PLANNING APPLICATION FOR A PROPOSED WESTERN EXTENSION TO THE EXISTING COLLYWESTON QUARRY

Working Method Statement

May 2014
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Appendix 1 – Leicestershire County Council Quarry Blasting Guidance
1 INTRODUCTION

1.1 Background

1.1.1 This statement provides details of the method/system of working of the proposed western extension to Collyweston Quarry. The extension would release 2 million tonnes of saleable limestone aggregate to replace the permitted reserves contained in the eastern extension of the quarry, currently being worked under planning permission reference EN/06/1278C.

1.1.2 Local residents have raised some concerns regarding blasting from quarrying operations at Collyweston Quarry. Concerns from blasting relate to the potential damage to property. It is not in Bullimore’s commercial interest to carry out quarry blasting any more than is necessary and there are fundamental benefits to the Company in avoiding blasting, both in terms of specific costs of blasts and also the fact that blasting results in greater volumes of limestone waste and thus reduces aggregate production.

1.2 Company Objective

1.2.1 It is Bullimore’s objective to seek to minimise and reduce any vibration and disturbance potentially generated by the quarry operations to acceptable levels for local residents whilst enabling effective, efficient extraction and processing of limestone and slate log.

1.2.2 To achieve this objective, the Company’s method/system of working proposed is set out below:
2 Method/System of Working

2.1.1 It is clear from borehole information in the proposed extension that a substantial proportion of the available limestone reserve can be removed without the need for blasting. This is borne out by past experience at the quarry where there have been prolonged periods during which the quarry operators have avoided the use of blasting as part of the mineral extraction process. In particular, over a period of approximately 18 months, no blasting took place. The Company confirms that the employment of a 45 tonne excavator during this period facilitated the excavation of all the available limestone, as the larger machine had the power/capacity to excavate both consolidated and less consolidated material.

2.1.2 Therefore, in light of local concerns over potential impact and to help achieve the objective to minimise and reduce vibration and potential disturbance to acceptable levels, Bullimores propose to work the western extension using a 45 tonne excavator rather than a lower capacity machine. The Company would accept a planning condition to formally control/require this.

2.1.3 Whilst the Company considers this will minimise the need for blasting, there is always some potential that they might need to carry out some limited quarry blasting if they were to encounter particularly hard or consolidated limestone material.

2.1.4 Based on the geology confirmed by the borehole data and taking a potential “worst case” view, a reasonable prediction would be that 50% of the limestone reserve trending to the eastern part of each phase in the extension appears from the borehole data to have the potential to be more consolidated. Looking at this from the point of view of timescales – (each proposed phase represents approximately 1 year of working) the working year is 48 weeks which means that 24 weeks in every year has some blasting potential. Potentially blasting, when carried out at Collyweston Quarry normally takes place every 2 weeks. Therefore the potential worst case based on these assumptions is around 12 blasts per year. Based on the Company’s past experience, employment of the 45 tonne excavator is likely though to reduce this worst case potential further.

2.1.5 The Company would accept a planning condition worded along the following lines:
“Unless otherwise agreed in writing or in an emergency, there shall be no more than 15 quarry blast events in any given 12 month period” (The reason is to minimise potential impact on local amenity).

2.1.6 Additionally, when carrying out the quarry blasting, the Company would adhere to a “Blast Management Plan (BMP)”. The basic purpose of the BMP is to achieve the above objective. The suggested content and the approach to managing the quarry blasting is set out in section 3 below.
3 Blast Management Plan

3.1 Introduction

3.1.1 There are not a lot of sources on blasting as it is a specialised area. In formulating this blast management plan we have looked at various approaches adopted elsewhere, both overseas and in the UK as well as consulting with blasting experts Vibrock who produced the Blasting Assessment submitted as part of the Planning Application/Planning and Environmental Statement.

3.1.2 Furthermore, guidance produced by Leicestershire County Council attached at Appendix 1, has been consulted. Although this guidance is in terms of hard rock extraction and the rock at Collyweston is much softer (even the consolidated material) so that in effect the blasting of limestone is easier than blasting hardrock, the general approach to blasting contained in this has been taken account of.

3.2 Rationale

3.2.1 Blasting can result in ground vibration and air blast overpressure that may cause annoyance, discomfort and alarm to blast site neighbours.

3.2.2 The objective of the blast management plan is to ensure blasting activities are carried out in order to minimise any public concerns in relation to ground vibration and air blast overpressure whilst enabling effective, efficient extraction and processing of limestone and slate log.

3.3 Issue/Aspects/Impacts

3.3.1 Based on the geological conditions, blasting for quarry development is anticipated to be carried out on a restricted basis. Each phase of quarry working contains a split of potentially consolidated and unconsolidated limestone. Based on the likely extent of the more consolidated limestone, it is expected that the number of blasts in any given year will be restricted to no more than 15.

3.3.2 There are established and proven design methodologies and technologies for blasting of limestone at the quarry site that can ensure any impacts are managed to below acceptable thresholds.
3.3.3 Nevertheless, it is accepted that poor blasting practice has the potential to generate unacceptable levels of ground vibration and air blast overpressure.

3.4 Previous Blast Monitoring Results

3.4.1 Blast monitoring has been previously carried out at Collyweton Quarry in terms of ground vibration and air overpressure. The majority of the previous monitoring was carried out at Bradden House, High Street, Duddington. Set out in the table below is a selection of previous results from the time period January 2004 – July 2007.

<table>
<thead>
<tr>
<th>Date</th>
<th>Ground Vibration</th>
<th>Air Overpressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 2004</td>
<td>0.70 mms⁻¹</td>
<td>113 dB</td>
</tr>
<tr>
<td>March 2004</td>
<td>0.70 mms⁻¹</td>
<td>109 dB</td>
</tr>
<tr>
<td>April 2004</td>
<td>0.50 mms⁻¹</td>
<td>108 dB</td>
</tr>
<tr>
<td>July 2004</td>
<td>0.50 mms⁻¹</td>
<td>108 dB</td>
</tr>
<tr>
<td>September 2004</td>
<td>0.67 mms⁻¹</td>
<td>105 dB</td>
</tr>
<tr>
<td>November 2004</td>
<td>0.55 mms⁻¹</td>
<td>106 dB</td>
</tr>
<tr>
<td>October 2005</td>
<td>0.85 mms⁻¹</td>
<td>105 dB</td>
</tr>
<tr>
<td>November 2005</td>
<td>0.90 mms⁻¹</td>
<td>106 dB</td>
</tr>
<tr>
<td>March 2006</td>
<td>0.67 mms⁻¹</td>
<td>108 dB</td>
</tr>
<tr>
<td>May 2006</td>
<td>0.62 mms⁻¹</td>
<td>109 dB</td>
</tr>
<tr>
<td>September 2006</td>
<td>0.52 mms⁻¹</td>
<td>105 dB</td>
</tr>
<tr>
<td>October 2006</td>
<td>0.47 mms⁻¹</td>
<td>105 dB</td>
</tr>
<tr>
<td>July 2007</td>
<td>0.45 mms⁻¹</td>
<td>107 dB</td>
</tr>
</tbody>
</table>

3.4.2 Blast monitoring has not taken place on as frequent a basis since 2007 due to the fact that quarrying began in the permitted eastern extension which moved the working further from sensitive receptors. This combined with the fact that there had been no record of disturbance, the Council no longer required Bullimores to carry out blast monitoring.

3.5 Performance Targets

3.5.1 Performance targets for blast management and its environmental impacts take into account advice received from Vibrock, the recommendations presented in the Vibrock Blasting Assessment submitted as part of the Planning Application/Planning and Environmental Statement, concerns raised by local residents as well as approaches adopted elsewhere both overseas and in the UK.

3.5.2 In order to minimise the vibration impact to nearby residents of any blasting
operations at Collyweston Quarry, the potential performance targets are as follows:

Ground Vibration - Inhabited Property

3.5.3 Vibrock have advised that the guidance within Mineral Planning Guidance notes (MPG) 9 and 14 permit a ground vibration limit of 6 to 10 mms$^{-1}$ at 95% confidence, with no individual blasts to exceed 12 mms$^{-1}$.

3.5.4 As set out in Appendix 1, values in excess of 50 mms$^{-1}$ are necessary to produce appreciable structural damage.

3.5.5 Therefore, in light of the above, a ground vibration limit will be established – when measured at an agreed potentially sensitive location - that not only is perfectly safe for the integrity of structures, but also takes into account the physiological effects on adjacent neighbours. In this case a vibration limit of 6 mms$^{-1}$ peak particle velocity is considered appropriate. The limit of 6 mms$^{-1}$ is lower than the current planning conditions at Collyweston Quarry (10 mms$^{-1}$), is lower than the relevant British Standard 6472-2: 2008 and will ensure that no individual blast will exceed 12 mms$^{-1}$.

3.5.6 As can be seen from the previous blast monitoring results, in terms of ground vibration, results have ranged from between 0.45 mms$^{-1}$ to a maximum of 0.90 mms$^{-1}$. Therefore, although it is proposed to introduce a vibration limit of 6 mms$^{-1}$ peak particle velocity, previous blasts have not come anywhere close to this level.

Air Overpressure

3.5.7 Vibrock have advised that no air overpressure limit exists within MPG 9 & 14 approved guidance due to the unpredictable effect of meteorological conditions which are out of the control of the mineral operator. To impose a limit would conflict with MPG 9 & 14 and inflict an unreasonable burden on the operator.

3.5.8 However, within the Leicestershire County Council Guidance (Appendix 1) with regards air overpressure, it states that Leicestershire county Council have generally adopted a maximum air overpressure limit of 120 dB peak linear, as part of the conditions covering blasting within modern Planning Permissions. The guidance goes on to state that relatively rarely do air overpressures exceed 125 dB. Within a range of values of $+ or –15$ dB some 7% of values are found to be in excess of that figure.
3.5.9 In line with the current best accepted modern practice in the extraction industries, it is recommended that safe and practical measures are adopted that ensure the minimisation of air overpressure generated by blasting at source, considering such factors as initiation technique. Furthermore, an air overpressure limit will be established – when measured at an agreed potentially sensitive location - that not only is perfectly safe for the integrity of structures, but also takes into account the physiological effects on adjacent neighbours. In this case for at least 93% of all blast events, a maximum air overpressure limit of 120 dB peak linear is considered appropriate.

3.5.10 As can be seen from the previous blast monitoring results, in terms of air overpressure, results have ranged from between 105 dB to a maximum of 113 dB. Therefore, although it is proposed to introduce a vibration limit of 120 dB peak linear, previous blasts have not come anywhere close to this level.

**Explosive Charges**

3.5.11 It is proposed that the extraction of aggregate will be achieved by blasting the rock through the use of controlled explosive charges with a maximum instantaneous charge (MIC) of 75 kg.

3.6 **Management Procedures and Practice**

3.6.1 Blasting will be restricted to between the hours of 10.00am to 03.00pm weekdays (special circumstances aside). Sentries will be placed to prevent any inadvertent access to the site when blasting. Neighbours to the quarry will be advised as soon as is known (normally within 1 to 2 days) of the date and expected time for a forthcoming blast by the quarry. The method of notification will take the form of one of the following:

- Phone
- Email
- Text

3.6.2 Signage will also be erected on nearby public rights of way to advise users that they are approaching the vicinity of a quarry site where occasional blasting occurs (eg monthly, for a few seconds). The public rights of way users are not at physical risk from the blasts because of the distance from the quarry blasts, but blast noise could
startle users. Quarry management will be responsible for ensuring that blasting is carried out to minimise the level of air blast overpressure and ground vibration generated.

3.6.3 Quarry management will adopt modern blasting technology (leading industry practices) and blasting risk management practices including securing of the site during the blast. Only suitably experienced and qualified blasting personnel will be employed to provide blasting services. These services may include laser surveying of quarry face profile; blast-hole design and layout; blast-hole deviation measurement; explosives loading and blast initiation planning; priming, loading, stemming and initiation of blast; ground vibration/air blast monitoring; and reporting.

3.6.4 Blast shot loading practices shall be documented and supervised by the Quarry Manager to ensure explosives are appropriately confined by interlocking stemming of sufficient depth and that appropriate burden distances are provided.

3.6.5 A blast plan shall be prepared for each blast shot and shall describe shot hole layout, initiation sequence, charging, stemming type and height, charge weight and any other design element required for good blasting practice. The blast plan shall include actions to be taken if levels of induced air overpressure or ground vibration approach maximum permissible levels set out above.

Monitoring and Reporting

- Blast monitoring of both ground vibration and air overpressure will be undertaken once a month at the nearest residence to the blast or at an adjacent location as required.
- Additional blast monitoring is to be undertaken to investigate complaint of blasting nuisance upon receipt of request from the MPA.
- The Quarry Manager will keep reports and records of any monitoring of air blast and ground vibrations at affected dwellings and will make them available for inspection by the MPA upon request.

Responsibility

- The Quarry Manager is to ensure that suitably experienced/qualified explosive suppliers, drillers, shot loaders and shot firers are used for drill and blast operations at the quarry, and that all matters relating to blasting are carried out in accordance with this Management Plan.
- All complaints received at Collyweston Quarry are to be recorded in the

Heaton Planning
public complaints register.

Corrective Actions

- Specialist consultants might be required to give advice on blasting techniques or audit blasting methods if airblast overpressure and/or ground vibration is consistently greater than the nominated performance targets.

Auditing and Review

- The Quarry Manager and shot firer are to undertake continual auditing and review of blast performance.
- Once every 3 months, blast results will be sent to the MPA for review.
- Quarry Manager (or consultant) will keep records of monitoring undertaken in the preceding 12 months.

3.6.6 The Company would accept a planning condition concerning limits of ground vibration and air overpressure levels at an identified sensitive property worded along the following lines:

“All blasts shall be designed in a manner that ensures levels of ground vibration, as monitored at closest agreed vibration sensitive property, shall not exceed a peak particle velocity of 6 mms$^{-1}$ for 95% of blasts measured over any period of 6 months and no individual blast shall exceed a peak particle velocity of 12 mms$^{-1}$.

All blasts shall be designed in a manner that ensures that, for at least 93% of all blast events, levels of air overpressure, as monitored at closest agreed sensitive property, shall not exceed a maximum air overpressure limit of 120 dB peak linear measured over any period of 6 months”.
4 Hydraulic Breaking

4.1.1 Based on Company experience of utilising a larger machine for limestone extraction at Collyweston Quarry, such as the 45 tonne excavator, the majority of excavated limestone is capable of being fed directly into the mobile processing plant. There are however cases where harder pieces of rock require secondary breaking. In the first instance, this can usually be achieved by simply dropping the rock from the excavator bucket causing it to fracture through impact on the quarry floor. In circumstances where this is not effective, the rock has to be set aside and then subsequently broken using a hydraulic breaker. To carry out this operation, the harder rocks are set aside and then hydraulically broken using plant brought to site for relatively short periods during a working year. Typically, previously, this might take place over a maximum of 6 weeks in a year. Given the usage of the 45 tonne excavator, it is expected that there will be a reduced volume resulting in no more than 4 weeks of hydraulic breaking in a given year.

4.1.2 Given that the breaking is generally more audible than day to day processing, the Company proposes to restrict its hours of usage to the hours of 09:00 – 15:30 on weekdays only.

4.1.3 The Company would accept a planning condition imposing this along the following lines:

“Unless otherwise agreed in writing hydraulic breaking will not take place outside the hours of 9:00 – 15:30 on weekdays only”.
5 CONCLUSIONS

5.1.1 It is not in Bullimore’s commercial interest to carry out quarry blasting any more than is necessary and there are fundamental benefits to the Company in avoiding blasting, both in terms of specific costs of blasts and also the fact that blasting results in greater volumes of limestone waste and thus reduces aggregate production.

5.1.2 It is Bullimore’s objective to seek to minimise and reduce any vibration and disturbance potentially generated by the quarry operations to acceptable levels for local residents whilst enabling effective, efficient extraction and processing of limestone and slate log.

5.1.3 It is considered that the Company can design and monitor blasting and with the imposition of appropriate planning conditions, the effects of blasting can be controlled adequately.
Appendix 1 – Leicester County Council Quarry Blasting Guidance
Quarry Blasting

Hard Rock Extraction

Basics Of Rock Blasting

Hard rock is extracted in an inverted "tier" method, these tiers or benches are cut by means of explosives.

Boreholes are drilled behind the quarry face at a calculated distance and interval, to release a given amount of burden.

The length of the borehole controls the height of the working bench, the inclination of the borehole from the vertical controls the repose of the bench face; at most quarries this inclination can vary from vertical to 80, the holes are charged with explosives and detonators and then packed or stemmed with inert material, to control the force of the blast.

In this manner the amount of explosives used in the blast is controlled, and varying the amount of explosives used in each blast cannot be carried out without affecting other factors.

The Environmental Impact Of Hard Rock Blasting

Ground Vibration

Department of Environment guidelines in the form of Mineral Planning Guidance notes, have recommended a ground vibration limit for hard rock blasting of between 6.0 and 12.0 mm/s at the nearest residential property as being acceptable.

The ground vibration can be affected by certain blast design parameters:-

1. The maximum instantaneous charge or MIC is the amount of explosives fired at the same moment in time.
2. The number and frequency of delays. The introduction of a delay sequence can reduce the size of the maximum wave produced.
3. The height of the working bench and therefore the length of borehole.
4. The number of "decks" or layers of explosives and detonators in each hole.
5. The spacing, burden and number of holes, in the blast ratio.
6. The diameter of the shot hole, which will effect the amount of explosives used.

Vibration can be generated within the ground by any dynamic source of sufficient energy. It is composed of various waves, known collectively as seismic waves which spread radially from the vibration source, decaying rapidly as distance increases.

Four interrelated parameters are used to define ground vibration magnitude:

Displacement - Velocity - Acceleration - Frequency

Much investigation has been undertaken into the damage potential of blast induced ground vibration, resulting in an adopted method of monitoring. This allows for results to be obtained in terms of the Peak Particle Velocity (P.P.V.), which is measured in mm/s.

Structural Damage

Research work has been undertaken by various Authorities around the world into vibration levels that are likely to induce damage in properties, both cosmetic and structural.

Values in excess of 50mm/s are necessary to produce appreciable structural damage.

The onset of cosmetic damage can be associated with lower levels and a limit of 12.7mm/s is therefore recommended.

The question is often asked

"What is the long term affect of vibration on my property?"

The vibration levels from normal every day occurrences can be seen below.

As shown the level of vibration on a property from rock blasting are comparable with every day household events, the major psychological difference is in that rock blasting is an alien operation most people never experience and therefore are unfamiliar with. There are no proven incidents of damage to property from rock blasting in Leicestershire where quarrying has been carried out since the last century.

Human Perception

Human perception levels are difficult to precisely define since they will vary from one person to another.
The human body is very sensitive to vibration, which can result in concern being expressed at energy levels well below the threshold of damage.

A person will generally become aware of blast induced vibration at levels of around 1.5mm/s and under some circumstances this can be as low as 0.5mm/s, even though such vibration is routinely generated within any property and is entirely safe.

The British Standards Institution have produced a relevant document, BS 6472: 1992, which specifically mentions blasting vibration. A satisfactory magnitude of 8.5mm/s at a 90% confidence level with an absolute limit of 12.7mm/s is recommended for such impulsive vibration at residential property.

Leicestershire County Council have generally adopted a maximum vibration limit of 6.0mm/s, with a confidence level of 95%, as part of the conditions covering blasting within modern Planning Permissions. This lies at the lower end of the vibration range recommended, as part of a planning consent, by the Department of the Environment.

Air Over Pressure

Whenever an explosive is detonated transient airborne pressure waves are generated.

This can be controlled by the amount of stemming used in each borehole and by employing a good borehole drilling technique to control the amount of burden throughout the length of the borehole.

The one piece of rock can only be worked once, and within the same quarry the homogeneous qualities of the material can differ, either by natural impurities found within the structure of the rock or by the introduction of fracturing and shattering of the rock from adjacent blasts, these are known as overbreaks.

Air Over Pressure can also be affected by these overbreaks or cracks and fissures in the rock mass permitting the explosive gases generated to vent to atmosphere.

Although it is possible that air over pressures could cause structural damage those produced by routine blasting operations under normal atmospheric conditions are not likely to do so. Many hundreds of air Over Pressure measurements undertaken over a wide range of conditions indicate that relatively rarely do air over pressures exceed 125 dB. Within a range of values of + or - 15 dB some 7% of values are found to be in excess of this figure.

The weakest parts of a structure that will be exposed to air Over Pressure are its windows, and so these are the most likely to suffer damage. Poorly mounted panes might be forced out of their frames while improperly mounted panes that are pre-stressed will be cracked and broken more easily.

Air Over Pressure values of 150 dB could be enough to damage a badly mounted pane with most windows breaking at 170 dB. Structural damage can be expected at 180 dB. Although structural damage is unlikely, air Over Pressure does play a most important role in the annoyance aspect of blasting. Relatively low levels can be sufficient to cause the rattling of loose ornaments or windows and hence give the impression of a significant ground vibration shaking the property.

Impulsive vibrations as low as 0.5mm/s can cause complaints when accompanied by such secondary noise effects. This is because the average person forms a judgement based largely on his or her psychoacoustic responses, and is usually unaware of the important distinction between the characteristics of the motion alone and the sound effects that accompany it.

Leicestershire County Council have generally adopted a maximum Air Over Pressure limit of 120 dB peak linear, as part of the conditions covering blasting within modern Planning Permissions.
References:

Vibrock Blast Vibration Document
United States Bureau of Mines