8.0 SOILS AND GEOLOGY

8.1 INTRODUCTION

This section of the EIS has been prepared by TMS Environment Ltd and assesses the impact the proposed development is likely to have on soils, subsoils and geology found in the vicinity of the proposed development and the potential impacts that may arise during both the construction and operational phases. The objectives are to:

The findings and analysis are based on the following sources of information:

- Maps and plans published by the Ordnance Survey of Ireland (OSI).
- Reports, maps and data published by the Geological Survey of Ireland (GSI) and the National Soil Survey of Ireland;
- Meteorological data from Met Eireann and hydrometric data from the Office of Public Works (OPW);
- Previous site investigations and Environmental Impact Assessment completed for the site.

8.2 THE RECEIVING ENVIRONMENT

8.2.1 Introduction

The Lagan Cement Ltd works occupies a total area of approximately 572 acres and is situated in Killaskillen, Kinnegad, Co Meath. The site lies between 2.5 km and 4.5 km southwest of the town centre of Kinnegad and between 1km and 3 km north of the small village of Ballinabrackey in Co Meath. The existing limestone quarry is permitted over an area of 24.8 hectares and to a depth of 5 benches (10 metres AOD). It is now proposed to extend the quarry in a northerly and southerly direction to result in an overall quarry size of 77.25 hectares. The proposed quarry extension will increase the surface area of the quarry by approximately 52.45 hectares and will result in safeguarding the on-site limestone reserves available for use in the cement manufacturing facility. The extended quarry will be worked to 1 no. bench in depth which will provide for an estimated extractive life of about 15 – 20 years at the current output rate. It is proposed to extract limestone rock to a depth of 70 metres above Ordnance Datum (AOD), which is the depth at which the existing quarry is currently being worked to, over three defined operational phases.

The general geological setting of the Killaskillen – Kinnegad area, and a generalised sequence of strata and overburden likely to be encountered during the proposed quarry extension workings are given in Figure No. 8.1. It is proposed to extend the limestone quarry in both a northern and southern direction to a depth of 1 no. bench (70 metres AOD). The limestone quarry, including the proposed extension, lies almost entirely within the Waulsortian (Reef) Limestone but the southern extremities of the proposed extension will just encroach onto the Argillaceous Bioclastic Limestone. The very northern boundary of the proposed limestone quarry will approach the Tober Colleen Formation. The Shale Quarry lies on the northern margin of the Waulsortian (Reef) Limestone and works both Tober Colleen Shale and Shaley Limestone (Lucan Formation).
The detailed workings proposed for the extended limestone quarry are presented in the Phasing of Works Section in Section 3.2.3 of this EIS. Excavation in the limestone quarry commenced in the southeast and worked in a northerly direction to 70 metres AOD. The existing quarry footprint is being extended in a northerly and southerly direction and will cover an area of approximately 77.25 hectares when fully developed. The quarry will be worked in 3 distinct phases as part of continued operations.

Phase 1 of the quarry extension will be to firstly extend in a northerly direction to the maximum permitted lateral extent of the quarry and work to 70 metres AOD which represents a continuation of the first production bench currently being worked at the quarry. Phase 2 will involve the extension of the existing quarry in a southerly and south-easterly direction to 70 metres AOD to the extent of the Phase 2 boundaries. Phase 3 will involve the removal of the asphalt plant from the site followed by quarrying of the asphalt plant lands to 70 metres AOD and finally extension in a southerly direction to 70 metres AOD to the final southern boundary.

Excavated overburden removed to expose the limestone rock will be engineered into permanent landscaped locations which will act as new screening banks (berms) for the southern and eastern areas of the proposed quarry extension. The overburden to be removed will include a significant proportion of free draining materials. The screening banks will be constructed to ensure long-term stability and detailed stability and construction reports will be prepared prior to bund construction to ensure that the structures are secure.

Soft clays, silts and peaty materials will be bunded inside containing cell walls and where appropriate, drainage blankets will be placed following the removal to top and sub-soils from the areas where bunds are to be built. Top soil and sub-soils will be separately stored to assist in re-vegetation of completed screening banks. Since silt may be suspended in surface water run-off from the large screening bunds, silt traps will be employed before discharge into existing watercourses until surface plant growth has been established.

The reef limestone will require ground preparation by drilling and blasting. Initially, the quarry extension will be worked using conventional hard-rock equipment including hydraulic loading shovels and 50 – 70 tonne dump trucks. Blast design will be based on careful monitoring of the initial blasts using low charge weights of explosive per delay.

Currently, limestone is crushed in the quarry and transported to the secondary crusher at surface by conveyor. The proposed working limits of the limestone quarry are presented in Figure 8.1 while the Shale Quarry will be unchanged from the previously consented scheme.

The bedrock strata are generally inclined to the northwest at variable dips and are covered by glacial and alluvial overburden. Above the bedrock, the thickness of superficial materials varies greatly since local excavations and stripping commenced in the quarry. The pre-existing soils mainly belonged to the Banagher Series of improved Fen Peat soils.

The data from which the geology has been inferred includes:
Boreholes drilled between January and May 1998 used in the original planning application for the site.

Trial pits and shallow soft ground drilling undertaken in 1999 and 2000 to answer queries raised by the EPA and others.

Infill check drilling for chemical quality and materials handling purposes undertaken between August and November 2001 resulting in some revisions to the geological model of the Shale Quarry.

Additional drilling and site investigation works which took place in 2007 and 2008 as part of the exploration and investigation process for this application.

The extensive database of information acquired during the development of the existing quarry at the site and detailed investigations undertaken to support the existing activity.

The regional hydrogeological characteristics in the Kinnegad area were described in the EIS which accompanied the original application for Planning Permission in 1998. A summary is presented in Table 8.1 below.

<table>
<thead>
<tr>
<th>Name</th>
<th>Thickness (metres)</th>
<th>Lithology</th>
<th>Likely hydrogeological properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peat</td>
<td>Up to 1 m</td>
<td>Peat</td>
<td>Aquitard</td>
</tr>
<tr>
<td>Glacial Till</td>
<td>1 to 12</td>
<td>Sandy Gravel soft Clay, Limestone cobbles</td>
<td>Aquitard with minor perched aquifers in sand lenses</td>
</tr>
<tr>
<td>Alluvial Sand Gravel</td>
<td>&gt;6.0 m</td>
<td>Gravel, med. to coarse Sand with occasional Fine Sand and Silt lenses</td>
<td>Aquifer</td>
</tr>
<tr>
<td>Limestone/Shale (Upper CPL)</td>
<td>20m+</td>
<td>Pale micritic limestone with shale bands</td>
<td>Complex banded aquifer with dual porosity, yield predominantly low with high yield horizons</td>
</tr>
<tr>
<td>Striped Beds (Upper CPL)</td>
<td>25 – 45m</td>
<td>Interlaminated shale and limestone</td>
<td>Complex banded aquifer with dual porosity. Poor yields</td>
</tr>
<tr>
<td>Shaley Limestone (Lower CPL)</td>
<td>40 – 80m</td>
<td>Basinal limestone with thin shale bands</td>
<td>Dual porosity fissured aquifer with reasonable yields</td>
</tr>
<tr>
<td>Silty Shales (T.C Formation)</td>
<td>0 – 45m</td>
<td>Dark grey shale with thin limestone bands</td>
<td>Low storage complex fissured aquifer</td>
</tr>
<tr>
<td>Micritic Limestone (Waulsortian)</td>
<td>300 to 500m</td>
<td>Pale to med., grey high purity micritic (reefal) Limestone</td>
<td>Permeability Variable with regional low yields varying from 0.1 to 1.0 l/s.</td>
</tr>
</tbody>
</table>
The materials which will be encountered in the quarry excavations include superficial materials, limestone and shales and shaley limestone. These are discussed in the sub-sections below.

8.2.2 Superficials

In essence these materials are comprised of all materials overlying limestone and shale including top-soil and sub-soil. The agricultural soils vary from approximately 0.5 to 1.0m depth but are less than this at and near limestone outcrops. Soils are generally silty, sandy loams with a variable stone content and are peaty in low lying areas especially near the southern boundary.

There is a raised bog to the south of the site and it is proposed to extend the limestone quarry into part of the bog lands. The ecological value of the raised bog has been assessed and is presented in the Flora and Fauna section of this Environmental Impact Statement. The conservation value of the bog has been assessed as low as it does not have any areas of active bog (i.e. areas where new peat is being formed) and its hydrology is so altered as to preclude any chance of regeneration.

Peat soils are characterized by a high content of organic carbon, greater than 30%, and by having a minimum of 0.3m depth. Typically there are two types of peat soils, basin peat and blanket peat. The raised bog peat, as found at the Lagan Cement Ltd site is a basin peat and their profile generally consist of a basal layer fen or woody fen peat overlain by a layer acid ombrogenous peat characterized by its high content of mosses and bog cotton. There are significant tracts of raised bog across County Meath which have been cut-over and large areas to the west of the site have been developed and processed for sod and milled peat by Bord Na Mona.

The superficial deposits above and adjacent to the raw material to be quarried comprise the following broad sub-divisions:

- Peaty sandy clay (agricultural soils generally 0.5 – 1.0 m thick).
- Sands and gravels with some silty clay, well developed in the shale area, with local patches of boulder clay. A sand-rich esker capped with thin boulder clay crosses the northern part of the site.
- Boulder clay, i.e. stony silty clays sometimes stiff to hard, but usually soft to firm, in the limestone area and southern part of the shale area.

The original thickness of supercifications was 1.5 to 6.5m in the limestone quarry, and 5.0 to 10.6m in the Shale Quarry. The base of overburden reflects both the undulations in the ground level surface and the geology beneath.

8.2.3 Subsoil (Quaternary) Geology

8.2.3.1 Reef Limestone

High to very high purity limestone belonging to the Feltrim Limestone Formation underlies the southern part of the site and provides the principal raw material for the cement. This limestone is described in the Geological Survey of Ireland (GSI) publication “Bedrock Geological Map of the...
Carboniferous of Central Ireland – Meath – Sheet 13 GSI 1992” as comprising Waulsortian mudbanks. It belongs to the Feltrim Limestone Foundation of Middle Dinantian (Chadrain) age (Strongen P. et al Geol. Jl. V25 pp 103-137 (1990)). The limestone is often referred to as Reef Limestone. It is generally a pale to medium grey biomicrite with some sparite banding and very little non-calcareous (intra-mudbank) material. Data from the GSI would suggest that the limestone is many hundreds of meters thick in this part of County Meath.

Previous investigations have shown that there are no significant variations in observable characteristics of the limestone which is typically a moderately strong rock, with widely spaced, tight discontinuities. The Rock Quality Designation has been shown to be well over 95%.

The northern boundary of the limestone dips to the north-west, running in a north-east south-west orientation across the site and forms the footwall of the Shale Quarry. As can be seen from Figure 8.1, the boundary with the overlying strata is inferred to extend ENE-WSW through a point approximately 300m north of the site where Lansdown Lodge was situated. Some minor faulting and solution features may be present at the northern margins but for the purpose of quarrying, the limestone can be regarded as homogenous.

8.2.3.2 Tober Colleen Shale

The Tober Colleen Shale lies directly beneath the superficials in the southern part of the Shale Quarry. It is a very weak to weak silty shale and readily breaks down (slakes) on wetting and drying. The variable bedding dip has been measured in several boreholes to be 15-35°. In some boreholes this shale is seen to overlie the Waulsortian Reef Limestone. The shale is very variable in thickness and is inferred to have been subject to erosion before the formation of the overlying Shaley Limestones (Lucan Formation or Lower Calp). The resulting gradient of the inferred upper surface of the Tober Colleen Shale is steep (c 60°). Figure No. 8.2 shows contours on the top of the Reef Limestone and Tober Colleen Shale (base of Lucan Formation) respectively.

8.2.3.3 Shaley Limestones (Lucan Formation / Calp)

The northern part of the Shale Quarry comprises a range of argillaceous limestones belonging to the Lower Calp (or the Lucan Formation). These are chiefly shaley limestones and thicker interbedded limestones and thin shales. Three units, Shaley Limestone, Striped Beds and Limestone with Shale) have been recognised. In places the Shaley Limestone directly overlies the Waulsortian Reef Limestone; elsewhere it rests on the Tober Colleen Shale. The three limestone units will be worked together, and are described as the Shaley Limestones.

8.3 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

8.3.1 Introduction

The overall proposed development will include an application for an extension to the existing limestone quarry over adjoining lands to the north and south. The proposed quarry extension is outlined in Section 3 of this EIS.
and will include a lateral extension to the north and to the south of the existing quarry to a depth of 1 no. bench (70 metres AOD).

8.3.2 Construction Phase

There will be a significant level of soil disturbance during the preparatory works for the quarry extension. The vast majority of which will comprise of the removal of topsoil (agricultural soils generally 0.5 – 1m thick) and other superfluous to allow access to the limestone for quarrying. The excavated materials and excess spoil will where appropriate be utilised as a raw material in the production process or will be incorporated into the screening banks on-site. The vast majority of the excavated overburden will be engineered into permanent landscaped locations which will act as new screening banks for the southern and eastern areas of the proposed quarry extension. The overburden materials will not require disposal or removal from the site and will be utilised to their full potential on the Lagan Cement Ltd site.

8.3.3 Operational Phase

The limestone quarry will be extended laterally in a northern and southern direction and the proposed extension working limits and final levels of the limestone quarry are fully detailed in Section 3 of this EIS. Quarry workings for the proposed extension will be to a final level of 70 metres AOD and there is no planned change in production rate of limestone and consequently there will be no adverse implications for slope stability.

There will be no increase required in rate of output from the quarry as there is no increase in production proposed for this development. Therefore all current quarrying facilities in place will be able to maintain the existing production rate within the existing operation hours at the quarry. The direction of working and phasing of excavation in the limestone quarry is detailed in the Quarry Report and the shale quarry remains unchanged from the previous application.

8.4 THE PREDICTED IMPACT OF THE PROPOSED DEVELOPMENT

8.4.1 Construction Phase

As discussed above, there will be a significant level of soil disturbance during the preparatory works for the quarry extension but there will not be any actual construction activities associated with the extension of the quarry. Quarry preparatory works will extend over a very short time interval for each of the various quarrying phases and will involve ground preparation activities and overburden removal. Overburden will be removed by small dump trucks loaded by hydraulic excavators or by scrapers. It will be removed to permanent, landscaped locations on the site which will act as screening or will be used as raw material, where appropriate in the cement manufacturing process.

There is no increase in quarrying facilities required as current infrastructure is sufficient to handle the materials that will be generated from the extended quarry lands.
8.4.2 **Operational Phase**

The extension of the limestone quarry will result in the removal of soils and other superficials to allow access to the limestone for quarrying. This material will be re-used on the site in manufacturing processes and landscaping.

The working limits and final levels of the Limestone Quarry will be changed according to the detailed Quarry Report as presented in Chapter 3 of this EIS. Quarry workings will be to a final level of 10 metres AOD for the currently permitted quarry and to a depth of 70 metres AOD for the proposed extension. There will be no increase in production rate of limestone. The frequency and charge size of blasting will remain unchanged from the current situation as a result of this proposal.

The impact of the operational phase of the proposed development will result in the eventual removal of significant quantities of limestone reserves at the site. The overall proposed increase in quarry lands is considered to have an insignificant impact on the soils and geology of the local area.

8.5 **REMEDIAL AND MITIGATION MEASURES**

There are no specific mitigation measures required as a result of the proposed developments. There is however a detailed Residuals Management Plan developed for the site which outlines a decommissioning programme for the facility following cessation of activities at the site. The Residuals Management Plan and particularly the Restoration Programme contained within has been modified and updated accordingly to reflect the increase in size of the limestone quarry on the Lagan Cement lands.

8.6 **CONCLUSIONS**

There will be no adverse or unacceptable impact on the geological environment as a result of either the construction phase or the operational phase of the proposed development. All changes to the shape and size of the limestone quarry will be accounted for in the Restoration Programme of the Residuals Management Plan for the site.
Appendix 8.1

Map of Geological Setting and Sequence of Strata
Appendix 8.2

Map of Inferred Contours on Base of Shaley Limestone