N4 Collooney to Castlebaldwin
Oral Hearing

Compulsory Purchase Order

and

Environmental Impact Statement
Oral Hearing

Brief of Evidence

Dr. Conor Quinlan
of
Minerex Environmental Ltd.

1.0 INTRODUCTION

My name is Conor Quinlan. I am the project manager for Minerex Environmental in relation to this road development. I have 9 years consultancy and research experience in soils, geology and hydrogeology in Ireland. I have completed a wide range of projects including quarry developments, landslide risk assessments, geological mapping and monitoring projects. I have completed over 30 Soil & Geology and Hydrology & Hydrogeology EIA submissions for a range of project types including wind energy developments, national roads and railway developments.

2.0 METHODOLOGY

The proposed road design, road cut and fill depths, details of site investigation and water level data from monitoring boreholes installed along the proposed road route were supplied by Sligo County Council.

The field investigations conducted for this study involved the following:

- Route walkover survey within the study area;
- Karst feature survey;
- Geophysical surveying.

3.0 RECEIVING ENVIRONMENT

Geology

Soil geology

According to the soil geology mapping, the *Proposed Road Development* and study area are underlain predominantly by acid brown earths and brown podzolics, peaty gleys, cutover basin peats and blanket peats, renzinas and lithosols and alluvium type soils.

Subsoil geology

According to the subsoil geology mapping, the *Proposed Road Development* and study area are underlain predominantly by shale and sandstone till, derived chiefly from Namurian rocks, interspersed with pockets of alluvium, karstified bedrock at the surface and cutover peat.

According to the results of site investigations, the *Proposed Road Development* is generally underlain by sandy gravelly clay/ silt and/ or very clayey sandy gravel. In addition, the site investigations identified isolated areas of very soft peat at the surface along the proposed alignment.

The subsoil thickness ranges from 0.8m and 14.7m. The highly variable nature of subsoil thickness is indicative of a karstified bedrock surface and a landscape punctuated with drumlin glacial features.

Bedrock Geology

The majority of the *Proposed Road Development* is mapped as being underlain by the Bricklieve Limestone Formation (lower). The *Proposed Road Development* is also underlain by the Bricklieve Limestone Formation (upper), and the Lisgorman Shale Formation (LG).

Structural Geology

The Bricklieve Limestone and Lisgorman Shale formations form part of the Ballymote Syncline, which is bound to the northwest by the Ox Mountains Inlier and to the southeast by the Curlew Mountains Inlier. Within this larger structure, there are two smaller synclines, separated by the north-east to south-west trending Belhavel Fault.

Karstification

Karstification is the process whereby limestone is slowly dissolved away by percolation waters and results in landscapes characterised by largely underground drainage. The Bricklieve Limestone Formation is extensively karstified with numerous karst features evident at the surface. The karst feature survey identified 57 possible karst features on the ground.

The majority of these features lie between c. Ch. 7,000 and Ch. 14,400 and are mapped as being underlain by the Bricklieve Limestone (upper). The clean, thick-bedded nature of the formation, along with the presence of abundant chert renders them very susceptible to karstification. The remainder of these features are mapped as being underlain by the Lisgorman Shale and the Bricklieve Limestone (lower).

A complex of two turloughs, numerous springs and 2 swallow holes was identified at approximately 330m north of Ch. 10,600m in the townland of Tawnagh. The complex is orientated north-south. The lakes were observed to be very full of water during the site visit in November 2009, with water spreading out onto the adjacent road, fence posts almost submerged and swallow holes totally submerged. The water levels were much reduced during site visits carried out during January, February, May and June 2011 with the turlough drying up completely. However, one of the turloughs at Tawnagh is fed by a surface channel and did not dry up completely.

Swallow holes

A swallow hole is described as *'a natural depression in the surface topography caused by the removal of soil or bedrock by water'* and which in some cases 'swallow' surface stream flows.

In addition to the swallow holes identified as part of the complex at Tawnagh, a swallow hole was identified at approximately 2km southeast of Ch. 14,400m.

Subsurface features

The results of the geophysical survey between c. Ch. 4,000m and Ch. 13,800m identified no large faults, fracture zones or cavities. The results of site investigation drilling identified a layer of weathered and possibly karstified bedrock underlying the subsoil in places, indicative of an epikarstic layer. This layer ranges from 2.6m to 6.8m in thickness. The 2013 geophysical survey also identified a subsurface, clay-filled solutional feature to the east of c.Ch. 8,500. The site investigation drilling also encountered cavities, most likely solutional karst cavities generally within the top 6-8m of bedrock. No other evidence of karst was noted during the site investigation drilling.

Geological heritage

The Bricklieve Mountains and Keshcorran are located approximately 1.5km to the south and southwest of the *Proposed Road Development*. The site is a large isolated block of Carboniferous limestone that reaches a height of approximately 300m. Typical landscape

features associated with karst topography are present, caves, dry valleys and limestone pavements.

4.0 PREDICTED IMPACTS

The removal of existing soil, subsoil and rock material from along the proposed road development and at the proposed road cuts is an inevitable part of road construction. The placement and compaction of soil and subsoil material for the proposed road embankments and for the disposal/ recovery of 'unsuitable materials' is likely to change the soil structure. The exposure of soil and subsoil material during construction is likely to temporarily increase the potential for soil contamination by leakages or spillages. The removal of existing soil and subsoil material is likely to reduce the level of protection afforded to the underlying groundwater aquifer. The exposure of contaminated soil material may cause the leaching of contaminants into groundwater or into runoff and watercourses. The excavation of road cuts and soft ground may induce local increases of water input into the subsurface and may cause a collapse of identified or unidentified subsurface karst features. The change to land use is an inevitable part of road construction.

5.0 MITIGATION MEASURES AND RECOMMENDATIONS

The design includes options for the appropriate re-use of suitable soil and subsoil material in construction works and the appropriate disposal/ recovery of unsuitable soil and subsoil material. Contaminated soil material is to be characterised and disposed of off-site in accordance with Waste Acts.

Mitigation by avoidance

The design is considered the best possible, in terms of minimising the impact to the geological environment. The 'cut and fill' approach has been followed as far as was reasonably practicable emphasising the requirement to utilise excavated suitable material from road cuts in road embankments; however, the earthworks balance has been largely determined by:

- Poor ground conditions;
- The requirement to accommodate over bridges and under bridges;
- Mitigation by avoidance and reduction which was been actively applied to the design primarily as a result of hydrological and hydrogeological impacts and the influence this has on the vertical alignment;
- The requirement to provide suitable cover for drainage culverts;

The result of these requirements is a significant deficit of suitable material and a surplus of unsuitable material generated onsite. However, having regard to the Department of Environment, Heritage and Local Government (DoEHLG) document: *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects* and the NRA Guidelines for *the Management of Waste from National Road Projects* and through the preparation of the Spoil Management and the Outline Construction and Demolition Waste Management Plan, the design phase included an analysis of the 'spoil' geological materials being generated and expected surplus and geological materials handling procedures.

6.0 RESIDUAL IMPACTS

Removal of soil, subsoil and rock material

The removal of soil, subsoil and bedrock material from the *Proposed Road Development* is a certain direct impact of the *Proposed Road Development* on the geological attributes. These impacts are unavoidable and are not possible to mitigate. Therefore the impacts remain

residual and are considered to remain at **slight** for topsoil, **moderate** for subsoil, bedrock and ground conditions and **permanent** in nature.

Change in soil structure

The change in topsoil structure is a likely indirect impact of the *Proposed Road Development* on the geological attributes. However assuming that the mitigation measures detailed above are implemented according to the relevant NRA and Highways Agency guidance and maintained appropriately, these impacts remain **residual** and are considered to reduce to **imperceptible**.

Change in soil chemistry

The change in soil chemistry as a result of an accidental spillage or leak is a possible indirect impact on the soil and subsoil geology during the construction phase. Following implementation and maintenance of mitigation measures, these impacts are considered to remain **imperceptible** for topsoil geology and to reduce to **imperceptible** for subsoil geology and **temporary** in nature.

Collapse of karst features

The potential collapse of identified and unidentified karst features is a possible direct impact on the karst features and on the Proposed Road Development during the construction phase. The key mitigation measures are the avoidance of lowering the water table below rock head in areas where there is exposed rock at surface or where multiple karst features have been identified and the provision of closed drainage within known karst areas. Following the implementation of mitigation measures and appropriate maintenance, these impacts remain residual and are considered to remain moderate/slight on the karst features and on the Proposed Road Development and permanent in nature.

7.0 SUMMARY/CONCLUSION

The removal of soil, subsoil and bedrock material constitutes a slight to moderate permanent impact. Changes in soils structure and soil chemistry will be an imperceptible impact of the Proposed Road Development. It is unlikely that collapse of karst features will occur as a result of the Proposed Road Development and this impact has been rated as unlikely but slight to moderate.