-Dec	15:07:07	16:13:43	01:06:37
1	24-Dec	09:48:48	10:28:56	00:40:07
1	24-Dec	11:12:35	11:38:07	00:25:32
1	24-Dec	15:07:41	16:14:22	01:06:41
1	25-Dec	09:49:22	10:29:22	00:40:00
1	25-Dec	11:13:19	11:38:19	00:25:01
1	25-Dec	15:08:16	16:15:03	01:06:47
1	26-Dec	09:49:56	10:29:47	00:39:51
1	26-Dec	11:14:07	11:38:26	00:24:18
1	26-Dec	15:08:53	16:15:47	01:06:54
1	27-Dec	09:50:31	10:30:10	00:39:39
1	27-Dec	11:15:01	11:38:25	00:23:24
1	27-Dec	15:09:32	16:16:35	01:07:03
1	28-Dec	09:51:07	10:30:32	00:39:25
1	28-Dec	11:16:01	11:38:16	00:22:15
1	28-Dec	15:10:12	16:17:29	01:07:16
1	29-Dec	09:51:45	10:30:53	00:39:08
1	29-Dec	11:17:08	11:37:57	00:20:49
1	29-Dec	15:10:55	16:18:25	01:07:30
1	30-Dec	09:52:23	10:31:12	00:38:49
1	30-Dec	11:18:23	11:37:23	00:18:59
1	30-Dec	15:11:40	16:19:22	01:07:42
1	31-Dec	09:53:03	10:31:29	00:38:26
1	31-Dec	11:19:49	11:36:24	00:16:36
1	31-Dec	15:12:28	16:20:20	01:07:53

Turbine ID	Date	Start Time	End Time	Duration
2	01-Jan	09:06:26	10:50:21	01:43:56

Calculated Maximum Theoretical Shadow Time per Turbine

2	01-Jan	14:41:19	15:08:18	00:26:58
2	01-Jan	15:35:50	16:06:21	00:30:31
2	02-Jan	08:51:58	09:00:19	00:08:21
2	02-Jan	09:06:56	10:47:17	01:40:22
2	02-Jan	14:42:19	15:08:13	00:25:54
2	02-Jan	15:36:31	16:06:41	00:30:10
2	03-Jan	08:50:17	09:02:53	00:12:35
2	03-Jan	09:07:26	10:36:42	01:29:16
2	03-Jan	10:40:43	10:44:51	00:04:08
2	03-Jan	14:43:24	15:08:03	00:24:39
2	03-Jan	15:37:15	16:06:59	00:29:44
2	04-Jan	08:49:05	09:04:58	00:15:53
2	04-Jan	09:07:56	10:35:21	01:27:25
2	04-Jan	14:44:35	15:07:46	00:23:11
2	04-Jan	15:38:01	16:07:15	00:29:14
2	05-Jan	08:48:05	09:06:50	00:18:45
2	05-Jan	09:08:27	10:34:39	01:26:12
2	05-Jan	14:45:53	15:07:21	00:21:28
2	05-Jan	15:38:49	16:07:28	00:28:39
2	06-Jan	08:47:14	09:08:33	00:21:19
2	06-Jan	09:08:59	10:34:25	01:25:26
2	06-Jan	14:47:20	15:06:45	00:19:24
2	06-Jan	15:39:41	16:07:39	00:27:57
2	07-Jan	08:46:27	10:34:05	01:47:37
2	07-Jan	14:49:03	15:05:54	00:16:52
2	07-Jan	15:40:37	16:07:46	00:27:09
2	08-Jan	08:45:45	10:33:36	01:47:51
2	08-Jan	14:51:09	15:04:40	00:13:31
2	08-Jan	15:41:38	16:07:51	00:26:12
2	09-Jan	08:45:06	10:32:59	01:47:53
2	09-Jan	14:54:13	15:02:31	00:08:18
2	09-Jan	15:42:46	16:07:51	00:25:05
2	10-Jan	08:44:30	09:10:34	00:26:04
2	10-Jan	09:11:15	10:32:08	01:20:53
2	10-Jan	15:44:03	16:07:46	00:23:43
2	11-Jan	08:43:56	10:30:59	01:47:03
2	11-Jan	15:45:33	16:07:36	00:22:03
2	12-Jan	08:43:24	10:29:25	01:46:01
2	12-Jan	15:47:06	16:07:18	00:20:12
2	13-Jan	08:42:21	10:29:43	01:47:22
2	13-Jan	15:48:23	16:06:51	00:18:28
2	14-Jan	08:41:23	10:30:06	01:48:43
2	14-Jan	15:49:54	16:06:12	00:16:18
2	15-Jan	08:40:31	09:52:03	01:11:32
2	15-Jan	09:52:59	10:30:06	00:37:08
2	15-Jan	15:51:48	16:05:14	00:13:26
2	16-Jan	08:39:44	10:29:22	01:49:39
2	16-Jan	15:54:37	16:03:44	00:09:07
2	17-Jan	08:39:00	09:55:27	01:16:27
2	17-Jan	09:55:48	10:28:27	00:32:39

2	18-Jan	08:38:19	09:55:01	01:16:43
2	18-Jan	09:57:27	10:27:18	00:29:50
2	19-Jan	08:37:38	09:54:28	01:16:50
2	19-Jan	09:59:21	10:25:47	00:26:27
2	20-Jan	08:37:01	09:53:45	01:16:45
2	20-Jan	10:01:35	10:23:41	00:22:06
2	21-Jan	08:36:26	09:52:51	01:16:25
2	21-Jan	10:04:28	10:20:01	00:15:33
2	22-Jan	08:35:54	09:51:41	01:15:46
2	22-Jan	10:09:26	10:14:58	00:05:32
2	23-Jan	08:32:03	09:50:07	01:18:04
2	24-Jan	08:29:09	09:24:36	00:55:28
2	24-Jan	09:25:03	09:47:49	00:22:47
2	25-Jan	08:27:09	09:25:15	00:58:06
2	25-Jan	09:27:10	09:45:06	00:17:56
2	26-Jan	08:25:35	09:25:50	01:00:15
2	26-Jan	09:30:01	09:42:44	00:12:43
2	27-Jan	08:24:12	09:26:21	01:02:09
2	28-Jan	08:22:48	09:26:49	01:04:01
2	29-Jan	08:21:36	09:27:14	01:05:38
2	30-Jan	08:20:34	09:27:35	01:07:01
2	31-Jan	08:19:39	09:27:52	01:08:12
2	01-Feb	08:18:11	09:28:05	01:09:54
2	02-Feb	08:15:42	09:28:14	01:12:33
2	03-Feb	08:13:48	09:28:19	01:14:32
2	04-Feb	08:12:10	09:28:20	01:16:11
2	05-Feb	08:10:25	09:32:13	01:21:48
2	06-Feb	08:08:51	09:32:05	01:23:14
2	07-Feb	08:07:31	09:31:53	01:24:22
2	08-Feb	08:06:22	09:31:35	01:25:13
2	09-Feb	08:05:22	09:31:12	01:25:49
2	10-Feb	08:04:30	09:30:43	01:26:13
2	11-Feb	08:03:45	09:30:08	01:26:24
2	12-Feb	08:03:05	09:29:27	01:26:22
2	13-Feb	08:02:31	09:28:38	01:26:07
2	14-Feb	08:02:03	09:27:41	01:25:38
2	15-Feb	08:01:40	09:26:35	01:24:56
2	16-Feb	08:01:21	09:25:19	01:23:57
2	17-Feb	08:01:08	09:23:49	01:22:41
2	18-Feb	08:00:59	09:22:04	01:21:04
2	19-Feb	08:00:56	09:19:57	01:19:01
2	20-Feb	08:00:58	09:17:54	01:16:56
2	21-Feb	07:35:58	07:47:46	00:11:48
2	21-Feb	08:01:05	09:15:57	01:14:53
2	22-Feb	07:33:02	07:50:26	00:17:24
2	22-Feb	08:01:18	09:13:35	01:12:18
2	23-Feb	07:30:50	07:52:11	00:21:21
2	23-Feb	08:01:37	09:10:31	01:08:55
2	24-Feb	07:28:16	07:53:28	00:25:12
2	24-Feb	08:02:02	08:50:58	00:48:56

2	24-Feb	08:54:30	09:05:46	00:11:15
2	25-Feb	07:25:27	07:54:26	00:28:58
2	25-Feb	08:02:35	08:48:08	00:45:33
2	26-Feb	07:23:20	07:55:10	00:31:50
2	26-Feb	08:03:16	08:43:41	00:40:25
2	27-Feb	07:21:16	07:55:41	00:34:25
2	27-Feb	08:04:07	08:42:16	00:38:09
2	28-Feb	07:19:39	07:56:01	00:36:23
2	28-Feb	08:05:09	08:40:39	00:35:30
2	01-Mar	07:18:22	07:56:10	00:37:49
2	01-Mar	08:06:25	08:38:42	00:32:17
2	02-Mar	07:17:20	07:56:10	00:38:49
2	02-Mar	08:08:01	08:36:17	00:28:16
2	03-Mar	07:14:38	07:55:59	00:41:21
2	03-Mar	08:10:06	08:33:02	00:22:56
2	04-Mar	07:11:43	07:55:39	00:43:57
2	04-Mar	08:13:04	08:28:54	00:15:50
2	05-Mar	07:09:30	07:55:09	00:45:40
2	06-Mar	07:07:26	07:54:29	00:47:03
2	07-Mar	07:05:50	07:53:37	00:47:48
2	08-Mar	07:04:32	07:52:33	00:48:00
2	09-Mar	07:03:30	07:51:12	00:47:42
2	10-Mar	07:02:40	07:49:32	00:46:52
2	11-Mar	07:02:01	07:47:29	00:45:28
2	12-Mar	07:01:33	07:45:02	00:43:29
2	13-Mar	07:01:14	07:41:08	00:39:54
2	14-Mar	07:01:05	07:33:42	00:32:38
2	15-Mar	07:01:06	07:32:05	00:30:59
2	16-Mar	07:01:18	07:31:10	00:29:52
2	17-Mar	07:01:41	07:30:01	00:28:19
2	18-Mar	07:02:19	07:28:35	00:26:16
2	19-Mar	07:03:14	07:26:52	00:23:38
2	20-Mar	07:04:33	07:24:42	00:20:09
2	21-Mar	07:06:31	07:21:37	00:15:05
2	22-Mar	07:10:19	07:16:48	00:06:28
2	21-Sep	06:54:24	07:05:09	00:10:45
2	22-Sep	06:51:05	07:08:27	00:17:23
2	23-Sep	06:48:47	07:10:24	00:21:37
2	24-Sep	06:47:01	07:11:41	00:24:40
2	25-Sep	06:45:35	07:12:39	00:27:04
2	26-Sep	06:44:25	07:13:19	00:28:54
2	27-Sep	06:43:28	07:13:45	00:30:17
2	28-Sep	06:42:43	07:13:59	00:31:16
2	29-Sep	06:42:08	07:16:09	00:34:01
2	30-Sep	06:41:43	07:23:03	00:41:19
2	01-Oct	06:41:29	07:25:40	00:44:11
2	02-Oct	06:41:25	07:27:19	00:45:54
2	03-Oct	06:41:31	07:28:43	00:47:12
2	04-Oct	06:41:49	07:29:43	00:47:54
2	05-Oct	06:42:20	07:30:25	00:48:05

Calculated Maximum Theoretical Shadow Time per Turbine

2	06-Oct	06:43:07	07:30:54	00:47:47
2	07-Oct	06:44:15	07:31:11	00:46:56
2	08-Oct	06:45:48	07:31:18	00:45:30
2	08-Oct	07:53:14	08:00:32	00:07:18
2	09-Oct	06:47:32	07:31:16	00:43:44
2	09-Oct	07:47:51	08:05:21	00:17:30
2	10-Oct	06:50:07	07:31:05	00:40:58
2	10-Oct	07:44:41	08:08:56	00:24:14
2	11-Oct	06:52:01	07:30:46	00:38:45
2	11-Oct	07:42:17	08:11:26	00:29:09
2	12-Oct	06:52:36	07:30:18	00:37:42
2	12-Oct	07:40:20	08:13:16	00:32:56
2	13-Oct	06:53:28	07:29:42	00:36:14
2	13-Oct	07:38:41	08:14:41	00:35:59
2	14-Oct	06:54:41	07:28:56	00:34:16
2	14-Oct	07:37:16	08:15:48	00:38:32
2	15-Oct	06:56:19	07:28:00	00:31:41
2	15-Oct	07:36:04	08:17:34	00:41:30
2	16-Oct	06:58:04	07:26:53	00:28:49
2	16-Oct	07:35:01	08:21:09	00:46:08
2	17-Oct	07:00:31	07:25:33	00:25:02
2	17-Oct	07:34:08	08:23:28	00:49:20
2	17-Oct	08:25:42	08:38:59	00:13:17
2	18-Oct	07:02:41	07:23:56	00:21:14
2	18-Oct	07:33:23	08:42:53	01:09:30
2	19-Oct	07:04:32	07:21:51	00:17:19
2	19-Oct	07:32:45	08:45:28	01:12:42
2	20-Oct	07:07:08	07:18:54	00:11:46
2	20-Oct	07:32:15	08:47:26	01:15:11
2	21-Oct	07:31:51	08:49:02	01:17:10
2	22-Oct	07:31:34	08:50:52	01:19:17
2	23-Oct	07:31:23	08:52:41	01:21:17
2	24-Oct	07:31:19	08:54:10	01:22:51
2	25-Oct	07:31:21	08:55:26	01:24:05
2	26-Oct	07:31:29	08:56:31	01:25:02
2	27-Oct	07:31:43	08:57:27	01:25:44
2	28-Oct	07:32:04	08:58:16	01:26:12
2	29-Oct	07:32:32	08:58:58	01:26:27
2	30-Oct	07:33:06	08:59:35	01:26:29
2	31-Oct	07:33:48	09:00:07	01:26:19
2	01-Nov	07:34:38	09:00:35	01:25:57
2	02-Nov	07:35:37	09:00:59	01:25:21
2	03-Nov	07:36:47	09:01:19	01:24:32
2	04-Nov	07:38:08	09:01:36	01:23:28
2	05-Nov	07:39:45	09:01:49	01:22:05
2	06-Nov	07:41:37	08:58:04	01:16:26
2	07-Nov	07:43:21	08:58:12	01:14:51
2	08-Nov	07:45:20	08:58:17	01:12:57
2	09-Nov	07:47:52	08:58:20	01:10:28
2	10-Nov	07:49:57	08:58:21	01:08:25

2	11-Nov	07:51:05	08:58:20	01:07:15
2	12-Nov	07:52:22	08:58:17	01:05:55
2	13-Nov	07:53:49	08:58:11	01:04:22
2	14-Nov	07:55:30	08:58:04	01:02:34
2	15-Nov	07:57:14	08:57:55	01:00:41
2	15-Nov	09:02:30	09:14:23	00:11:53
2	16-Nov	07:59:08	08:57:44	00:58:37
2	16-Nov	08:59:55	09:17:16	00:17:21
2	17-Nov	08:01:24	08:57:32	00:56:08
2	17-Nov	08:58:10	09:20:16	00:22:06
2	18-Nov	08:04:25	09:23:09	01:18:44
2	19-Nov	08:09:30	09:25:14	01:15:45
2	19-Nov	09:44:29	09:47:32	00:03:03
2	20-Nov	08:10:30	09:26:57	01:16:26
2	20-Nov	09:39:09	09:53:34	00:14:25
2	21-Nov	08:11:35	09:28:24	01:16:49
2	21-Nov	09:36:42	09:58:11	00:21:29
2	22-Nov	08:12:45	09:29:41	01:16:57
2	22-Nov	09:34:58	10:00:55	00:25:57
2	23-Nov	08:13:59	09:30:50	01:16:52
2	23-Nov	09:33:38	10:03:03	00:29:25
2	24-Nov	08:15:16	09:31:53	01:16:37
2	24-Nov	09:32:34	10:04:50	00:32:17
2	24-Nov	15:33:33	15:38:33	00:05:01
2	25-Nov	08:16:36	10:06:24	01:49:49
2	25-Nov	15:30:51	15:41:37	00:10:46
2	26-Nov	08:18:01	09:29:48	01:11:47
2	26-Nov	09:30:59	10:07:49	00:36:49
2	26-Nov	15:29:05	15:43:33	00:14:28
2	27-Nov	08:19:32	10:09:05	01:49:33
2	27-Nov	15:28:01	15:45:04	00:17:03
2	28-Nov	08:21:10	10:08:49	01:47:39
2	28-Nov	15:27:18	15:46:21	00:19:03
2	29-Nov	08:22:56	10:09:07	01:46:11
2	29-Nov	15:26:48	15:47:28	00:20:40
2	30-Nov	08:24:20	10:11:24	01:47:04
2	30-Nov	15:25:54	15:48:29	00:22:34
2	01-Dec	08:25:39	08:52:18	00:26:39
2	01-Dec	08:52:46	10:13:23	01:20:36
2	01-Dec	15:25:15	15:49:24	00:24:08
2	02-Dec	08:27:02	10:15:03	01:48:01
2	02-Dec	14:35:47	14:45:28	00:09:41
2	02-Dec	15:24:49	15:50:14	00:25:25
2	03-Dec	08:28:28	10:16:31	01:48:03
2	03-Dec	14:33:50	14:48:08	00:14:17
2	03-Dec	15:24:32	15:51:01	00:26:29
2	04-Dec	08:29:58	10:17:50	01:47:52
2	04-Dec	14:32:40	14:50:05	00:17:25
2	04-Dec	15:24:22	15:51:45	00:27:23
2	05-Dec	08:31:34	08:53:39	00:22:05

2	05-Dec	08:53:45	10:19:02	01:25:17
2	05-Dec	14:31:53	14:51:43	00:19:50
2	05-Dec	15:24:19	15:52:28	00:28:09
2	06-Dec	08:33:15	08:52:50	00:19:35
2	06-Dec	08:54:05	10:20:09	01:26:04
2	06-Dec	14:31:19	14:53:08	00:21:49
2	06-Dec	15:24:19	15:53:08	00:28:49
2	07-Dec	08:35:04	08:51:55	00:16:51
2	07-Dec	08:54:26	10:21:25	01:26:59
2	07-Dec	14:30:55	14:54:24	00:23:29
2	07-Dec	15:24:24	15:53:47	00:29:23
2	08-Dec	08:37:05	08:50:48	00:13:43
2	08-Dec	08:54:49	10:23:48	01:28:59
2	08-Dec	10:29:21	10:30:59	00:01:39
2	08-Dec	14:30:40	14:55:33	00:24:53
2	08-Dec	15:24:33	15:54:24	00:29:51
2	09-Dec	08:39:27	08:49:21	00:09:54
2	09-Dec	08:55:13	10:25:36	01:30:23
2	09-Dec	10:25:58	10:35:14	00:09:16
2	09-Dec	14:30:30	14:56:37	00:26:06
2	09-Dec	15:24:44	15:54:59	00:30:16
2	10-Dec	08:43:03	08:46:40	00:03:37
2	10-Dec	08:55:38	10:39:12	01:43:34
2	10-Dec	14:30:26	14:57:36	00:27:09
2	10-Dec	15:24:58	15:55:35	00:30:36
2	11-Dec	08:56:04	10:41:29	01:45:24
2	11-Dec	14:30:27	14:58:31	00:28:04
2	11-Dec	15:25:15	15:52:12	00:26:57
2	12-Dec	08:56:31	10:43:11	01:46:40
2	12-Dec	14:30:28	14:59:22	00:28:54
2	12-Dec	15:25:33	15:52:45	00:27:12
2	13-Dec	08:56:59	10:44:35	01:47:36
2	13-Dec	14:30:30	15:00:11	00:29:41
2	13-Dec	15:25:53	15:53:17	00:27:24
2	14-Dec	08:57:27	10:45:48	01:48:21
2	14-Dec	14:30:37	15:00:57	00:30:20
2	14-Dec	15:26:15	15:53:49	00:27:34
2	15-Dec	08:57:56	10:46:52	01:48:56
2	15-Dec	14:30:47	15:01:19	00:30:32
2	15-Dec	15:26:39	15:54:21	00:27:42
2	16-Dec	08:58:25	10:47:49	01:49:24
2	16-Dec	14:31:01	15:02:01	00:30:59
2	16-Dec	15:27:03	15:54:52	00:27:49
2	17-Dec	08:58:54	10:48:40	01:49:46
2	17-Dec	14:31:19	15:00:58	00:29:39
2	17-Dec	15:27:29	15:55:23	00:27:54
2	18-Dec	08:59:23	10:49:26	01:50:03
2	18-Dec	14:31:39	14:59:41	00:28:02
2	18-Dec	15:27:56	15:55:53	00:27:58
2	19-Dec	08:59:53	10:50:08	01:50:14

Calculated Maximum Theoretical Shadow Time per Turbine

2	19-Dec	14:32:02	15:00:15	00:28:14
2	19-Dec	15:28:23	15:56:24	00:28:00
2	20-Dec	09:00:23	10:50:45	01:50:22
2	20-Dec	14:32:28	15:00:48	00:28:21
2	20-Dec	15:28:52	15:56:54	00:28:02
2	21-Dec	09:00:53	10:51:17	01:50:25
2	21-Dec	14:32:56	15:01:19	00:28:23
2	21-Dec	15:29:21	15:57:24	00:28:02
2	22-Dec	09:01:22	10:51:46	01:50:23
2	22-Dec	14:33:27	15:01:48	00:28:21
2	22-Dec	15:29:51	15:57:53	00:28:02
2	23-Dec	09:01:52	10:52:10	01:50:18
2	23-Dec	14:34:00	15:02:15	00:28:14
2	23-Dec	15:30:22	15:58:22	00:28:00
2	24-Dec	09:02:22	10:52:30	01:50:08
2	24-Dec	14:34:36	15:02:39	00:28:03
2	24-Dec	15:30:54	15:58:51	00:27:58
2	25-Dec	09:02:51	10:52:45	01:49:54
2	25-Dec	14:35:15	15:04:56	00:29:41
2	25-Dec	15:31:26	15:59:20	00:27:54
2	26-Dec	09:03:21	10:52:55	01:49:34
2	26-Dec	14:35:56	15:06:58	00:31:02
2	26-Dec	15:31:59	15:59:48	00:27:49
2	27-Dec	09:03:50	10:52:59	01:49:09
2	27-Dec	14:36:40	15:07:15	00:30:35
2	27-Dec	15:32:33	16:00:16	00:27:42
2	28-Dec	09:04:20	10:52:56	01:48:36
2	28-Dec	14:37:28	15:07:51	00:30:23
2	28-Dec	15:33:08	16:00:42	00:27:34
2	29-Dec	09:04:49	10:52:45	01:47:56
2	29-Dec	14:38:19	15:08:03	00:29:44
2	29-Dec	15:33:44	16:01:08	00:27:24
2	30-Dec	09:05:19	10:52:24	01:47:05
2	30-Dec	14:39:13	15:08:12	00:28:58
2	30-Dec	15:34:21	16:01:33	00:27:12
2	31-Dec	09:05:48	10:51:47	01:45:58
2	31-Dec	14:40:09	15:08:17	00:28:07
2	31-Dec	15:34:59	16:01:57	00:26:57

Turbine ID	Date	Start Time	End Time	Duration
3	01-Jan	09:11:02	09:39:10	00:28:08
3	01-Jan	15:31:30	16:09:42	00:38:12
3	02-Jan	09:11:34	09:39:32	00:27:58
3	02-Jan	15:31:58	16:10:17	00:38:19
3	03-Jan	09:12:07	09:39:53	00:27:46
3	03-Jan	15:32:26	16:10:50	00:38:24
3	04-Jan	09:12:41	09:40:11	00:27:31
3	04-Jan	15:32:54	16:11:23	00:38:28
3	05-Jan	09:13:15	09:44:24	00:31:09
3	05-Jan	15:33:23	16:11:54	00:38:31

Calculated Maximum Theoretical Shadow Time per Turbine

3	06-Jan	09:13:51	09:44:38	00:30:47
3	06-Jan	15:33:53	16:12:24	00:38:32
3	07-Jan	09:14:29	09:44:50	00:30:21
3	07-Jan	15:34:23	16:12:53	00:38:30
3	08-Jan	09:15:08	09:44:58	00:29:50
3	08-Jan	15:34:55	16:13:20	00:38:25
3	09-Jan	09:15:50	09:45:03	00:29:13
3	09-Jan	15:35:28	16:13:45	00:38:17
3	10-Jan	09:16:34	09:45:04	00:28:30
3	10-Jan	15:36:02	16:14:08	00:38:06
3	11-Jan	09:17:21	09:45:01	00:27:40
3	11-Jan	15:36:37	16:18:24	00:41:47
3	11-Jan	16:27:17	16:30:12	00:02:55
3	12-Jan	09:18:11	09:44:51	00:26:40
3	12-Jan	15:37:15	16:18:41	00:41:26
3	12-Jan	16:24:06	16:34:11	00:10:06
3	13-Jan	09:19:06	09:44:36	00:25:29
3	13-Jan	15:37:55	16:18:55	00:41:00
3	13-Jan	16:22:33	16:36:30	00:13:57
3	14-Jan	09:20:06	09:44:12	00:24:06
3	14-Jan	15:38:38	16:19:06	00:40:28
3	14-Jan	16:21:27	16:38:22	00:16:55
3	15-Jan	09:21:13	09:43:37	00:22:25
3	15-Jan	15:39:23	16:19:12	00:39:49
3	15-Jan	16:20:35	16:40:34	00:19:59
3	16-Jan	09:22:28	09:42:48	00:20:20
3	16-Jan	15:40:13	16:19:14	00:39:02
3	16-Jan	16:19:52	16:42:24	00:22:33
3	17-Jan	09:23:55	09:41:44	00:17:49
3	17-Jan	15:41:07	16:19:11	00:38:05
3	17-Jan	16:19:16	16:44:03	00:24:47
3	18-Jan	09:25:41	09:40:30	00:14:49
3	18-Jan	15:42:06	16:45:46	01:03:41
3	19-Jan	09:28:04	09:38:26	00:10:22
3	19-Jan	15:43:12	16:47:27	01:04:16
3	20-Jan	15:44:26	16:48:53	01:04:27
3	21-Jan	15:45:48	16:50:48	01:04:59
3	22-Jan	15:47:12	16:17:18	00:30:06
3	22-Jan	16:17:26	16:52:33	00:35:07
3	23-Jan	15:48:52	16:16:22	00:27:30
3	23-Jan	16:17:16	16:54:23	00:37:08
3	24-Jan	15:50:59	16:15:05	00:24:05
3	24-Jan	16:17:08	16:56:03	00:38:55
3	25-Jan	15:54:19	16:02:24	00:08:05
3	25-Jan	16:02:50	16:13:06	00:10:16
3	25-Jan	16:17:04	16:57:27	00:40:23
3	26-Jan	16:17:02	16:58:38	00:41:36
3	27-Jan	16:17:05	16:59:40	00:42:35
3	28-Jan	16:17:10	17:01:48	00:44:37
3	29-Jan	16:17:20	17:04:25	00:47:05

3	30-Jan	16:17:33	17:06:22	00:48:49
3	31-Jan	16:17:50	17:08:26	00:50:35
3	01-Feb	16:18:12	17:10:06	00:51:54
3	02-Feb	16:18:39	17:13:28	00:54:49
3	03-Feb	16:19:11	17:15:29	00:56:18
3	04-Feb	16:19:50	17:17:28	00:57:38
3	05-Feb	16:20:36	17:19:24	00:58:48
3	06-Feb	16:21:32	17:21:20	00:59:49
3	07-Feb	16:22:39	17:22:52	01:00:13
3	08-Feb	16:23:48	17:24:01	01:00:13
3	09-Feb	16:25:04	17:24:55	00:59:51
3	10-Feb	16:26:40	17:25:36	00:58:56
3	11-Feb	16:28:47	17:26:05	00:57:18
3	12-Feb	16:29:58	17:26:24	00:56:26
3	13-Feb	16:31:27	17:26:33	00:55:06
3	14-Feb	16:33:24	17:26:32	00:53:08
3	15-Feb	16:36:19	17:26:42	00:50:23
3	16-Feb	16:42:16	17:26:53	00:44:38
3	17-Feb	16:43:07	17:26:57	00:43:50
3	18-Feb	16:44:13	17:26:54	00:42:41
3	19-Feb	16:44:41	17:26:44	00:42:02
3	20-Feb	16:44:56	17:26:26	00:41:30
3	21-Feb	16:45:18	17:25:59	00:40:42
3	22-Feb	16:45:47	17:25:26	00:39:39
3	23-Feb	16:46:25	17:24:43	00:38:18
3	24-Feb	16:47:13	17:23:51	00:36:38
3	25-Feb	16:48:13	17:22:48	00:34:35
3	26-Feb	16:49:29	17:21:33	00:32:05
3	27-Feb	16:51:00	17:20:06	00:29:06
3	28-Feb	16:52:23	17:18:19	00:25:56
3	01-Mar	16:54:12	17:16:05	00:21:53
3	02-Mar	16:56:47	17:13:01	00:16:14
3	03-Mar	17:02:04	17:06:50	00:04:47
3	11-Mar	18:09:09	18:21:12	00:12:02
3	12-Mar	18:06:09	18:23:40	00:17:31
3	13-Mar	18:04:03	18:25:25	00:21:23
3	14-Mar	18:02:25	18:27:01	00:24:36
3	15-Mar	18:01:06	18:28:07	00:27:01
3	16-Mar	18:00:03	18:28:52	00:28:50
3	17-Mar	17:59:12	18:29:22	00:30:10
3	18-Mar	17:58:32	18:29:39	00:31:07
3	19-Mar	17:58:03	18:32:43	00:34:40
3	20-Mar	17:57:44	18:35:22	00:37:38
3	21-Mar	17:57:35	18:37:12	00:39:37
3	22-Mar	17:57:36	18:38:58	00:41:21
3	23-Mar	17:57:45	18:40:40	00:42:54
3	24-Mar	17:58:02	18:42:06	00:44:04
3	25-Mar	17:58:31	18:43:58	00:45:27
3	26-Mar	17:59:15	18:45:36	00:46:21
3	27-Mar	18:00:19	18:47:23	00:47:04

3	28-Mar	18:01:22	18:48:49	00:47:27
3	29-Mar	18:00:44	18:50:33	00:49:49
3	30-Mar	18:00:13	18:52:08	00:51:55
3	31-Mar	17:59:49	18:53:55	00:54:06
3	01-Apr	17:59:32	18:55:40	00:56:08
3	02-Apr	17:59:23	18:57:02	00:57:39
3	03-Apr	17:59:20	18:58:06	00:58:46
3	04-Apr	17:59:25	18:58:57	00:59:32
3	05-Apr	17:59:37	18:59:38	01:00:00
3	06-Apr	17:59:57	19:00:09	01:00:11
3	07-Apr	18:00:27	19:02:53	01:02:27
3	08-Apr	18:01:06	19:06:24	01:05:18
3	09-Apr	18:01:57	19:08:44	01:06:48
3	10-Apr	18:02:40	19:10:30	01:07:51
3	11-Apr	18:03:33	19:12:03	01:08:30
3	12-Apr	18:04:41	19:13:59	01:09:19
3	13-Apr	18:06:07	19:15:39	01:09:32
3	14-Apr	18:06:56	19:16:59	01:10:03
3	15-Apr	18:07:46	19:18:05	01:10:19
3	16-Apr	18:08:31	19:18:59	01:10:28
3	17-Apr	18:09:26	19:19:44	01:10:18
3	18-Apr	18:10:35	19:20:21	01:09:46
3	19-Apr	18:11:59	19:20:50	01:08:50
3	20-Apr	18:13:42	19:21:14	01:07:32
3	21-Apr	18:14:43	19:21:31	01:06:48
3	22-Apr	18:15:27	19:21:44	01:06:17
3	23-Apr	18:16:18	19:21:52	01:05:33
3	24-Apr	18:17:21	19:21:55	01:04:34
3	25-Apr	18:18:35	19:21:54	01:03:18
3	26-Apr	18:20:07	19:21:49	01:01:42
3	27-Apr	18:22:02	19:21:40	00:59:38
3	28-Apr	18:24:36	19:21:27	00:56:51
3	29-Apr	18:27:47	19:21:11	00:53:23
3	30-Apr	18:28:05	19:20:51	00:52:47
3	01-May	18:28:27	19:20:28	00:52:01
3	02-May	18:28:54	19:20:01	00:51:08
3	03-May	18:29:26	19:19:31	00:50:05
3	04-May	18:30:04	19:18:58	00:48:54
3	05-May	18:30:47	19:18:20	00:47:33
3	06-May	18:31:37	19:17:39	00:46:02
3	07-May	18:32:31	19:16:55	00:44:24
3	08-May	18:33:12	19:16:06	00:42:54
3	09-May	18:33:59	19:15:13	00:41:14
3	10-May	18:34:51	19:14:18	00:39:27
3	10-May	19:48:48	19:53:55	00:05:07
3	11-May	18:35:50	19:13:18	00:37:28
3	11-May	19:43:26	19:59:21	00:15:55
3	12-May	18:36:56	19:12:12	00:35:16
3	12-May	19:40:35	20:02:14	00:21:39
3	13-May	18:38:10	19:10:59	00:32:49

3	13-May	19:38:29	20:04:25	00:25:56
3	14-May	18:39:35	19:09:38	00:30:03
3	14-May	19:36:48	20:06:12	00:29:24
3	15-May	18:41:13	19:08:06	00:26:53
3	15-May	19:35:23	20:07:43	00:32:20
3	16-May	18:43:10	19:06:19	00:23:08
3	16-May	19:34:10	20:09:03	00:34:52
3	17-May	18:45:41	19:04:07	00:18:27
3	17-May	19:33:08	20:10:35	00:37:27
3	18-May	18:49:40	19:01:05	00:11:25
3	18-May	19:32:13	20:12:09	00:39:56
3	19-May	19:31:26	20:13:31	00:42:06
3	20-May	19:30:44	20:14:44	00:44:00
3	21-May	19:30:07	20:15:49	00:45:42
3	22-May	19:29:35	20:16:49	00:47:13
3	23-May	19:29:07	20:17:43	00:48:35
3	24-May	19:28:43	20:18:32	00:49:49
3	25-May	19:28:22	20:19:18	00:50:56
3	26-May	19:28:05	20:20:01	00:51:56
3	27-May	19:27:50	20:20:41	00:52:51
3	28-May	19:27:38	20:21:18	00:53:40
3	29-May	19:27:28	20:21:53	00:54:25
3	30-May	19:27:21	20:22:26	00:55:06
3	31-May	19:27:15	20:22:58	00:55:42
3	01-Jun	19:27:12	20:23:27	00:56:16
3	02-Jun	19:27:10	20:23:56	00:56:45
3	03-Jun	19:27:10	20:24:22	00:57:12
3	04-Jun	19:27:11	20:24:48	00:57:36
3	05-Jun	19:27:14	20:25:12	00:57:58
3	06-Jun	19:27:18	20:25:36	00:58:17
3	07-Jun	19:27:23	20:25:58	00:58:34
3	08-Jun	19:27:30	20:26:19	00:58:50
3	09-Jun	19:27:37	20:26:40	00:59:03
3	10-Jun	19:27:45	20:26:59	00:59:15
3	11-Jun	19:27:54	20:27:19	00:59:25
3	12-Jun	19:28:03	20:27:37	00:59:34
3	13-Jun	19:28:13	20:27:55	00:59:41
3	14-Jun	19:28:24	20:28:12	00:59:48
3	15-Jun	19:28:35	20:28:28	00:59:53
3	16-Jun	19:28:47	20:28:44	00:59:57
3	17-Jun	19:28:59	20:28:59	01:00:01
3	18-Jun	19:29:11	20:29:14	01:00:03
3	19-Jun	19:29:24	20:29:28	01:00:05
3	20-Jun	19:29:36	20:29:42	01:00:06
3	21-Jun	19:29:49	20:29:55	01:00:05
3	22-Jun	19:30:03	20:30:07	01:00:04
3	23-Jun	19:30:16	20:30:18	01:00:02
3	24-Jun	19:30:30	20:30:29	00:59:59
3	25-Jun	19:30:43	20:30:39	00:59:56
3	26-Jun	19:30:57	20:30:49	00:59:51

Calculated Maximum Theoretical Shadow Time per Turbine

3	27-Jun	19:31:12	20:30:57	00:59:46
3	28-Jun	19:31:26	20:31:05	00:59:39
3	29-Jun	19:31:41	20:31:11	00:59:31
3	30-Jun	19:31:56	20:31:17	00:59:22
3	01-Jul	19:32:11	20:31:22	00:59:11
3	02-Jul	19:32:26	20:31:25	00:58:59
3	03-Jul	19:32:42	20:31:27	00:58:45
3	04-Jul	19:32:58	20:31:27	00:58:29
3	05-Jul	19:33:15	20:31:26	00:58:11
3	06-Jul	19:33:32	20:31:24	00:57:51
3	07-Jul	19:33:50	20:31:19	00:57:29
3	08-Jul	19:34:09	20:31:13	00:57:04
3	09-Jul	19:34:28	20:31:04	00:56:36
3	10-Jul	19:34:48	20:30:54	00:56:06
3	11-Jul	19:35:09	20:30:41	00:55:32
3	12-Jul	19:35:31	20:30:25	00:54:54
3	13-Jul	19:35:54	20:30:06	00:54:12
3	14-Jul	19:36:19	20:29:45	00:53:26
3	15-Jul	19:36:45	20:29:21	00:52:36
3	16-Jul	19:37:13	20:28:53	00:51:40
3	17-Jul	19:37:42	20:28:21	00:50:38
3	18-Jul	19:38:14	20:27:44	00:49:30
3	19-Jul	19:38:48	20:27:03	00:48:15
3	20-Jul	19:39:25	20:26:16	00:46:51
3	21-Jul	19:40:04	20:25:23	00:45:18
3	22-Jul	19:40:48	20:24:22	00:43:34
3	23-Jul	19:41:35	20:23:13	00:41:37
3	24-Jul	18:58:58	19:11:45	00:12:47
3	24-Jul	19:42:28	20:21:53	00:39:25
3	25-Jul	18:55:26	19:14:37	00:19:11
3	25-Jul	19:43:26	20:20:19	00:36:53
3	26-Jul	18:53:05	19:16:45	00:23:40
3	26-Jul	19:44:31	20:18:55	00:34:24
3	27-Jul	18:51:12	19:18:29	00:27:17
3	27-Jul	19:45:45	20:17:35	00:31:49
3	28-Jul	18:49:36	19:19:58	00:30:22
3	28-Jul	19:47:11	20:16:01	00:28:50
3	29-Jul	18:48:11	19:21:15	00:33:05
3	29-Jul	19:48:53	20:14:10	00:25:16
3	30-Jul	18:46:55	19:22:24	00:35:29
3	30-Jul	19:51:00	20:11:52	00:20:52
3	31-Jul	18:45:46	19:23:25	00:37:38
3	31-Jul	19:53:55	20:08:45	00:14:50
3	01-Aug	18:44:43	19:24:19	00:39:35
3	02-Aug	18:43:46	19:25:06	00:41:21
3	03-Aug	18:42:52	19:25:51	00:42:59
3	04-Aug	18:42:03	19:26:30	00:44:27
3	05-Aug	18:40:59	19:27:04	00:46:05
3	06-Aug	18:39:59	19:27:34	00:47:35
3	07-Aug	18:39:04	19:27:58	00:48:54

Calculated Maximum Theoretical Shadow Time per Turbine

3	08-Aug	18:38:13	19:28:18	00:50:05
3	09-Aug	18:37:27	19:28:33	00:51:07
3	10-Aug	18:36:44	19:28:44	00:52:00
3	11-Aug	18:36:05	19:28:50	00:52:45
3	12-Aug	18:35:30	19:28:52	00:53:22
3	13-Aug	18:32:18	19:28:49	00:56:31
3	14-Aug	18:29:20	19:28:42	00:59:22
3	15-Aug	18:27:02	19:28:30	01:01:28
3	16-Aug	18:25:07	19:28:13	01:03:06
3	17-Aug	18:23:28	19:27:51	01:04:23
3	18-Aug	18:22:01	19:27:24	01:05:23
3	19-Aug	18:20:43	19:26:52	01:06:09
3	20-Aug	18:19:34	19:26:14	01:06:40
3	21-Aug	18:18:09	19:25:31	01:07:22
3	22-Aug	18:16:10	19:24:41	01:08:31
3	23-Aug	18:14:13	19:23:44	01:09:31
3	24-Aug	18:12:33	19:22:40	01:10:07
3	25-Aug	18:11:05	19:21:27	01:10:22
3	26-Aug	18:09:47	19:20:05	01:10:18
3	27-Aug	18:08:30	19:18:31	01:10:01
3	28-Aug	18:07:09	19:16:44	01:09:35
3	29-Aug	18:05:20	19:14:38	01:09:18
3	30-Aug	18:03:34	19:12:11	01:08:37
3	31-Aug	18:02:03	19:10:00	01:07:58
3	01-Sep	18:00:43	19:07:49	01:07:06
3	02-Sep	17:59:20	19:05:09	01:05:49
3	03-Sep	17:58:01	19:01:38	01:03:37
3	04-Sep	17:56:52	18:56:59	01:00:08
3	05-Sep	17:55:51	18:55:56	01:00:04
3	06-Sep	17:54:59	18:54:43	00:59:44
3	07-Sep	17:54:13	18:53:19	00:59:06
3	08-Sep	17:53:34	18:51:44	00:58:10
3	09-Sep	17:53:02	18:49:54	00:56:52
3	10-Sep	17:52:36	18:47:44	00:55:07
3	11-Sep	17:52:17	18:45:13	00:52:56
3	12-Sep	17:52:05	18:43:02	00:50:58
3	13-Sep	17:51:59	18:40:36	00:48:37
3	14-Sep	17:51:30	18:38:32	00:47:02
3	15-Sep	17:49:33	18:36:17	00:46:44
3	16-Sep	17:47:59	18:33:50	00:45:52
3	17-Sep	17:46:42	18:31:38	00:44:56
3	18-Sep	17:45:38	18:29:12	00:43:33
3	19-Sep	17:44:47	18:27:08	00:42:22
3	20-Sep	17:43:59	18:24:40	00:40:41
3	21-Sep	17:43:23	18:22:24	00:39:01
3	22-Sep	17:42:56	18:19:45	00:36:49
3	23-Sep	17:42:39	18:16:05	00:33:27
3	24-Sep	17:42:32	18:13:26	00:30:54
3	25-Sep	17:42:35	18:12:28	00:29:53
3	26-Sep	17:42:50	18:11:18	00:28:28

3	27-Sep	17:43:18	18:09:52	00:26:33
3	28-Sep	17:44:02	18:08:05	00:24:02
3	29-Sep	17:45:07	18:05:47	00:20:40
3	30-Sep	17:46:42	18:03:29	00:16:46
3	01-Oct	17:49:19	18:00:13	00:10:54
3	09-Oct	16:38:14	16:41:24	00:03:10
3	10-Oct	16:31:55	16:47:40	00:15:46
3	11-Oct	16:28:49	16:50:19	00:21:30
3	12-Oct	16:26:32	16:52:08	00:25:36
3	13-Oct	16:24:43	16:53:30	00:28:47
3	14-Oct	16:22:50	16:54:33	00:31:44
3	15-Oct	16:21:09	16:55:24	00:34:15
3	16-Oct	16:19:45	16:56:06	00:36:21
3	17-Oct	16:18:34	16:56:38	00:38:03
3	18-Oct	16:17:35	16:57:01	00:39:26
3	19-Oct	16:16:45	16:57:17	00:40:32
3	20-Oct	16:16:05	16:57:26	00:41:21
3	21-Oct	16:15:32	16:57:29	00:41:57
3	22-Oct	16:15:06	16:57:26	00:42:20
3	23-Oct	16:13:44	16:57:17	00:43:33
3	24-Oct	16:12:37	16:57:03	00:44:26
3	25-Oct	16:07:28	16:56:42	00:49:15
3	26-Oct	16:04:00	16:56:18	00:52:17
3	27-Oct	16:01:43	16:56:13	00:54:30
3	28-Oct	16:00:01	16:56:01	00:56:00
3	29-Oct	15:58:40	16:55:40	00:57:01
3	30-Oct	15:56:50	16:55:11	00:58:22
3	31-Oct	15:55:03	16:54:33	00:59:30
3	01-Nov	15:53:41	16:53:45	01:00:04
3	02-Nov	15:52:36	16:52:43	01:00:08
3	03-Nov	15:51:27	16:51:25	00:59:58
3	04-Nov	15:50:32	16:49:41	00:59:09
3	05-Nov	15:49:48	16:47:46	00:57:57
3	06-Nov	15:49:14	16:46:05	00:56:51
3	07-Nov	15:48:48	16:44:20	00:55:31
3	08-Nov	15:48:30	16:41:59	00:53:30
3	09-Nov	15:48:18	16:39:32	00:51:14
3	10-Nov	15:48:13	16:37:54	00:49:41
3	11-Nov	15:48:14	16:36:13	00:47:59
3	12-Nov	15:48:20	16:34:18	00:45:58
3	13-Nov	15:48:31	16:31:33	00:43:01
3	14-Nov	15:48:48	16:30:56	00:42:09
3	15-Nov	15:37:21	15:43:15	00:05:54
3	15-Nov	15:49:09	16:30:13	00:41:04
3	16-Nov	15:25:16	15:46:34	00:21:18
3	16-Nov	15:49:36	16:29:21	00:39:45
3	17-Nov	15:23:03	15:48:37	00:25:34
3	17-Nov	15:50:07	16:28:17	00:38:10
3	18-Nov	15:21:36	15:50:11	00:28:35
3	18-Nov	15:50:43	16:26:56	00:36:13

Calculated Maximum Theoretical Shadow Time per Turbine

3	19-Nov	15:20:32	16:25:38	01:05:06
3	20-Nov	15:19:43	16:24:25	01:04:41
3	21-Nov	15:18:54	16:23:14	01:04:20
3	22-Nov	09:03:58	09:13:10	00:09:12
3	22-Nov	15:18:16	16:22:17	01:04:01
3	23-Nov	09:01:59	09:16:06	00:14:07
3	23-Nov	15:17:48	16:21:09	01:03:20
3	24-Nov	09:00:45	09:18:02	00:17:17
3	24-Nov	15:17:28	15:55:53	00:38:25
3	24-Nov	15:56:07	16:20:03	00:23:56
3	25-Nov	08:59:52	09:19:44	00:19:51
3	25-Nov	15:17:14	15:56:32	00:39:18
3	25-Nov	15:57:23	16:19:03	00:21:40
3	26-Nov	08:59:15	09:21:15	00:22:01
3	26-Nov	15:17:06	15:57:08	00:40:02
3	26-Nov	15:58:48	16:17:44	00:18:56
3	27-Nov	08:58:47	09:22:33	00:23:45
3	27-Nov	15:17:02	15:57:41	00:40:39
3	27-Nov	16:00:25	16:16:23	00:15:57
3	28-Nov	08:58:28	09:23:40	00:25:12
3	28-Nov	15:17:03	15:58:12	00:41:09
3	28-Nov	16:02:21	16:15:07	00:12:46
3	29-Nov	08:58:16	09:24:41	00:26:25
3	29-Nov	15:17:07	15:58:40	00:41:33
3	29-Nov	16:04:52	16:13:16	00:08:24
3	30-Nov	08:58:09	09:25:36	00:27:27
3	30-Nov	15:17:15	15:59:07	00:41:52
3	01-Dec	08:58:08	09:26:27	00:28:19
3	01-Dec	15:17:27	15:55:36	00:38:10
3	02-Dec	08:58:10	09:27:14	00:29:04
3	02-Dec	15:17:40	15:56:01	00:38:20
3	03-Dec	08:58:17	09:27:58	00:29:42
3	03-Dec	15:17:57	15:56:24	00:38:27
3	04-Dec	08:58:26	09:28:40	00:30:14
3	04-Dec	15:18:15	15:56:46	00:38:31
3	05-Dec	08:58:39	09:29:20	00:30:41
3	05-Dec	15:18:36	15:57:08	00:38:32
3	06-Dec	08:58:54	09:29:58	00:31:04
3	06-Dec	15:18:58	15:57:29	00:38:31
3	07-Dec	08:59:11	09:26:38	00:27:27
3	07-Dec	15:19:22	15:57:50	00:38:28
3	08-Dec	08:59:31	09:27:13	00:27:42
3	08-Dec	15:19:48	15:58:11	00:38:23
3	09-Dec	08:59:52	09:27:47	00:27:55
3	09-Dec	15:20:14	15:58:31	00:38:17
3	10-Dec	09:00:15	09:28:21	00:28:06
3	10-Dec	15:20:42	15:58:52	00:38:11
3	11-Dec	09:00:39	09:28:53	00:28:15
3	11-Dec	15:21:10	15:59:14	00:38:04
3	12-Dec	09:01:04	09:29:25	00:28:21

Calculated Maximum Theoretical Shadow Time per Turbine

3	12-Dec	15:21:39	15:59:35	00:37:56
3	13-Dec	09:01:30	09:29:57	00:28:27
3	13-Dec	15:22:08	15:59:57	00:37:49
3	14-Dec	09:01:57	09:30:28	00:28:31
3	14-Dec	15:22:38	16:00:20	00:37:42
3	15-Dec	09:02:25	09:30:59	00:28:34
3	15-Dec	15:23:08	16:00:44	00:37:35
3	16-Dec	09:02:54	09:31:30	00:28:36
3	16-Dec	15:23:39	16:01:08	00:37:29
3	17-Dec	09:03:22	09:32:00	00:28:38
3	17-Dec	15:24:09	16:01:33	00:37:24
3	18-Dec	09:03:51	09:32:30	00:28:39
3	18-Dec	15:24:39	16:01:59	00:37:20
3	19-Dec	09:04:21	09:33:00	00:28:40
3	19-Dec	15:25:10	16:02:27	00:37:17
3	20-Dec	09:04:50	09:33:30	00:28:40
3	20-Dec	15:25:40	16:02:55	00:37:15
3	21-Dec	09:05:20	09:34:00	00:28:40
3	21-Dec	15:26:10	16:03:24	00:37:14
3	22-Dec	09:05:50	09:34:30	00:28:40
3	22-Dec	15:26:39	16:03:54	00:37:15
3	23-Dec	09:06:20	09:34:59	00:28:40
3	23-Dec	15:27:09	16:04:26	00:37:17
3	24-Dec	09:06:50	09:35:29	00:28:39
3	24-Dec	15:27:38	16:04:58	00:37:20
3	25-Dec	09:07:19	09:35:58	00:28:38
3	25-Dec	15:28:07	16:05:31	00:37:24
3	26-Dec	09:07:49	09:36:26	00:28:37
3	26-Dec	15:28:35	16:06:04	00:37:29
3	27-Dec	09:08:20	09:36:55	00:28:35
3	27-Dec	15:29:03	16:06:39	00:37:35
3	28-Dec	09:08:50	09:37:22	00:28:32
3	28-Dec	15:29:31	16:07:13	00:37:42
3	29-Dec	09:09:20	09:37:49	00:28:29
3	29-Dec	15:29:59	16:07:48	00:37:49
3	30-Dec	09:09:51	09:38:15	00:28:24
3	30-Dec	15:30:27	16:08:23	00:37:56
3	31-Dec	09:10:22	09:38:40	00:28:18
3	31-Dec	15:30:55	16:08:58	00:38:04

Turbine ID	Date	Start Time	End Time	Duration
4	01-Jan	08:37:21	08:53:34	00:16:13
4	01-Jan	09:05:29	09:46:41	00:41:12
4	01-Jan	09:52:05	10:01:29	00:09:23
4	02-Jan	08:37:08	08:54:41	00:17:33
4	02-Jan	09:06:07	09:50:13	00:44:07
4	02-Jan	09:54:48	09:59:05	00:04:17
4	03-Jan	08:36:51	08:55:47	00:18:56
4	03-Jan	09:06:45	09:50:52	00:44:06
4	04-Jan	08:36:35	08:56:51	00:20:16

Calculated Maximum Theoretical Shadow Time per Turbine

4	04-Jan	09:07:26	09:50:53	00:43:28
4	05-Jan	08:36:21	08:57:54	00:21:33
4	05-Jan	09:08:07	09:50:51	00:42:44
4	06-Jan	08:36:07	08:58:55	00:22:48
4	06-Jan	09:08:51	09:50:44	00:41:53
4	07-Jan	08:35:41	08:59:55	00:24:13
4	07-Jan	09:09:37	09:50:31	00:40:54
4	08-Jan	08:35:17	09:00:52	00:25:35
4	08-Jan	09:10:25	09:50:11	00:39:46
4	09-Jan	08:34:56	09:01:48	00:26:52
4	09-Jan	09:11:16	09:49:41	00:38:25
4	10-Jan	08:34:38	09:02:41	00:28:04
4	10-Jan	09:12:10	09:49:00	00:36:50
4	11-Jan	08:34:22	09:03:33	00:29:11
4	11-Jan	09:13:09	09:48:01	00:34:52
4	12-Jan	08:34:07	09:04:21	00:30:14
4	12-Jan	09:14:12	09:47:31	00:33:19
4	13-Jan	08:33:55	09:01:13	00:27:17
4	13-Jan	09:15:21	09:50:44	00:35:23
4	14-Jan	08:33:45	09:01:58	00:28:13
4	14-Jan	09:16:38	09:51:02	00:34:24
4	15-Jan	08:33:37	09:02:40	00:29:03
4	15-Jan	09:17:57	09:50:41	00:32:44
4	16-Jan	08:33:31	09:03:20	00:29:48
4	16-Jan	09:19:02	09:50:12	00:31:10
4	17-Jan	08:33:27	09:03:56	00:30:29
4	17-Jan	09:20:13	09:49:34	00:29:21
4	18-Jan	08:32:53	09:04:29	00:31:36
4	18-Jan	09:21:32	09:48:45	00:27:13
4	19-Jan	08:29:03	09:05:03	00:35:59
4	19-Jan	09:23:01	09:47:39	00:24:39
4	20-Jan	08:27:17	09:05:35	00:38:18
4	20-Jan	09:24:44	09:46:10	00:21:26
4	21-Jan	08:26:01	09:09:43	00:43:42
4	21-Jan	09:26:49	09:43:53	00:17:04
4	22-Jan	08:24:48	09:10:02	00:45:13
4	22-Jan	09:29:37	09:41:09	00:11:32
4	23-Jan	08:23:50	09:10:16	00:46:25
4	24-Jan	08:22:45	09:10:25	00:47:40
4	25-Jan	08:21:42	09:10:30	00:48:48
4	26-Jan	08:20:45	09:10:30	00:49:45
4	27-Jan	08:19:59	09:10:24	00:50:25
4	28-Jan	08:19:21	09:10:11	00:50:50
4	29-Jan	08:18:51	09:09:52	00:51:01
4	30-Jan	08:18:27	09:09:26	00:50:59
4	31-Jan	08:18:09	09:08:50	00:50:41
4	01-Feb	08:17:56	09:08:04	00:50:08
4	02-Feb	08:17:49	09:07:10	00:49:21
4	03-Feb	08:17:47	09:06:01	00:48:14
4	04-Feb	08:09:51	09:04:30	00:54:39

Calculated Maximum Theoretical Shadow Time per Turbine

4	05-Feb	08:07:27	09:02:22	00:54:55
4	06-Feb	08:05:44	08:59:07	00:53:23
4	07-Feb	08:04:19	08:54:10	00:49:50
4	08-Feb	08:02:39	08:51:10	00:48:31
4	09-Feb	08:01:11	08:50:21	00:49:09
4	10-Feb	08:00:02	08:49:16	00:49:15
4	11-Feb	07:59:07	08:47:57	00:48:50
4	12-Feb	07:58:25	08:46:22	00:47:57
4	13-Feb	07:57:54	08:44:10	00:46:16
4	14-Feb	07:57:31	08:40:27	00:42:56
4	15-Feb	07:57:18	08:28:29	00:31:12
4	15-Feb	08:30:55	08:35:10	00:04:15
4	16-Feb	07:57:13	08:28:09	00:30:56
4	17-Feb	07:57:17	08:27:39	00:30:22
4	18-Feb	07:57:30	08:26:56	00:29:26
4	19-Feb	07:57:53	08:25:59	00:28:06
4	20-Feb	07:58:28	08:24:45	00:26:17
4	21-Feb	07:59:17	08:23:07	00:23:50
4	22-Feb	08:00:25	08:20:58	00:20:33
4	23-Feb	08:02:02	08:17:48	00:15:46
4	24-Feb	08:04:39	08:14:46	00:10:06
4	06-Mar	07:20:07	07:24:58	00:04:51
4	07-Mar	07:12:57	07:27:56	00:14:59
4	08-Mar	07:10:38	07:29:38	00:19:01
4	09-Mar	07:08:23	07:30:47	00:22:23
4	10-Mar	07:06:37	07:31:36	00:24:58
4	11-Mar	07:05:15	07:32:07	00:26:52
4	12-Mar	07:04:10	07:32:25	00:28:15
4	13-Mar	07:03:19	07:32:30	00:29:10
4	14-Mar	07:02:41	07:32:23	00:29:42
4	15-Mar	07:02:14	07:32:04	00:29:51
4	16-Mar	07:01:57	07:31:34	00:29:37
4	17-Mar	07:01:52	07:30:53	00:29:01
4	18-Mar	07:01:58	07:29:58	00:27:59
4	19-Mar	07:02:17	07:28:48	00:26:31
4	20-Mar	06:42:22	06:54:49	00:12:27
4	20-Mar	07:02:51	07:27:19	00:24:28
4	21-Mar	06:39:43	06:56:49	00:17:06
4	21-Mar	07:03:42	07:25:32	00:21:50
4	22-Mar	06:37:22	06:58:05	00:20:42
4	22-Mar	07:04:59	07:23:17	00:18:17
4	23-Mar	06:35:25	06:58:57	00:23:32
4	23-Mar	07:07:01	07:19:48	00:12:47
4	24-Mar	06:33:55	06:59:31	00:25:36
4	24-Mar	07:12:11	07:14:01	00:01:50
4	25-Mar	06:32:44	06:59:49	00:27:05
4	26-Mar	06:31:49	06:59:54	00:28:06
4	27-Mar	06:31:06	06:59:48	00:28:41
4	28-Mar	06:30:36	06:59:30	00:28:54
4	29-Mar	06:30:17	06:59:01	00:28:44

Calculated Maximum Theoretical Shadow Time per Turbine

4	30-Mar	06:30:09	06:58:20	00:28:11
4	31-Mar	06:30:12	06:57:27	00:27:15
4	01-Apr	06:30:29	06:56:19	00:25:51
4	02-Apr	06:30:59	06:54:58	00:23:58
4	03-Apr	06:31:48	06:53:14	00:21:26
4	04-Apr	06:33:00	06:50:54	00:17:54
4	05-Apr	06:34:53	06:47:50	00:12:57
4	06-Apr	06:38:55	06:43:13	00:04:18
4	06-Sep	06:31:49	06:42:16	00:10:28
4	07-Sep	06:28:52	06:44:47	00:15:55
4	08-Sep	06:26:48	06:46:53	00:20:04
4	09-Sep	06:25:13	06:48:10	00:22:57
4	10-Sep	06:23:57	06:49:00	00:25:04
4	11-Sep	06:22:56	06:49:35	00:26:39
4	12-Sep	06:22:07	06:49:55	00:27:48
4	13-Sep	06:21:30	06:50:01	00:28:31
4	14-Sep	06:21:04	06:49:56	00:28:53
4	15-Sep	06:20:48	06:49:40	00:28:52
4	16-Sep	06:20:44	06:49:13	00:28:30
4	17-Sep	06:20:51	06:48:35	00:27:44
4	18-Sep	06:21:12	06:47:45	00:26:33
4	19-Sep	06:21:49	06:46:42	00:24:52
4	19-Sep	06:56:16	07:05:00	00:08:44
4	20-Sep	06:22:48	06:45:22	00:22:35
4	20-Sep	06:52:46	07:08:17	00:15:31
4	21-Sep	06:24:18	06:43:45	00:19:26
4	21-Sep	06:50:29	07:10:24	00:19:55
4	22-Sep	06:25:58	06:41:39	00:15:41
4	22-Sep	06:48:45	07:11:42	00:22:57
4	23-Sep	06:28:20	06:38:35	00:10:15
4	23-Sep	06:47:23	07:12:43	00:25:20
4	24-Sep	06:46:17	07:13:25	00:27:07
4	25-Sep	06:45:25	07:13:50	00:28:25
4	26-Sep	06:44:45	07:14:01	00:29:16
4	27-Sep	06:44:16	07:14:01	00:29:45
4	28-Sep	06:43:58	07:13:50	00:29:51
4	29-Sep	06:43:52	07:13:28	00:29:36
4	30-Sep	06:43:57	07:12:56	00:28:59
4	01-Oct	06:44:14	07:12:12	00:27:58
4	02-Oct	06:44:47	07:11:17	00:26:30
4	03-Oct	06:45:39	07:10:08	00:24:29
4	04-Oct	06:46:56	07:08:42	00:21:47
4	05-Oct	06:48:37	07:06:57	00:18:20
4	06-Oct	06:50:27	07:04:35	00:14:08
4	07-Oct	06:59:09	07:00:41	00:01:32
4	17-Oct	07:36:29	07:47:19	00:10:50
4	18-Oct	07:33:42	07:49:49	00:16:07
4	19-Oct	07:31:50	07:52:40	00:20:50
4	20-Oct	07:30:26	07:54:26	00:24:00
4	21-Oct	07:29:21	07:55:44	00:26:23

Calculated Maximum Theoretical Shadow Time per Turbine

4	22-Oct	07:28:31	07:56:41	00:28:10
4	23-Oct	07:27:54	07:57:22	00:29:28
4	24-Oct	07:27:28	07:57:51	00:30:23
4	25-Oct	07:27:13	07:58:10	00:30:57
4	26-Oct	07:27:08	07:58:20	00:31:13
4	26-Oct	08:00:45	08:05:04	00:04:19
4	27-Oct	07:27:12	08:10:10	00:42:57
4	28-Oct	07:27:27	08:13:44	00:46:18
4	29-Oct	07:27:52	08:15:50	00:47:59
4	30-Oct	07:28:28	08:17:21	00:48:53
4	31-Oct	07:29:18	08:18:37	00:49:19
4	01-Nov	07:30:24	08:19:41	00:49:17
4	02-Nov	07:31:50	08:20:32	00:48:41
4	03-Nov	07:33:34	08:21:12	00:47:38
4	04-Nov	07:34:59	08:28:25	00:53:25
4	05-Nov	07:36:45	08:31:46	00:55:01
4	06-Nov	07:39:03	08:34:04	00:55:01
4	07-Nov	07:47:38	08:35:46	00:48:08
4	08-Nov	07:47:50	08:37:06	00:49:17
4	09-Nov	07:48:08	08:38:13	00:50:05
4	10-Nov	07:48:33	08:39:13	00:50:40
4	11-Nov	07:49:05	08:40:05	00:50:59
4	12-Nov	07:49:44	08:40:49	00:51:05
4	13-Nov	07:50:32	08:41:28	00:50:56
4	14-Nov	07:51:27	08:42:01	00:50:34
4	15-Nov	07:52:32	08:42:29	00:49:57
4	16-Nov	07:53:49	08:42:54	00:49:05
4	17-Nov	07:55:16	08:43:15	00:47:59
4	18-Nov	07:56:46	08:43:33	00:46:47
4	19-Nov	07:58:14	08:43:48	00:45:34
4	19-Nov	09:03:57	09:14:26	00:10:29
4	20-Nov	07:59:52	08:44:01	00:44:09
4	20-Nov	09:01:28	09:17:37	00:16:09
4	21-Nov	08:01:37	08:40:26	00:38:49
4	21-Nov	08:59:51	09:20:38	00:20:48
4	22-Nov	08:03:45	08:40:28	00:36:43
4	22-Nov	08:58:38	09:22:45	00:24:07
4	23-Nov	08:06:59	08:40:29	00:33:30
4	23-Nov	08:57:42	09:24:28	00:26:46
4	24-Nov	08:09:54	08:40:33	00:30:39
4	24-Nov	08:56:58	09:25:56	00:28:58
4	25-Nov	08:10:35	08:40:35	00:30:00
4	25-Nov	08:56:24	09:27:13	00:30:50
4	26-Nov	08:11:19	08:40:36	00:29:17
4	26-Nov	08:55:57	09:28:23	00:32:26
4	27-Nov	08:12:07	08:40:35	00:28:28
4	27-Nov	08:55:24	09:29:26	00:34:02
4	28-Nov	08:12:58	08:40:33	00:27:34
4	28-Nov	08:54:48	09:30:02	00:35:14
4	29-Nov	08:13:53	08:43:42	00:29:49

Calculated Maximum Theoretical Shadow Time per Turbine

4	29-Nov	08:54:20	09:27:22	00:33:02
4	30-Nov	08:14:51	08:44:21	00:29:30
4	30-Nov	08:54:01	09:28:22	00:34:21
4	01-Dec	08:15:52	08:44:18	00:28:26
4	01-Dec	08:53:47	09:30:12	00:36:25
4	02-Dec	08:16:57	08:44:12	00:27:15
4	02-Dec	08:53:39	09:31:44	00:38:04
4	03-Dec	08:18:06	08:44:06	00:26:00
4	03-Dec	08:53:36	09:33:03	00:39:27
4	04-Dec	08:19:18	08:43:58	00:24:41
4	04-Dec	08:53:37	09:34:15	00:40:38
4	05-Dec	08:20:34	08:43:50	00:23:16
4	05-Dec	08:53:41	09:35:20	00:41:39
4	06-Dec	08:21:43	08:43:41	00:21:58
4	06-Dec	08:53:48	09:36:20	00:42:31
4	07-Dec	08:22:49	08:43:31	00:20:42
4	07-Dec	08:53:59	09:37:16	00:43:17
4	08-Dec	08:23:58	08:43:21	00:19:23
4	08-Dec	08:54:11	09:38:08	00:43:57
4	09-Dec	08:25:09	08:43:10	00:18:01
4	09-Dec	08:54:27	09:38:55	00:44:29
4	09-Dec	09:44:14	09:46:14	00:02:00
4	10-Dec	08:26:18	08:42:59	00:16:40
4	10-Dec	08:54:44	09:35:48	00:41:05
4	10-Dec	09:41:41	09:50:02	00:08:21
4	11-Dec	08:27:26	08:42:47	00:15:20
4	11-Dec	08:55:02	09:36:33	00:41:31
4	11-Dec	09:40:43	09:52:35	00:11:53
4	12-Dec	08:28:35	08:42:34	00:13:59
4	12-Dec	08:55:23	09:37:16	00:41:53
4	12-Dec	09:40:09	09:54:17	00:14:08
4	13-Dec	08:29:45	08:42:22	00:12:36
4	13-Dec	08:55:45	09:37:57	00:42:12
4	13-Dec	09:39:50	09:55:39	00:15:49
4	14-Dec	08:30:56	08:42:09	00:11:13
4	14-Dec	08:56:08	09:38:37	00:42:29
4	14-Dec	09:39:41	09:56:49	00:17:08
4	15-Dec	08:32:07	08:41:56	00:09:49
4	15-Dec	08:56:33	09:39:15	00:42:42
4	15-Dec	09:39:40	09:57:50	00:18:11
4	16-Dec	08:33:18	08:41:43	00:08:25
4	16-Dec	08:56:58	09:58:45	01:01:47
4	17-Dec	08:34:29	08:41:31	00:07:02
4	17-Dec	08:57:24	09:59:34	01:02:10
4	18-Dec	08:35:39	08:41:21	00:05:42
4	18-Dec	08:57:52	10:00:19	01:02:27
4	19-Dec	08:36:46	08:41:13	00:04:27
4	19-Dec	08:58:20	10:00:59	01:02:40
4	20-Dec	08:37:47	08:41:11	00:03:24
4	20-Dec	08:58:48	10:01:36	01:02:47

Calculated Maximum Theoretical Shadow Time per Turbine

4	21-Dec	08:38:35	08:41:23	00:02:48
4	21-Dec	08:59:18	10:02:08	01:02:51
4	22-Dec	08:39:00	08:41:57	00:02:57
4	22-Dec	08:59:47	10:02:37	01:02:50
4	23-Dec	08:39:06	08:42:51	00:03:46
4	23-Dec	09:00:18	10:03:02	01:02:44
4	24-Dec	08:39:01	08:43:56	00:04:55
4	24-Dec	09:00:49	10:03:23	01:02:34
4	25-Dec	08:38:52	08:45:04	00:06:13
4	25-Dec	09:01:20	10:03:40	01:02:19
4	26-Dec	08:38:40	08:46:14	00:07:34
4	26-Dec	09:01:53	10:03:52	01:01:59
4	27-Dec	08:38:28	08:47:26	00:08:58
4	27-Dec	09:02:25	09:45:14	00:42:49
4	27-Dec	09:45:21	10:03:58	00:18:37
4	28-Dec	08:38:15	08:48:37	00:10:22
4	28-Dec	09:02:59	09:45:35	00:42:36
4	28-Dec	09:46:18	10:03:59	00:17:41
4	29-Dec	08:38:02	08:49:48	00:11:46
4	29-Dec	09:03:33	09:45:54	00:42:21
4	29-Dec	09:47:21	10:03:51	00:16:30
4	30-Dec	08:37:49	08:50:58	00:13:09
4	30-Dec	09:04:07	09:46:11	00:42:03
4	30-Dec	09:48:32	10:03:33	00:15:01
4	31-Dec	08:37:36	08:52:08	00:14:32
4	31-Dec	09:04:43	09:46:26	00:41:43
4	31-Dec	09:49:54	10:02:59	00:13:04

Turbine ID	Date	Start Time	End Time	Duration
5	01-Jan	09:12:23	09:52:17	00:39:54
5	02-Jan	09:12:58	09:52:25	00:39:27
5	03-Jan	09:13:35	09:52:30	00:38:55
5	04-Jan	09:14:12	09:52:31	00:38:18
5	05-Jan	09:14:51	09:52:27	00:37:36
5	06-Jan	09:15:31	09:52:17	00:36:46
5	07-Jan	09:16:14	09:52:01	00:35:47
5	08-Jan	09:16:58	09:51:35	00:34:38
5	09-Jan	09:17:45	09:50:58	00:33:13
5	10-Jan	09:18:35	09:50:02	00:31:27
5	11-Jan	09:19:28	09:48:29	00:29:01
5	12-Jan	09:20:25	09:47:04	00:26:39
5	13-Jan	09:21:28	09:46:42	00:25:14
5	14-Jan	09:22:35	09:46:11	00:23:35
5	15-Jan	09:23:50	09:45:27	00:21:37
5	16-Jan	09:25:15	09:44:25	00:19:10
5	17-Jan	09:26:55	09:42:51	00:15:57
5	18-Jan	09:28:59	09:41:27	00:12:27
5	19-Jan	09:32:08	09:38:58	00:06:50
5	08-Mar	18:13:23	18:14:45	00:01:22
5	09-Mar	18:07:44	18:19:53	00:12:09

Calculated Maximum Theoretical Shadow Time per Turbine

5	10-Mar	18:05:16	18:21:50	00:16:33
5	11-Mar	18:03:32	18:23:40	00:20:08
5	12-Mar	18:02:12	18:24:59	00:22:47
5	13-Mar	18:01:11	18:25:51	00:24:40
5	14-Mar	18:00:24	18:28:45	00:28:21
5	15-Mar	17:59:51	18:30:35	00:30:44
5	16-Mar	17:59:29	18:32:25	00:32:56
5	17-Mar	17:59:20	18:33:47	00:34:27
5	18-Mar	17:59:22	18:34:41	00:35:19
5	19-Mar	17:59:39	18:35:15	00:35:37
5	20-Mar	18:00:10	18:35:34	00:35:23
5	21-Mar	18:01:02	18:35:39	00:34:37
5	22-Mar	18:02:01	18:35:31	00:33:31
5	23-Mar	18:03:17	18:35:12	00:31:55
5	24-Mar	18:05:23	18:34:42	00:29:19
5	25-Mar	18:07:21	18:33:59	00:26:38
5	26-Mar	18:08:04	18:33:03	00:24:59
5	26-Mar	18:39:14	18:48:50	00:09:36
5	27-Mar	18:08:57	18:31:51	00:22:55
5	27-Mar	18:35:50	18:51:37	00:15:47
5	28-Mar	18:10:02	18:30:22	00:20:20
5	28-Mar	18:33:35	18:53:20	00:19:45
5	29-Mar	18:11:42	18:28:27	00:16:46
5	29-Mar	18:31:53	18:55:03	00:23:10
5	30-Mar	18:14:07	18:25:45	00:11:38
5	30-Mar	18:30:32	18:56:16	00:25:44
5	31-Mar	18:29:27	18:57:05	00:27:39
5	01-Apr	18:28:35	18:57:38	00:29:03
5	02-Apr	18:27:55	18:57:58	00:30:03
5	03-Apr	18:27:25	18:58:05	00:30:40
5	04-Apr	18:27:06	18:58:03	00:30:57
5	05-Apr	18:26:57	18:57:50	00:30:53
5	06-Apr	18:26:58	18:57:28	00:30:30
5	07-Apr	18:27:10	18:56:56	00:29:47
5	08-Apr	18:27:33	18:56:14	00:28:41
5	09-Apr	18:28:11	18:55:22	00:27:11
5	10-Apr	18:29:06	18:54:17	00:25:11
5	11-Apr	18:30:00	18:52:57	00:22:57
5	12-Apr	18:31:08	18:51:22	00:20:14
5	13-Apr	18:32:46	18:49:19	00:16:33
5	14-Apr	18:35:26	18:46:24	00:10:58
5	16-Apr	19:17:18	19:24:01	00:06:42
5	17-Apr	19:13:28	19:27:24	00:13:56
5	18-Apr	19:11:11	19:29:16	00:18:04
5	19-Apr	19:09:30	19:30:58	00:21:28
5	20-Apr	19:08:10	19:32:31	00:24:21
5	21-Apr	19:07:06	19:33:38	00:26:32
5	22-Apr	19:06:14	19:34:27	00:28:13
5	23-Apr	19:05:34	19:35:03	00:29:30
5	24-Apr	19:05:02	19:35:28	00:30:26

Calculated Maximum Theoretical Shadow Time per Turbine

5	25-Apr	19:04:39	19:35:45	00:31:05
5	26-Apr	19:04:24	19:35:53	00:31:29
5	27-Apr	19:04:17	19:35:54	00:31:37
5	28-Apr	19:04:17	19:35:48	00:31:30
5	29-Apr	19:04:25	19:35:35	00:31:10
5	30-Apr	19:04:41	19:35:16	00:30:36
5	01-May	19:05:04	19:34:51	00:29:47
5	02-May	19:05:37	19:34:19	00:28:42
5	03-May	19:06:20	19:33:40	00:27:21
5	03-May	19:44:48	19:50:19	00:05:30
5	04-May	19:07:15	19:32:54	00:25:39
5	04-May	19:40:54	19:54:06	00:13:12
5	05-May	19:08:25	19:31:59	00:23:34
5	05-May	19:38:43	19:56:11	00:17:28
5	06-May	19:09:22	19:30:56	00:21:34
5	06-May	19:37:07	19:57:46	00:20:39
5	07-May	19:10:31	19:29:40	00:19:09
5	07-May	19:35:51	19:59:12	00:23:21
5	08-May	19:12:00	19:28:05	00:16:05
5	08-May	19:34:49	20:00:20	00:25:31
5	09-May	19:14:05	19:25:57	00:11:52
5	09-May	19:33:59	20:01:16	00:27:17
5	10-May	19:18:29	19:21:51	00:03:22
5	10-May	19:33:18	20:02:01	00:28:44
5	11-May	19:32:44	20:02:40	00:29:55
5	12-May	19:32:17	20:03:11	00:30:54
5	13-May	19:31:54	20:03:38	00:31:43
5	14-May	19:31:37	20:03:59	00:32:22
5	15-May	19:31:24	20:04:16	00:32:52
5	16-May	19:31:17	20:04:30	00:33:13
5	17-May	19:31:13	20:04:40	00:33:27
5	18-May	19:31:13	20:04:47	00:33:35
5	19-May	19:31:17	20:04:52	00:33:35
5	20-May	19:31:24	20:04:54	00:33:30
5	20-May	20:07:33	20:16:54	00:09:21
5	21-May	19:31:34	20:04:53	00:33:19
5	21-May	20:05:24	20:19:12	00:13:49
5	22-May	19:31:47	20:20:50	00:49:03
5	23-May	19:32:03	20:22:08	00:50:05
5	24-May	19:32:22	20:23:36	00:51:14
5	25-May	19:32:44	20:25:25	00:52:41
5	26-May	19:33:08	20:26:48	00:53:40
5	27-May	19:33:34	20:28:01	00:54:28
5	28-May	19:34:02	20:29:20	00:55:17
5	29-May	19:34:33	20:30:25	00:55:52
5	30-May	19:35:05	20:31:21	00:56:16
5	31-May	19:35:40	20:32:10	00:56:31
5	01-Jun	19:36:16	20:32:55	00:56:39
5	02-Jun	19:36:54	20:33:52	00:56:58
5	03-Jun	19:37:33	20:34:50	00:57:17

Calculated Maximum Theoretical Shadow Time per Turbine

5	04-Jun	19:38:14	20:35:42	00:57:28
5	05-Jun	19:38:56	20:36:32	00:57:35
5	06-Jun	19:39:40	20:37:36	00:57:56
5	07-Jun	19:40:24	20:38:31	00:58:07
5	08-Jun	19:41:10	20:39:20	00:58:10
5	09-Jun	19:41:52	20:40:03	00:58:12
5	10-Jun	19:42:31	20:40:42	00:58:11
5	11-Jun	19:43:10	20:41:18	00:58:07
5	12-Jun	19:43:48	20:41:49	00:58:01
5	13-Jun	19:44:25	20:42:19	00:57:53
5	14-Jun	19:45:01	19:59:40	00:14:39
5	14-Jun	20:00:00	20:42:45	00:42:45
5	15-Jun	19:45:35	19:59:31	00:13:56
5	15-Jun	20:00:12	20:43:10	00:42:58
5	16-Jun	19:46:06	19:59:25	00:13:19
5	16-Jun	20:00:23	20:43:32	00:43:08
5	17-Jun	19:46:35	19:59:23	00:12:48
5	17-Jun	20:00:36	20:43:52	00:43:16
5	18-Jun	19:46:59	19:59:24	00:12:24
5	18-Jun	20:00:48	20:44:10	00:43:22
5	19-Jun	19:47:20	19:59:29	00:12:08
5	19-Jun	20:01:01	20:44:26	00:43:26
5	20-Jun	19:47:37	19:59:38	00:12:01
5	20-Jun	20:01:13	20:44:41	00:43:27
5	21-Jun	19:47:49	19:59:52	00:12:03
5	21-Jun	20:01:26	20:44:53	00:43:27
5	22-Jun	19:47:57	20:00:10	00:12:13
5	22-Jun	20:01:40	20:45:04	00:43:24
5	23-Jun	19:48:00	20:00:33	00:12:32
5	23-Jun	20:01:53	20:45:13	00:43:20
5	24-Jun	19:48:00	20:00:59	00:12:59
5	24-Jun	20:02:06	20:45:20	00:43:13
5	25-Jun	19:47:56	20:01:28	00:13:32
5	25-Jun	20:02:20	20:45:24	00:43:04
5	26-Jun	19:47:50	20:02:01	00:14:11
5	26-Jun	20:02:34	20:45:27	00:42:53
5	27-Jun	19:47:40	20:02:35	00:14:55
5	27-Jun	20:02:48	20:45:27	00:42:39
5	28-Jun	19:47:29	20:45:24	00:57:55
5	29-Jun	19:47:16	20:45:18	00:58:02
5	30-Jun	19:47:02	20:45:09	00:58:07
5	01-Jul	19:46:47	20:44:57	00:58:10
5	02-Jul	19:46:31	20:44:40	00:58:09
5	03-Jul	19:46:10	20:44:17	00:58:07
5	04-Jul	19:45:47	20:43:48	00:58:01
5	05-Jul	19:45:24	20:43:11	00:57:47
5	06-Jul	19:45:02	20:42:31	00:57:29
5	07-Jul	19:44:41	20:42:04	00:57:23
5	08-Jul	19:44:20	20:41:29	00:57:09
5	09-Jul	19:44:00	20:40:46	00:56:46

5	10-Jul	19:43:41	20:40:16	00:56:35
5	11-Jul	19:43:22	20:39:47	00:56:25
5	12-Jul	19:43:05	20:39:12	00:56:07
5	13-Jul	19:42:48	20:38:28	00:55:40
5	14-Jul	19:42:33	20:37:34	00:55:01
5	15-Jul	19:42:18	20:36:28	00:54:09
5	16-Jul	19:42:05	20:35:28	00:53:22
5	17-Jul	19:41:53	20:34:10	00:52:17
5	18-Jul	19:41:43	20:32:27	00:50:44
5	19-Jul	19:41:34	20:31:22	00:49:48
5	20-Jul	19:41:27	20:30:08	00:48:41
5	21-Jul	19:41:21	20:14:44	00:33:23
5	21-Jul	20:15:42	20:28:30	00:12:48
5	22-Jul	19:41:18	20:14:50	00:33:32
5	22-Jul	20:18:17	20:25:58	00:07:40
5	23-Jul	19:41:16	20:14:53	00:33:36
5	24-Jul	19:41:17	20:14:51	00:33:34
5	25-Jul	19:41:21	20:14:46	00:33:26
5	26-Jul	19:41:27	20:14:37	00:33:10
5	27-Jul	19:41:36	20:14:23	00:32:47
5	28-Jul	19:41:48	20:14:04	00:32:16
5	29-Jul	19:42:04	20:13:40	00:31:36
5	30-Jul	19:42:25	20:13:10	00:30:46
5	31-Jul	19:42:48	20:12:34	00:29:46
5	01-Aug	19:27:34	19:32:35	00:05:02
5	01-Aug	19:43:17	20:11:50	00:28:33
5	02-Aug	19:23:40	19:36:02	00:12:21
5	02-Aug	19:43:52	20:10:57	00:27:05
5	03-Aug	19:21:33	19:37:56	00:16:23
5	03-Aug	19:44:35	20:09:53	00:25:18
5	04-Aug	19:19:58	19:39:19	00:19:21
5	04-Aug	19:45:29	20:08:35	00:23:06
5	05-Aug	19:18:41	19:40:24	00:21:43
5	05-Aug	19:46:35	20:06:57	00:20:22
5	06-Aug	19:17:33	19:41:14	00:23:42
5	06-Aug	19:48:02	20:05:12	00:17:10
5	07-Aug	19:16:12	19:41:56	00:25:44
5	07-Aug	19:50:03	20:02:53	00:12:49
5	08-Aug	19:15:05	19:42:28	00:27:24
5	08-Aug	19:53:59	19:58:36	00:04:37
5	09-Aug	19:14:08	19:42:52	00:28:44
5	10-Aug	19:13:20	19:43:08	00:29:48
5	11-Aug	19:12:40	19:43:16	00:30:36
5	12-Aug	19:12:06	19:43:16	00:31:10
5	13-Aug	19:11:39	19:43:10	00:31:31
5	14-Aug	19:11:19	19:42:56	00:31:37
5	15-Aug	19:11:04	19:42:34	00:31:30
5	16-Aug	19:10:56	19:42:04	00:31:08
5	17-Aug	19:10:55	19:41:26	00:30:31
5	18-Aug	19:11:01	19:40:37	00:29:36

Calculated Maximum Theoretical Shadow Time per Turbine

5	19-Aug	19:11:15	19:39:38	00:28:22
5	20-Aug	19:11:39	19:38:24	00:26:46
5	21-Aug	19:12:13	19:36:54	00:24:40
5	22-Aug	19:13:02	19:34:58	00:21:56
5	23-Aug	19:14:09	19:32:47	00:18:38
5	24-Aug	19:15:47	19:30:35	00:14:48
5	25-Aug	19:18:34	19:27:13	00:08:39
5	27-Aug	18:37:43	18:46:35	00:08:53
5	28-Aug	18:34:08	18:49:23	00:15:16
5	29-Aug	18:31:46	18:51:02	00:19:16
5	30-Aug	18:29:57	18:52:09	00:22:12
5	31-Aug	18:28:30	18:52:58	00:24:27
5	01-Sep	18:26:57	18:53:31	00:26:34
5	02-Sep	18:25:40	18:53:52	00:28:12
5	03-Sep	18:24:36	18:54:01	00:29:25
5	04-Sep	18:23:43	18:53:59	00:30:16
5	05-Sep	18:23:01	18:53:48	00:30:47
5	06-Sep	18:22:29	18:53:27	00:30:58
5	07-Sep	18:22:06	18:52:56	00:30:50
5	08-Sep	18:21:52	18:52:15	00:30:23
5	09-Sep	18:21:49	18:51:23	00:29:34
5	10-Sep	18:21:56	18:50:19	00:28:23
5	11-Sep	18:08:17	18:15:56	00:07:39
5	11-Sep	18:22:14	18:48:59	00:26:45
5	12-Sep	18:04:40	18:18:51	00:14:11
5	12-Sep	18:22:47	18:47:21	00:24:34
5	13-Sep	18:01:52	18:20:25	00:18:33
5	13-Sep	18:23:36	18:45:15	00:21:39
5	14-Sep	17:59:52	18:21:25	00:21:33
5	14-Sep	18:24:51	18:42:54	00:18:04
5	15-Sep	17:58:18	18:22:06	00:23:48
5	15-Sep	18:26:46	18:40:15	00:13:29
5	16-Sep	17:56:47	18:22:31	00:25:44
5	16-Sep	18:31:00	18:35:18	00:04:18
5	17-Sep	17:55:32	18:22:41	00:27:09
5	18-Sep	17:52:13	18:22:39	00:30:25
5	19-Sep	17:49:52	18:22:25	00:32:33
5	20-Sep	17:48:08	18:22:00	00:33:53
5	21-Sep	17:46:30	18:21:24	00:34:54
5	22-Sep	17:45:07	18:20:36	00:35:29
5	23-Sep	17:44:02	18:19:35	00:35:34
5	24-Sep	17:43:11	18:18:18	00:35:07
5	25-Sep	17:42:33	18:16:41	00:34:07
5	26-Sep	17:42:08	18:14:32	00:32:24
5	27-Sep	17:41:54	18:12:10	00:30:15
5	28-Sep	17:41:53	18:09:35	00:27:42
5	29-Sep	17:42:05	18:06:28	00:24:23
5	30-Sep	17:42:33	18:04:57	00:22:24
5	01-Oct	17:43:19	18:02:58	00:19:38
5	02-Oct	17:44:32	18:00:37	00:16:04

Calculated Maximum Theoretical Shadow Time per Turbine

5	03-Oct	17:46:32	17:57:59	00:11:28
5	22-Nov	09:08:23	09:13:29	00:05:06
5	23-Nov	09:05:22	09:16:59	00:11:37
5	24-Nov	09:03:47	09:19:07	00:15:20
5	25-Nov	09:02:41	09:21:17	00:18:36
5	26-Nov	09:01:54	09:23:03	00:21:09
5	27-Nov	09:01:18	09:24:30	00:23:12
5	28-Nov	09:00:52	09:25:45	00:24:54
5	29-Nov	09:00:32	09:26:53	00:26:21
5	30-Nov	09:00:18	09:28:36	00:28:18
5	01-Dec	09:00:10	09:31:09	00:30:59
5	02-Dec	09:00:07	09:32:58	00:32:51
5	03-Dec	09:00:08	09:34:27	00:34:19
5	04-Dec	09:00:12	09:35:44	00:35:32
5	05-Dec	09:00:20	09:36:53	00:36:33
5	06-Dec	09:00:31	09:37:55	00:37:24
5	07-Dec	09:00:44	09:38:53	00:38:09
5	08-Dec	09:00:59	09:39:46	00:38:47
5	09-Dec	09:01:17	09:40:37	00:39:19
5	10-Dec	09:01:37	09:41:24	00:39:47
5	11-Dec	09:01:58	09:42:09	00:40:11
5	11-Dec	09:48:54	09:53:17	00:04:23
5	12-Dec	09:02:20	09:42:52	00:40:32
5	12-Dec	09:47:01	09:55:51	00:08:50
5	13-Dec	09:02:44	09:43:33	00:40:49
5	13-Dec	09:46:17	09:57:28	00:11:11
5	14-Dec	09:03:09	09:44:13	00:41:04
5	14-Dec	09:45:55	09:58:45	00:12:50
5	15-Dec	09:03:35	09:44:26	00:40:52
5	15-Dec	09:45:46	09:59:51	00:14:05
5	16-Dec	09:04:01	09:41:31	00:37:29
5	16-Dec	09:45:46	10:00:49	00:15:03
5	17-Dec	09:04:29	09:42:06	00:37:37
5	17-Dec	09:45:52	10:01:40	00:15:47
5	18-Dec	09:04:57	09:42:40	00:37:44
5	18-Dec	09:46:05	10:02:25	00:16:21
5	19-Dec	09:05:25	09:43:13	00:37:48
5	19-Dec	09:46:22	10:03:06	00:16:44
5	20-Dec	09:05:54	09:43:45	00:37:51
5	20-Dec	09:46:45	10:03:43	00:16:59
5	21-Dec	09:06:24	09:44:15	00:37:52
5	21-Dec	09:47:11	10:04:16	00:17:05
5	22-Dec	09:06:53	09:44:45	00:37:51
5	22-Dec	09:47:42	10:04:45	00:17:03
5	23-Dec	09:07:24	09:45:13	00:37:50
5	23-Dec	09:48:17	10:05:09	00:16:53
5	24-Dec	09:07:54	09:45:40	00:37:46
5	24-Dec	09:48:56	10:05:30	00:16:34
5	25-Dec	09:08:25	09:46:06	00:37:41
5	25-Dec	09:49:40	10:05:46	00:16:05

Calculated Maximum Theoretical Shadow Time per Turbine

5	26-Dec	09:08:56	09:46:30	00:37:34
5	26-Dec	09:50:30	10:05:56	00:15:27
5	27-Dec	09:09:28	09:46:53	00:37:25
5	27-Dec	09:51:25	10:06:01	00:14:36
5	28-Dec	09:10:00	09:50:46	00:40:46
5	28-Dec	09:52:28	10:05:57	00:13:29
5	29-Dec	09:10:33	09:51:30	00:40:57
5	29-Dec	09:53:41	10:05:44	00:12:03
5	30-Dec	09:11:06	09:51:47	00:40:41
5	30-Dec	09:55:10	10:05:15	00:10:06
5	31-Dec	09:11:39	09:52:01	00:40:22
5	31-Dec	09:57:11	10:04:16	00:07:04

Turbine ID	Date	Start Time	End Time	Duration
6	03-Feb	17:05:14	17:11:56	00:06:42
6	04-Feb	17:01:57	17:15:25	00:13:28
6	05-Feb	17:00:01	17:17:32	00:17:31
6	06-Feb	16:58:36	17:19:28	00:20:52
6	07-Feb	16:57:30	17:21:11	00:23:42
6	08-Feb	16:56:36	17:23:03	00:26:27
6	09-Feb	16:55:54	17:24:46	00:28:52
6	10-Feb	16:55:21	17:26:42	00:31:21
6	11-Feb	16:54:55	17:28:10	00:33:15
6	12-Feb	16:54:38	17:30:01	00:35:24
6	13-Feb	16:54:27	17:32:03	00:37:36
6	14-Feb	16:54:24	17:33:52	00:39:28
6	15-Feb	16:54:28	17:35:53	00:41:25
6	16-Feb	16:54:40	17:37:23	00:42:43
6	17-Feb	16:55:00	17:38:33	00:43:32
6	18-Feb	16:55:30	17:39:27	00:43:57
6	19-Feb	16:56:11	17:40:09	00:43:58
6	20-Feb	16:56:55	17:40:40	00:43:45
6	21-Feb	16:57:41	17:41:01	00:43:20
6	22-Feb	16:58:28	17:41:12	00:42:44
6	23-Feb	16:59:30	17:41:15	00:41:45
6	24-Feb	17:00:53	17:49:46	00:48:52
6	25-Feb	17:01:52	17:53:42	00:51:51
6	26-Feb	17:03:07	17:56:04	00:52:57
6	27-Feb	17:04:52	17:57:49	00:52:57
6	28-Feb	17:05:52	17:59:43	00:53:51
6	01-Mar	17:06:32	18:01:15	00:54:42
6	02-Mar	17:07:26	18:02:26	00:54:59
6	03-Mar	17:08:38	18:03:21	00:54:43
6	04-Mar	17:10:15	18:04:03	00:53:48
6	05-Mar	17:12:37	18:04:34	00:51:57
6	06-Mar	17:15:11	18:04:55	00:49:44
6	07-Mar	17:23:25	18:05:07	00:41:42
6	08-Mar	17:23:05	18:05:11	00:42:07
6	09-Mar	17:22:51	18:05:07	00:42:16
6	10-Mar	17:22:45	18:04:55	00:42:10

Calculated Maximum Theoretical Shadow Time per Turbine

6	11-Mar	17:22:46	18:04:34	00:41:49
6	12-Mar	17:22:55	18:04:06	00:41:12
6	13-Mar	17:23:12	18:03:30	00:40:18
6	14-Mar	17:23:39	18:02:45	00:39:06
6	15-Mar	17:24:17	18:01:51	00:37:34
6	16-Mar	17:24:49	18:00:47	00:35:58
6	17-Mar	17:25:32	17:59:31	00:33:59
6	18-Mar	17:26:29	17:58:03	00:31:34
6	19-Mar	17:27:43	17:56:21	00:28:37
6	20-Mar	17:29:22	17:54:17	00:24:55
6	21-Mar	17:31:42	17:51:41	00:19:59
6	22-Mar	17:34:59	17:47:59	00:12:59
6	26-Mar	18:30:30	18:43:40	00:13:10
6	27-Mar	18:26:39	18:46:54	00:20:15
6	28-Mar	18:23:57	18:48:59	00:25:03
6	29-Mar	18:21:48	18:50:32	00:28:44
6	30-Mar	18:20:01	18:52:19	00:32:18
6	31-Mar	18:18:30	18:54:03	00:35:32
6	01-Apr	18:17:13	18:55:21	00:38:09
6	02-Apr	18:16:05	18:56:22	00:40:17
6	03-Apr	18:15:08	18:57:10	00:42:02
6	04-Apr	18:14:19	18:57:46	00:43:27
6	05-Apr	18:13:38	18:58:12	00:44:35
6	06-Apr	18:13:04	18:58:30	00:45:27
6	07-Apr	18:12:37	18:58:41	00:46:04
6	08-Apr	18:12:17	18:58:44	00:46:27
6	09-Apr	18:12:03	18:58:41	00:46:38
6	10-Apr	18:11:57	18:58:32	00:46:35
6	11-Apr	18:11:57	18:58:16	00:46:19
6	12-Apr	18:12:04	18:57:54	00:45:51
6	13-Apr	18:12:18	18:57:27	00:45:09
6	14-Apr	18:12:40	18:56:53	00:44:13
6	15-Apr	18:13:10	18:56:13	00:43:03
6	16-Apr	18:13:49	18:55:27	00:41:38
6	16-Apr	19:07:04	19:11:17	00:04:13
6	17-Apr	18:14:39	18:54:33	00:39:54
6	17-Apr	19:00:22	19:17:33	00:17:11
6	18-Apr	18:15:41	18:53:32	00:37:51
6	18-Apr	18:56:58	19:20:34	00:23:35
6	19-Apr	18:16:26	18:52:22	00:35:57
6	19-Apr	18:54:25	19:22:43	00:28:18
6	20-Apr	18:17:21	18:51:05	00:33:44
6	20-Apr	18:52:20	19:24:25	00:32:05
6	21-Apr	18:18:29	18:49:37	00:31:08
6	21-Apr	18:50:35	19:26:09	00:35:35
6	22-Apr	18:19:54	18:47:56	00:28:02
6	22-Apr	18:49:03	19:27:37	00:38:34
6	23-Apr	18:21:42	18:45:54	00:24:12
6	23-Apr	18:47:44	19:28:51	00:41:07
6	24-Apr	18:24:10	18:43:22	00:19:12

Calculated Maximum Theoretical Shadow Time per Turbine

6	24-Apr	18:46:34	19:29:53	00:43:19
6	25-Apr	18:28:03	18:39:44	00:11:41
6	25-Apr	18:45:32	19:30:46	00:45:14
6	26-Apr	18:44:38	19:31:31	00:46:53
6	27-Apr	18:43:50	19:32:10	00:48:20
6	28-Apr	18:43:08	19:32:43	00:49:35
6	29-Apr	18:42:32	19:33:10	00:50:38
6	30-Apr	18:42:00	19:33:33	00:51:33
6	01-May	18:41:34	19:33:52	00:52:18
6	02-May	18:41:12	19:34:07	00:52:55
6	03-May	18:40:54	19:34:18	00:53:24
6	04-May	18:40:41	19:34:26	00:53:45
6	05-May	18:40:31	19:34:31	00:53:59
6	06-May	18:40:25	19:34:33	00:54:08
6	07-May	18:40:23	19:34:32	00:54:10
6	08-May	18:40:24	19:34:29	00:54:05
6	09-May	18:40:28	19:34:24	00:53:55
6	10-May	18:40:36	19:34:16	00:53:40
6	11-May	18:40:47	19:34:06	00:53:19
6	11-May	19:39:21	19:53:32	00:14:11
6	12-May	18:41:01	19:33:55	00:52:53
6	12-May	19:36:17	19:56:45	00:20:28
6	13-May	18:41:18	19:33:41	00:52:23
6	13-May	19:34:05	19:59:03	00:24:58
6	14-May	18:41:38	20:00:54	01:19:16
6	15-May	18:42:01	20:02:28	01:20:27
6	16-May	18:42:27	20:03:49	01:21:22
6	17-May	18:42:55	20:05:05	01:22:10
6	18-May	18:43:26	20:07:33	01:24:07
6	19-May	18:44:00	20:09:35	01:25:35
6	20-May	18:44:37	20:11:15	01:26:38
6	21-May	18:45:16	20:12:40	01:27:24
6	22-May	18:45:58	20:13:55	01:27:57
6	23-May	18:46:42	20:15:27	01:28:45
6	24-May	18:47:21	20:16:47	01:29:26
6	25-May	18:48:01	20:17:58	01:29:57
6	26-May	18:48:43	20:19:01	01:30:18
6	27-May	18:49:26	20:19:58	01:30:32
6	28-May	18:50:12	20:20:50	01:30:38
6	29-May	18:50:59	20:21:38	01:30:39
6	30-May	18:51:48	20:22:23	01:30:34
6	31-May	18:52:39	20:23:04	01:30:24
6	01-Jun	18:53:32	20:23:44	01:30:12
6	02-Jun	18:54:26	20:24:43	01:30:17
6	03-Jun	18:55:22	20:25:36	01:30:14
6	04-Jun	18:56:20	20:26:25	01:30:06
6	05-Jun	18:57:19	19:22:23	00:25:04
6	05-Jun	19:22:41	20:27:11	01:04:30
6	06-Jun	18:58:19	19:21:42	00:23:23
6	06-Jun	19:22:44	20:28:08	01:05:24

Calculated Maximum Theoretical Shadow Time per Turbine

6	07-Jun	18:59:21	19:21:01	00:21:40
6	07-Jun	19:22:49	20:29:09	01:06:20
6	08-Jun	19:00:25	19:20:19	00:19:54
6	08-Jun	19:22:55	20:30:04	01:07:09
6	09-Jun	19:01:31	19:19:35	00:18:05
6	09-Jun	19:23:02	20:30:53	01:07:51
6	10-Jun	19:02:38	19:18:51	00:16:12
6	10-Jun	19:23:09	20:31:37	01:08:28
6	11-Jun	19:03:48	19:18:04	00:14:16
6	11-Jun	19:23:18	20:32:18	01:08:59
6	12-Jun	19:05:00	19:17:15	00:12:15
6	12-Jun	19:23:27	20:32:55	01:09:28
6	13-Jun	19:06:17	19:16:23	00:10:05
6	13-Jun	19:23:37	20:33:28	01:09:51
6	14-Jun	19:07:41	19:15:23	00:07:42
6	14-Jun	19:23:47	20:33:59	01:10:11
6	15-Jun	19:09:22	19:14:08	00:04:46
6	15-Jun	19:23:58	20:34:27	01:10:28
6	16-Jun	19:24:10	20:34:52	01:10:42
6	17-Jun	19:24:21	20:35:14	01:10:52
6	18-Jun	19:24:34	20:35:34	01:11:00
6	19-Jun	19:24:46	20:35:51	01:11:05
6	20-Jun	19:24:59	20:36:06	01:11:07
6	21-Jun	19:25:12	20:36:19	01:11:07
6	22-Jun	19:25:25	20:36:29	01:11:03
6	23-Jun	19:25:39	20:36:36	01:10:57
6	24-Jun	19:25:52	20:36:41	01:10:49
6	25-Jun	19:13:25	19:14:23	00:00:58
6	25-Jun	19:26:06	20:36:43	01:10:37
6	26-Jun	19:11:14	19:16:59	00:05:46
6	26-Jun	19:26:21	20:36:43	01:10:22
6	27-Jun	19:10:06	19:18:33	00:08:27
6	27-Jun	19:26:35	20:36:39	01:10:04
6	28-Jun	19:09:10	19:19:55	00:10:45
6	28-Jun	19:26:50	20:36:32	01:09:43
6	29-Jun	19:08:19	19:21:11	00:12:51
6	29-Jun	19:27:04	20:36:22	01:09:17
6	30-Jun	19:07:32	19:22:23	00:14:51
6	30-Jun	19:27:20	20:36:08	01:08:48
6	01-Jul	19:06:47	19:23:33	00:16:45
6	01-Jul	19:27:35	20:35:50	01:08:14
6	02-Jul	19:06:04	19:24:40	00:18:36
6	02-Jul	19:27:51	20:35:27	01:07:36
6	03-Jul	19:05:22	19:25:46	00:20:24
6	03-Jul	19:28:07	20:34:59	01:06:51
6	04-Jul	19:04:41	19:26:50	00:22:09
6	04-Jul	19:28:24	20:34:24	01:06:00
6	05-Jul	19:04:01	19:27:52	00:23:51
6	05-Jul	19:28:41	20:33:43	01:05:01
6	06-Jul	19:03:22	19:28:53	00:25:31

Calculated Maximum Theoretical Shadow Time per Turbine

6	06-Jul	19:28:59	20:33:14	01:04:15
6	07-Jul	19:02:44	20:32:48	01:30:04
6	08-Jul	19:02:07	20:32:17	01:30:10
6	09-Jul	19:01:30	20:31:41	01:30:11
6	10-Jul	19:00:55	20:31:06	01:30:11
6	11-Jul	19:00:20	20:30:44	01:30:24
6	12-Jul	18:59:46	20:30:18	01:30:32
6	13-Jul	18:59:13	20:29:48	01:30:35
6	14-Jul	18:58:40	20:29:13	01:30:33
6	15-Jul	18:58:09	20:28:33	01:30:24
6	16-Jul	18:57:38	20:27:47	01:30:09
6	17-Jul	18:57:08	20:26:53	01:29:45
6	18-Jul	18:56:39	20:25:51	01:29:11
6	19-Jul	18:56:09	20:24:37	01:28:29
6	20-Jul	18:55:33	20:23:18	01:27:44
6	21-Jul	18:54:59	20:22:08	01:27:09
6	22-Jul	18:54:27	20:20:47	01:26:20
6	23-Jul	18:53:56	20:19:08	01:25:12
6	24-Jul	18:53:27	20:17:04	01:23:37
6	25-Jul	18:52:59	20:14:53	01:21:54
6	26-Jul	18:52:33	20:13:42	01:21:09
6	27-Jul	18:52:08	20:12:20	01:20:12
6	28-Jul	18:51:45	20:10:44	01:18:59
6	29-Jul	18:51:24	19:43:50	00:52:27
6	29-Jul	19:44:29	20:08:48	00:24:19
6	30-Jul	18:51:04	19:44:01	00:52:57
6	30-Jul	19:46:43	20:06:22	00:19:40
6	31-Jul	18:50:46	19:44:08	00:53:22
6	31-Jul	19:49:54	20:02:53	00:12:59
6	01-Aug	18:50:30	19:44:12	00:53:42
6	02-Aug	18:50:16	19:44:13	00:53:57
6	03-Aug	18:50:04	19:44:11	00:54:06
6	04-Aug	18:49:55	19:44:05	00:54:10
6	05-Aug	18:49:47	19:43:55	00:54:08
6	06-Aug	18:49:42	19:43:42	00:54:00
6	07-Aug	18:49:39	19:43:25	00:53:45
6	08-Aug	18:49:39	19:43:03	00:53:24
6	09-Aug	18:49:42	19:42:38	00:52:55
6	10-Aug	18:49:48	19:42:07	00:52:19
6	11-Aug	18:49:58	19:41:32	00:51:34
6	12-Aug	18:50:10	19:40:51	00:50:41
6	13-Aug	18:50:27	19:40:05	00:49:38
6	14-Aug	18:50:48	19:39:13	00:48:25
6	15-Aug	18:51:13	19:38:14	00:47:01
6	16-Aug	18:34:59	18:45:29	00:10:29
6	16-Aug	18:51:44	19:37:08	00:45:23
6	17-Aug	18:30:34	18:48:57	00:18:23
6	17-Aug	18:52:21	19:35:53	00:43:31
6	18-Aug	18:27:35	18:51:09	00:23:33
6	18-Aug	18:53:05	19:34:28	00:41:23

Calculated Maximum Theoretical Shadow Time per Turbine

6	19-Aug	18:25:19	18:52:47	00:27:28
6	19-Aug	18:53:58	19:32:52	00:38:54
6	20-Aug	18:23:26	18:54:04	00:30:38
6	20-Aug	18:54:59	19:31:01	00:36:01
6	21-Aug	18:21:49	18:55:06	00:33:17
6	21-Aug	18:56:15	19:28:51	00:32:36
6	22-Aug	18:20:24	18:55:56	00:35:31
6	22-Aug	18:57:46	19:26:46	00:28:59
6	23-Aug	18:19:10	18:56:38	00:37:28
6	23-Aug	18:59:43	19:24:15	00:24:32
6	24-Aug	18:17:43	18:57:10	00:39:28
6	24-Aug	19:02:22	19:21:00	00:18:38
6	25-Aug	18:16:21	18:57:35	00:41:14
6	25-Aug	19:07:00	19:15:46	00:08:45
6	26-Aug	18:15:09	18:57:51	00:42:42
6	27-Aug	18:14:05	18:58:01	00:43:56
6	28-Aug	18:13:09	18:58:03	00:44:54
6	29-Aug	18:12:20	18:57:59	00:45:39
6	30-Aug	18:11:37	18:57:48	00:46:12
6	31-Aug	18:11:00	18:57:31	00:46:31
6	01-Sep	18:10:30	18:57:08	00:46:38
6	02-Sep	18:10:05	18:56:38	00:46:33
6	03-Sep	18:09:46	18:56:01	00:46:15
6	04-Sep	18:09:34	18:55:17	00:45:43
6	05-Sep	18:09:27	18:54:26	00:44:58
6	06-Sep	18:09:28	18:53:26	00:43:58
6	07-Sep	18:09:35	18:52:17	00:42:42
6	08-Sep	18:09:50	18:50:57	00:41:08
6	09-Sep	18:10:13	18:49:25	00:39:12
6	10-Sep	18:10:46	18:47:38	00:36:53
6	11-Sep	18:11:29	18:45:30	00:34:01
6	12-Sep	18:12:27	18:43:05	00:30:38
6	13-Sep	18:13:42	18:40:50	00:27:08
6	14-Sep	18:15:23	18:38:26	00:23:04
6	15-Sep	18:17:45	18:35:20	00:17:35
6	16-Sep	18:22:04	18:30:19	00:08:15
6	19-Sep	17:27:32	17:29:17	00:01:44
6	20-Sep	17:20:22	17:35:43	00:15:22
6	21-Sep	17:16:47	17:38:18	00:21:31
6	22-Sep	17:14:04	17:40:02	00:25:58
6	23-Sep	17:11:55	17:41:19	00:29:24
6	24-Sep	17:10:07	17:42:17	00:32:09
6	25-Sep	17:08:36	17:43:03	00:34:27
6	26-Sep	17:07:19	17:43:38	00:36:19
6	27-Sep	17:06:09	17:44:02	00:37:52
6	28-Sep	17:04:57	17:44:17	00:39:19
6	29-Sep	17:03:56	17:44:23	00:40:27
6	30-Sep	17:03:04	17:44:22	00:41:18
6	01-Oct	17:02:21	17:44:13	00:41:52
6	02-Oct	17:01:46	17:43:58	00:42:12

Calculated Maximum Theoretical Shadow Time per Turbine

6	03-Oct	17:01:19	17:43:35	00:42:16
6	04-Oct	17:00:59	17:43:05	00:42:06
6	05-Oct	16:58:17	17:00:25	00:02:08
6	05-Oct	17:00:48	17:42:29	00:41:41
6	06-Oct	16:52:01	17:41:44	00:49:43
6	07-Oct	16:48:59	17:40:52	00:51:52
6	08-Oct	16:46:08	17:39:51	00:53:43
6	09-Oct	16:44:02	17:38:40	00:54:38
6	10-Oct	16:42:22	17:37:17	00:54:55
6	11-Oct	16:41:00	17:35:40	00:54:39
6	12-Oct	16:39:53	17:33:44	00:53:50
6	13-Oct	16:38:38	17:31:26	00:52:48
6	14-Oct	16:36:26	17:29:19	00:52:52
6	15-Oct	16:34:46	17:26:40	00:51:54
6	16-Oct	16:33:25	17:22:41	00:49:16
6	17-Oct	16:31:43	17:13:15	00:41:32
6	18-Oct	16:30:19	17:12:54	00:42:35
6	19-Oct	16:29:11	17:12:25	00:43:14
6	20-Oct	16:28:10	17:11:48	00:43:38
6	21-Oct	16:27:09	17:11:04	00:43:55
6	22-Oct	16:26:12	17:10:10	00:43:57
6	23-Oct	16:25:27	17:09:05	00:43:39
6	24-Oct	16:24:52	17:07:48	00:42:56
6	25-Oct	16:24:27	17:06:14	00:41:47
6	26-Oct	16:24:11	17:04:15	00:40:03
6	27-Oct	16:24:04	17:02:11	00:38:06
6	28-Oct	16:24:06	17:00:14	00:36:08
6	29-Oct	16:24:16	16:58:02	00:33:45
6	30-Oct	16:24:35	16:56:38	00:32:02
6	31-Oct	16:25:03	16:54:51	00:29:48
6	01-Nov	16:25:42	16:52:59	00:27:18
6	02-Nov	16:26:31	16:51:18	00:24:47
6	03-Nov	16:27:34	16:49:37	00:22:03
6	04-Nov	16:28:55	16:47:46	00:18:52
6	05-Nov	16:30:41	16:45:59	00:15:19
6	06-Nov	16:33:16	16:43:28	00:10:12