Appendix 9.1 Flood Risk Assessment

1. Introduction

CDM Smith Ireland Ltd (CDM Smith) was requested by MKO, on behalf of Glenora Wind Farm DAC, to complete a Preliminary Flood Risk Assessment (FRA) for the planning application for the Proposed Development in Glenora, Co. Mayo.

The Proposed Development comprises, inter alia, 22 no. turbines (located in Glenora Forest) and an associated grid connection route to Tawnaghmore substation as set out in Chapter 4 of the Environmental Impact Assessment Report (EIAR).

Within Glenora Forest, the Wind Farm Site covers a total area of 1,290 hectares (ha). However, the proposed permanent development footprint within the Wind Farm Site is only approximately 42 ha, or 3.26 % of the total area. The subcatchments of the Proposed Development are characterised in detail in Chapter 9 of the EIAR (Hydrology and Hydrogeology).

1.1 Purpose of Assessment

This FRA supplements Chapter 9 of the EIAR. The purpose of the FRA is to determine and communicate whether the Proposed Development may cause a flood risk within or downgradient of the Proposed Development Site.

Flood risk can generally be expressed as:

Probability of Flooding x Consequences of Flooding

Accordingly, the FRA has considered both the catchment characteristics and the proposed drainage design (see **Appendix 4-4**, Drainage Design Drawings; and **Appendix 9-2**, Drainage Design Calculations).

1.2 Statement of Authority

This flood risk assessment (FRA) was prepared by Henning Moe (registered P. Geo.), a hydrogeologist with over 30 years of practical experience working with CDM Smith. Established in Ireland since 2001, CDM Smith's ISO 9001, ISO 14001 and OHSAS 18001-accredited Dublin office works on a diverse range of water and environmental projects for public and private sector clients, including the preparation of flood risk assessment and water resources protection initiatives.

Henning Moe was supported by Jon Hunt (registered P. Geo.), a geologist with over 20 years of practical experience. Both Henning and Jon prepared the FRA of the proposed nearby Sheskin wind farm development, approximately 8 km southwest of Glenora, and within the same Owenmore River catchment that extends to the headwaters of Glenora Forest. Ruairi O'Carroll (CEng MIEI), a chartered engineer with over 20 years of practical experience, provided technical review.

1.3 Methodology

This FRA was carried out in accordance with "The Planning System and Flood Risk Management Guidelines for Planning Authorities" (DEHLG/OPW, 2009). Per the guidance, this FRA incorporates:

- Flood risk identification, to determine whether surface water flooding issues may be present at a site; and
- Initial flood risk assessment, to confirm sources of flooding that may affect a new development.

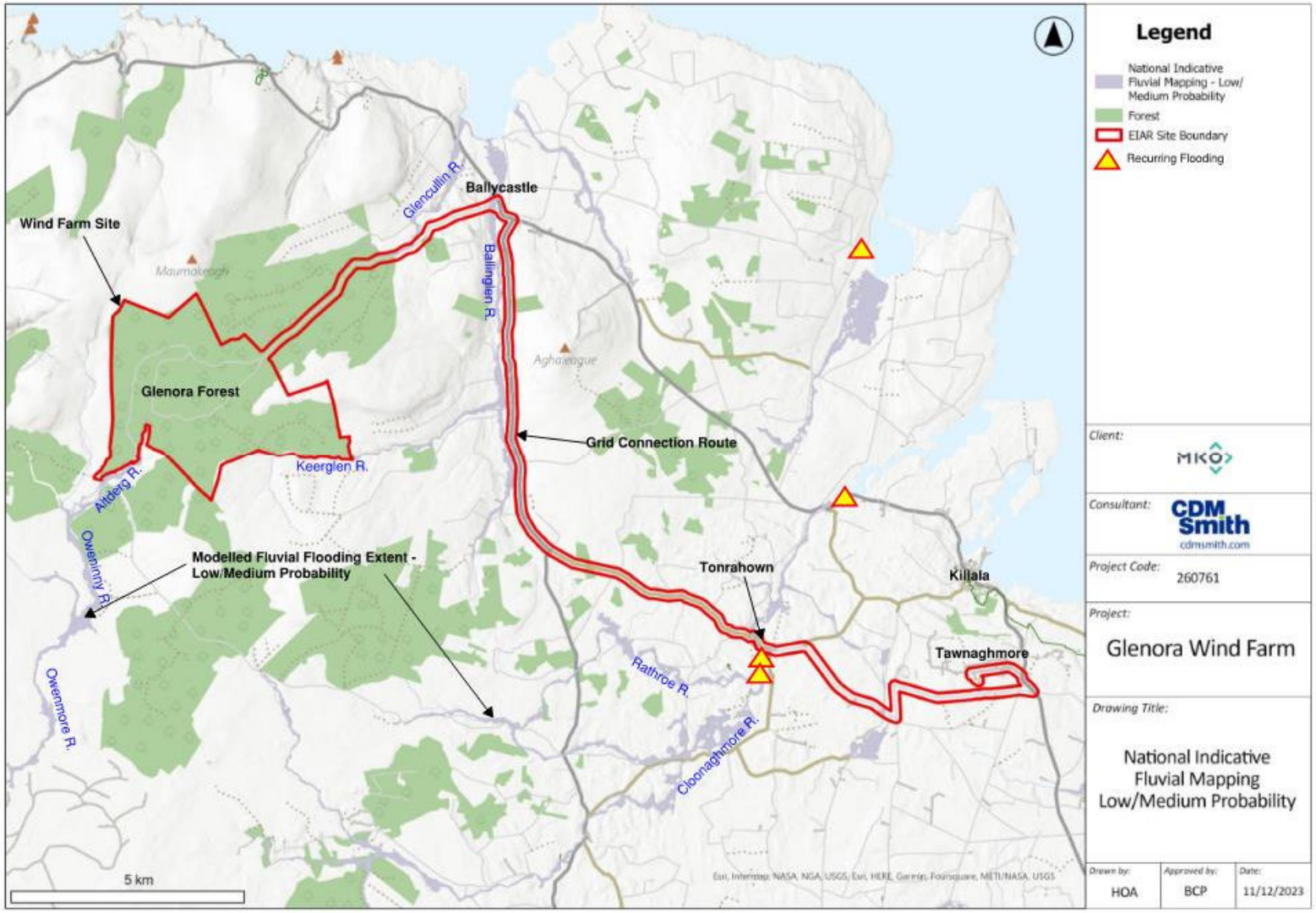

Figure 1: Flood Area Identification and Flood Risk Probability Based on OPW Mapping

2.5 Existing Infrastructure Downstream of Wind Farm Site

Existing infrastructure around Glenora Forest comprises sparse dwellings/farms and associated secondary roads. However, in the immediate, downstream position of the Wind Farm Site, there are only two identified structures, circled red in **Figure 2**. Neither is residential and the southern structure comprises farming-related sheds (Chapter 5 of the EIAR). Both structures are situated along the floodplain of the Altderg River.

As indicated in **Figure 3**, the northern structure is located at the boundary of the "*Moderate*" and "*Low*" probability (modelled) fluvial flood extents. The southern structure red circle is located within the "*Moderate*" and "*Low*" probability (modelled) fluvial flood extents.

2.6 Summary of Flood Risk Identification

The Proposed Development is located outside any modelled fluvial flood zones (Flood Zones A-B) and the proposed infrastructure is situated at elevations which are higher than the OPW-modelled 100-year and 1,000-year flood levels. The proposed infrastructure will also be situated higher than the extents of 50 m buffer zones along water courses. Hence, all of the proposed infrastructure is situated in Flood Zone C (Low Risk), which is defined by a less than 0.1% probability of flooding.

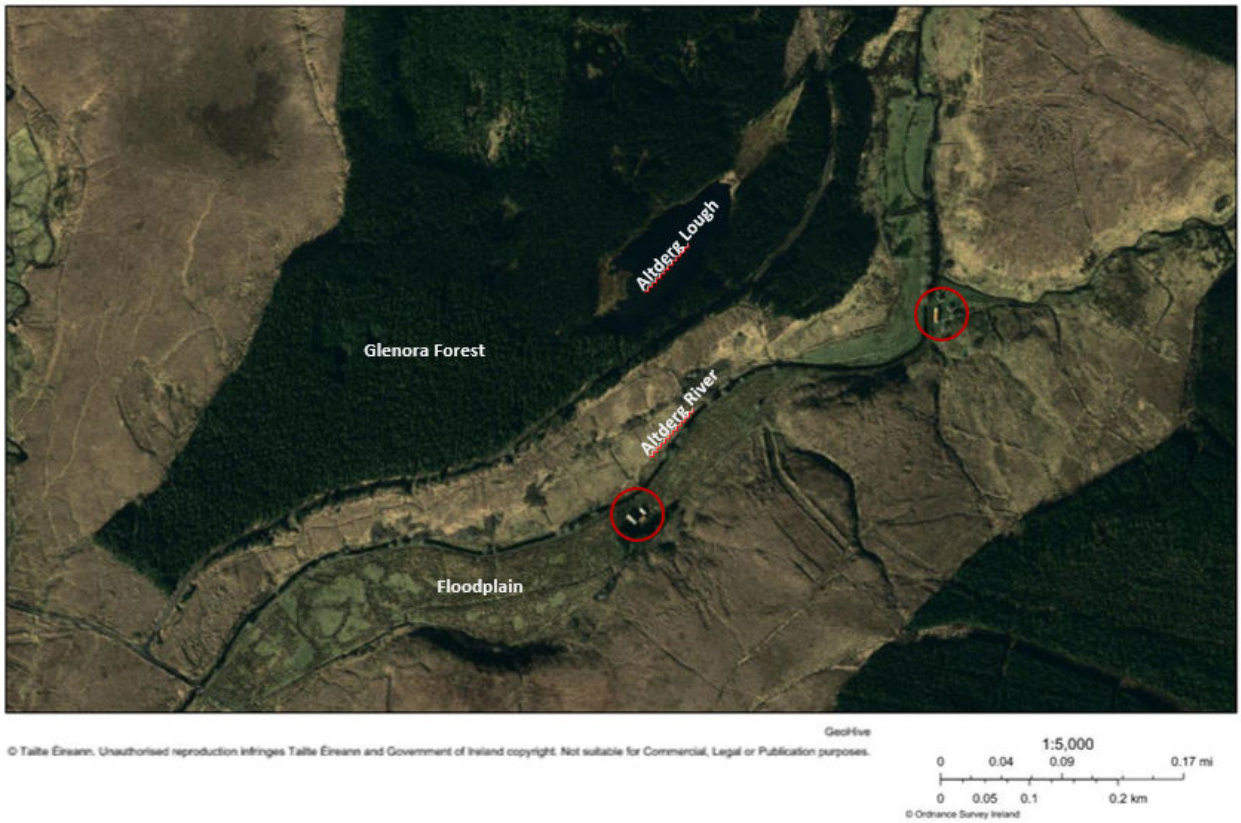

Figure 2: Existing Infrastructure Downstream of the Proposed Development Site

Site has also been affected by slumping (**Photo 1**) which appears to be drainage related at a culvert location (likely due to insufficient culvert capacity).

Photo 1: Road slump at culvert location (Source: FT, 2022)

As presented in Chapter 9 of the EIAR, mapped soil types within the Wind Farm Site comprises blanket peat and smaller pockets of poorly drained mineral soils derived from glacial till. Alluvium sediments are only mapped along lower sections of the Altderg and Keerglen Rivers.

Most of the headwater streams within the Wind Farm Site originate as headwater seeps or springs at higher ground within Glenora Forest. These gradually merge in the downstream direction to form: a) in the western and greater part of the Wind Farm Site, the Altderg River; and b) in the eastern and smaller part of the Wind Farm Site, the Keerglen River. In turn, the Altderg and Keerglen Rivers flow into the Oweninny/Owenmore and Ballinglen Rivers, respectively.

Both the Altderg and Keerglen Rivers are ungauged. However, as detailed in Chapter 9 of the EIAR, the estimated mean flow of the two rivers downstream of the Proposed Development Site boundaries, based on EPA's Qube model of streamflow in ungauged catchments, are approximately 0.44 and 0.53 m^3/s, respectively. The corresponding mean specific runoff within the Proposed Development Site is approximately 0.035 $m^3/s/km^2$. Peak flows, represented by estimated 1-percentile flows, are approximately 2.35 and 2.78 m^3/s, respectively.

Conceptually, the principal flood risk within the Wind Farm Site is fluvial flooding resulting from runoff (overland flow), driven by high intensity rainfall events and existing slopes. The underlying bedrock, which is considered 'poorly productive', likely serves to enhance runoff and build-up of heads and shallow flow in subsoils, as the bedrock has limited capacity for recharge from rainfall.

Conceptually, fluvial flooding will be manifested as overbank spills, and fluvial flood risk will increase in the downstream direction. In the case of Altderg River, fluvial flood risk becomes relevant on the flatter terrain to the south of the Wind Farm Site, which is also indicated by OPW's modelled flood extent mapping (as indicated by **Figure 1**).

The flood risk associated with the proposed infrastructure is, therefore, low. All proposed infrastructure are also deliberately situated at least 50 m from watercourses. Access roads will cross the 50 m buffer zone, and all water courses that cross existing or proposed new access roads will be culverted, mainly as pipes.

The county development plan specifically states that "*The Council will endeavour to continue to facilitate wind energy projects that accord with the Mayo RES, the Landscape Appraisal of County Mayo and relevant Section 28 ministerial guidelines*". Furthermore, the county's rural energy policy #7 is "*To promote the harnessing of wind energy to contribute toward decarbonising County Mayo, including new emerging by-product markets*".

With regard to flood risk, the county development plan incorporates a Strategic Flood Risk Assessment (SFRA) which includes mapped boundaries for indicative flood risk zones that account for factors such as local knowledge, site walkovers and flood risk indicators. Neither the Wind Farm Site nor downstream areas feature in the county SFRA.

However, the SFRA contains numerous principles and policies which have been factored into the proposed drainage design for the Proposed Development. For example, MCC advocates surface water management through Sustainable Urban Drainage Systems (SuDS) to minimise the effects on flooding and pollution of water courses through engineering solutions, including ponds, swales, filter drains or other installations.

In the context of flood risk, the county SFRA sets the following surface water objectives (SWOs):

- SWO 16: "*To support, promote and facilitate the use of green infrastructure …. in the interests of flood mitigation….*".
- SWO 17: "*To require the use of SuDS …. to reduce the potential impact of existing and predicted flooding risks*".
- SWO 18: "*To ensure new development is adequately serviced with surface water drainage infrastructure, which meets the requirements of the Water Framework Directive, associated River Basin Management Plans and Catchment Flood Risk Assessment Management (CFRAM) Plans*".

The Proposed Development and the associated drainage design are consistent with these requirements. Many of the proposed drainage solutions are SuDS-compatible, and the referenced plans have been included in the overall assessment of likely significant effects (Section 9.4 of the EIAR).

Specific, relevant SFRA objectives which are included in the county SFRA are summarised in **Table 2**, along with notes on how the planning application addresses the objectives.

Table 2: County Mayo SFRA Objectives and Responses in Planning Application

Objective No.	SFRA Objective	Response in Planning Application
19	*"To ensure that a flood risk assessment is carried out for any development proposal where a flood risk is identified in accordance with the Planning System and Flood Risk Management (DEHLG/OPW 2009) and Circular PL2/2014. This assessment shall be appropriate to the scale and nature of risk to the potential development."*	A Stage 2 FRA was carried out based on the DEHLG Guidelines document and OPW flood risk mapping.
20	*"To consult with the OPW in relation to proposed developments in the vicinity of drainage channels and rivers for which the OPW are responsible and retain a strip on either side of such channels where required, to facilitate maintenance access thereto."*	Checks were conducted. The Wind Farm Site is not located within any OPW Arterial Drainage Schemes or Drainage Districts (as per www.floodinfo.ie). The grid connection route crosses a tributary of Cloonaghmore River which is part of the Lough Dalla Drainage District to the southwest of Killala (specifically, the 'Cloonaghmore_050' river water body). However, the

Streams intercepted by access roads will be crossed by clear-span culverts (at 2 no. locations). The culverts will be designed to accommodate 100-year flood events. Along the grid connection route to Tawnaghmore, grid cables which traverse streams will be passed across existing bridges/culverts or through horizontal borings beneath streambeds, depending on location-specific conditions (see Chapter 2 of the EIAR for further details).

Flow along interceptor drains upslope of access tracks and swales downslope of works areas within the Proposed Development Site will be buffered with check dams at regular intervals to help break the energy of flow, settle out suspended sediments, and reduce sediment load to streams. Spacing of such dams will depend on slope, but will generally be every 50 m (or less). Discharges will be dispersed across vegetation and dilute with greenfield runoff as stated above.

The Proposed Development is divided into subcatchments for each infrastructure component and segment of access road between streams. The runoff associated with each subcatchment is calculated and serves to guide the placement of settlement ponds. The settlement ponds will be dimensioned to provide temporary storage for runoff that is defined by 6-hour duration, 10-year return storm events.

6. Summary of FRA

The flood risk associated with the Proposed Development is low. The proposed infrastructure, within the Wind Farm Site, is situated above any OPW-mapped, indicative flood extents. Drainage management is proposed which retains the existing drainage characteristics, and the Proposed Development will not change fluvial flood risk within or downstream of the Proposed Development Site.

One existing structure (farm shed) is situated within the current OPW-modelled "*Medium*" and "*Low*" probability flood extents of the Altderg River downstream of the Proposed Development Site.

The proposed drainage system will serve to control discharges of runoff waters to streams at greenfield runoff rates using a combination of interceptor drains, check dams, swales, settlement ponds, and buffered, disperse outfalls. The majority of discharges will be outside a 50 m buffer zone along all water courses..

As such, the Proposed Development will not augment flood risk downstream of Wind Farm Site. The Proposed Development thus complies with the objectives of the County Mayo Development Plan (2022-2028) and is compatible with the county-wide SFRA.

While there is a natural risk of flooding near Tonrahown (on grid connection route), the watercourse crossing already exists along a public road. For this reason, there will be no change to the hydrological regime post-construction.

7. References

DEHLG/OPW (2009). The Planning System and Flood Risk Management. Guidelines for Planning Authorities. November 2009. Accessible from: https://www.opr.ie/wp-content/uploads/2019/08/2009-Planning-System-Flood-Risk-Mgmt-1.pdf

MCC (2022). Mayo County Development Plan 2022-2028. Accessible from: https://www.mayo.ie/planning/county-development-plans/2022-2028

MCC (2011). Renewable Energy Strategy for County Mayo (2011-2020). Accessible from: https://www.mayo.ie/getmedia/6c162d3e-ed53-47ae-9b47-9d870df29397/1-Document1,16467,en.pdf