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1. INTRODUCTION

1.1 Minerals are a valuable but finite natural resource. Cardiff is one of the largest producers and consumers of minerals in the region and those currently worked in Cardiff provide essential raw materials for construction and industry. Natural minerals include quarried hard rock (carboniferous limestone and dolomite) and dredged sand landed at Cardiff Docks. There is a land-based sand and gravel resource in the east of the city and coal resources in the north-west.

1.2 This background paper will provide information on the range of mineral resources in Cardiff and the extent of the minerals landbank that exists. It will provide an explanation of the following:
   - Limestone
     - Description of limestone resources and the landbank that exists;
     - Buffer zones;
     - Resource areas protected in policy M1;
     - Limestone resource safeguarding areas covered in policy M9.
   - Coal
     - Coal resource safeguarding area covered in policy M8.
   - Land-based Sand and Gravel
     - Sand and gravel safeguarding area covered in policy M7;
   - Marine Dredged Sand and Gravel
     - Safeguarding of wharves covered in policy M6;

2. POLICY CONTEXT

2.1 Planning policy in respect of minerals is contained in:
   - Minerals Planning Policy Wales (MPPW) (2000);
   - Minerals Technical Advice Note 1: Aggregates (MTAN1) (2004);
   - Minerals Technical Advice Note 2: Coal (MTAN2) (2009);

2.2 Specific guidance on mineral landbanks is contained in paragraph 17 of MPPW and paragraph 49 of MTAN1. MTAN1 states that a minimum 10 year landbank of crushed rock should be maintained throughout the Plan period. Guidance on inactive sites is contained in paragraph 19 of MPPW, which states that inactive sites which are considered unlikely to be reactivated for the foreseeable future should be identified in the development plan, and should be the subject of a suitable strategy and associated policies to explain future proposals for the land.

2.3 Guidance on mineral buffer zones is contained in paragraph 71 of MTAN1 which states that, at hard rock quarries, a minimum distance of 200m should be adopted, defined around the outer edge of where extraction and processing operations will take place.
2.4 Guidance on the safeguarding of mineral resources is contained in paragraph 13 of MPPW, which states that it is important that access to mineral deposits which society may need is safeguarded. Areas to be safeguarded should be identified on proposals maps and policies should protect potential mineral resources from other types of permanent development which would either sterilise them or hinder extraction.

2.5 Specific guidance on the safeguarding of coal resources is also found in paragraph 34 of MTAN 2, which advises that a long-term strategy is required to protect what may become a strategic resource. Guidance on the safeguarding of land-based sand and gravel is contained in paragraph 32 of MTAN 1. It states that, whilst it is recognised that land based extraction is not considered appropriate at the present time, the resources must be safeguarded for potential use by future generations in development plans now in view of their relatively limited regional availability.

3. RELATIONSHIP TO OTHER PLANS AND PUBLICATIONS

3.1 In October 2008 a Regional Technical Statement (RTS) was prepared for the area covered by the South Wales Aggregates Working Party (SWRAWP). Its purpose was to set out the strategy for the provision of aggregates in the South Wales Region for the period until 2021. As appropriate, the mineral planning authorities comprising the SWRAWP will then include any necessary allocations for future aggregates provision in their area as part of the Local Development Plan process.

3.2 The recommendation of the RTS in respect of Cardiff is that no resource allocation is required at present, but that existing and potential wharves should be identified for protection and that additional rock, sand and gravel resources should be investigated and safeguarded for possible future use. For confidentiality reasons, Cardiff’s apportionment has been paired with Rhondda Cynon Taff (RCT). The two authorities are expected to contribute between 22.5 and 23.9Mt (million tonnes) over the next 15 years. There are sufficient permitted reserves across the two areas to meet this requirement, although permitted reserves are more concentrated in Cardiff than in RCT.

3.3 The SWRAWP also publish an annual report based on the findings of an annual survey of aggregate sales information. The SWRAWP Annual Report 2011 provides information on patterns in supply of, and demand for, aggregates. The information gathered by the survey is presented in the report in a collated form, rather than as individual
Cardiff Deposit Local Development Plan 2006-2026

quarry returns, in order to protect the confidentiality of individual operators.

3.4 The Welsh Assembly Government (WAG) commissioned Symonds to produce South Wales Sand and Gravel: Appraisal of Land-based Extraction in South East Wales (2000). This is an independent study which assesses the nature and distribution of potential land-based sand and gravel resources and a review of other supply options. It identifies areas of sand and gravel resource which should be safeguarded within Local Development Plans.

3.5 The British Geological Survey (BGS) Resource Maps provide information on coal resources. Resources are divided into primary resource zones (where open cast coal has been exploited), secondary resource zones (where coals are thinner and less concentrated in distribution), and tertiary zones (small areas of thin coal outside of the other two zones). It identifies areas of coal resource which should be safeguarded within Local Development Plans.

4. **LIMESTONE: RESOURCES**

4.1 Much of the higher ground in North Cardiff is formed by Carboniferous Limestone, forming a band from Pentyrch eastwards to Tongwynlais. Limestone is a sedimentary rock, composed mainly of calcium carbonate. The limestone has been dolomitised in places to varying degrees i.e. it contains up to 45% magnesium carbonate. This northern outcrop of limestone represents the southern boundary of the South Wales coalfield.

4.2 **Taffs Well Quarry** is situated on the south side of the Little Garth ridge overlooking Morganstown. A new planning permission for the quarry was granted in 1998, which involved the quarry operators giving up the right to quarry the south and east rims in exchange for an equivalent extension to the west. Also included in the application is a new access road, relocation of the plant and substantial environmental/operational changes. The quarry is currently active, producing carboniferous limestone.

4.3 **Ton Mawr Quarry** is located on the south side of the Little Garth ridge, adjacent to Taffs Well Quarry. Permission was granted to extend the site laterally and vertically in 2002. The quarry is currently active, producing carboniferous limestone, although output is restricted by planning condition to 150,000 tonnes per annum.

4.4 **Blaengwynlais Quarry** is located on the eastern side of Rhiwbina Hill, and extends across the county boundary with Caerphilly. The majority of unworked reserves fall within Caerphilly’s administrative area, although the access and processing areas lie within Cardiff. The
quarry is inactive at present, but an application for a review of conditions is currently pending the submission of further environmental information.

4.5 **Cefn Garw Quarry** is located north of Tongwynlais, to the south east of Heol-y-Fforest. The quarry was last worked in 1987 and is currently dormant. A concrete batching plant remains near the entrance to the quarry, although all material used at the plant is imported.

4.6 **Creigiau Quarry** is located on the hillside east of Creigiau, between the villages of Creigiau and Pentyrch. The quarry was last worked in 2001 and is currently dormant.

5. **LIMESTONE: LANDBANK**

5.1 The landbank is made up of reserves of minerals, that is, mineral resources which have planning permission for working. The landbank consists of the sum of all permitted reserves at active and inactive sites. Paragraph 49 of MPPW states that a minimum 10 year landbank of crushed rock should be maintained during the entire Plan period. It also states that where landbanks already provide for more than 20 years, new allocations in development plans will not be necessary.

5.2 The SWRAWP Annual Report 2011 shows that Cardiff had sufficient reserves to provide a landbank in excess of 40 years. Some of these reserves, however, are at dormant sites i.e. Cefn Garw and Creigiau.

5.3 The landbank is, therefore, sufficient for the 15 year plan period. There is no need to allocate any sites for minerals, although it remains necessary to safeguard resources for the future.

6. **LIMESTONE: BUFFER ZONES**

6.1 Buffer zones are defined around limestone mineral reserves and resources in order to protect them from the encroachment of incompatible development, which could cause sterilisation, and to reduce the environmental impact of quarrying by separating sensitive developments and mineral working. MTAN1 recommends a minimum buffer zone distance of 200m for hard rock quarries. However, it is important that buffer zones are based on the actual impact of blasting at each individual quarry. Consequently, buffer zones in Cardiff have been defined based upon extensive research and measurement. They vary from the smallest at 225m and the largest at 468m and may vary in size in different directions from the same quarry.
6.2 A quarry can affect its surroundings in a variety of ways. Day to day operations can generate noise, dust, pollution and general disturbance in the immediate vicinity. These are relatively localised in their effect with, for example, unacceptable noise from plant or machinery and excessive dust emission only experienced in areas very close to the quarry. However, disturbance from traffic can be experienced along routes leading to a quarry and it may be visible within the landscape over a considerable area, though the effect on amenity is likely to diminish with distance from the site.

6.3 In Cardiff every quarry is permitted to operate by the use of explosives, and all active quarries do so. Blasting operations do not occur continuously, but when blasting does take place the disturbance it creates can be felt over a substantial area. Allowance must be made for the relative infrequency of the disturbance in determining whether blasting causes an unacceptable loss of amenity. Nevertheless, it is blasting which generates the majority of complaints received about quarrying – the other effects rarely give rise to widespread public concern. It is, therefore, the impact of blasting which is used as the basis for calculating buffer zones, since protection against this will automatically also protect the much smaller area affected by the other causes of nuisance.

6.4 The major sources of disturbance from blasting can be identified in terms of four parameters:
- Ground vibration;
- Noise;
- Air over-pressure (‘shock wave’); and
- Risk of fly-rock.
Other effects, such as dust, are unlikely to affect areas outside the quarry on sufficient occasions so as to be considered unacceptable.

6.5 Levels of ground vibration can be measured for each blast. Using the controls imposed on the use of explosives in the planning permission, calculations can be made of the likely effect of all future blasting operations on the quarry’s surroundings. These calculations can then be related to pre-determined standards of acceptability, and the distance around the quarry at which levels cease to be unacceptable can be identified. In this way the Council can be reasonably certain that new housing developments built outside of the buffer zone will not lead to an unreasonable conflict of interest with the quarrying activity within it, and that residents of the housing will not suffer an unacceptable impact upon residential amenity. Equally, the Council can be certain that mineral working or residential development within the buffer zone would be likely to lead to such conflicts and undermine the purpose of the buffer zone.
6.6 a) CAUSES OF GROUND VIBRATION
The two most significant influences on ground vibration are:
- Distance from the blast; and
- Weight of the explosive detonated instantaneously (Maximum instantaneous charge or MIC).
Many other factors play a lesser part, including the type of explosive used and the method of firing. Assessments are made using the maximum (i.e. the worst) set of conditions which might occur within the limits of a quarry’s planning permission. This information is used to determine the limits that should be applied to blasting when assessing new proposals and to determine how near blasting operations other development should be allowed to be located. To avoid nuisance to the occupiers of new residential and other sensitive development, the LDP defines a buffer zone around each quarry, based upon the nearest distance that such development can be located without suffering nuisance in excess of the levels described below.

6.7 The Council has regularly monitored the effects of blasting at all its active quarries over many years and has built up a substantial, independent record of its effects. Analysis of this data allows the likely future impact of continuing operations to be calculated. Table 1 below summarises the results to date.

### TABLE 1

<table>
<thead>
<tr>
<th>QUARRY</th>
<th>NO. OF RECORDS</th>
<th>MAXIMUM CHARGE (kg)</th>
<th>IMPACT DISTANCE AT 8.5 mm/sec (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blaengwynlais</td>
<td>39</td>
<td>90</td>
<td>313</td>
</tr>
<tr>
<td>Cefn Garw (East)</td>
<td>144</td>
<td>64</td>
<td>465</td>
</tr>
<tr>
<td>Cefn Garw (Other)</td>
<td>28</td>
<td>64</td>
<td>225</td>
</tr>
<tr>
<td>Creigiau</td>
<td>24</td>
<td>120</td>
<td>284</td>
</tr>
<tr>
<td>Taffs Well (Blast Zone A)</td>
<td>92</td>
<td>220</td>
<td>468</td>
</tr>
<tr>
<td>Taffs Well (Blast Zone B)</td>
<td>92</td>
<td>170</td>
<td>412</td>
</tr>
<tr>
<td>Taffs Well (Blast Zone C)</td>
<td>92</td>
<td>130</td>
<td>360</td>
</tr>
<tr>
<td>Ton Mawr</td>
<td>8</td>
<td>90</td>
<td>270</td>
</tr>
</tbody>
</table>
6.8 **b) GROUND VIBRATION ANALYSIS**

Ground vibration is 4-dimensional: movement occurs for a finite period of time, and in all directions, not just along the surface. It can be simultaneously analysed in three mutually-orthogonal directions: outward from the source (longitudinal), from side-to-side (transverse), and up-and-down (vertical). To be certain of identifying the maximum degree of nuisance it may cause, it is essential to measure in all three directions to find the greatest value. Vibration decays over both time and distance from its source. By measuring it at different distances from its source, that rate of decay can be identified. Regression analysis can then calculate the vibration at other distances from that particular source.

6.9 Further monitoring of identical vibration sources in identical conditions would produce the same results, and their impact could therefore be confidently predicted. In the reality of quarry blasting, it is impossible to reproduce identical blasts. Their location will always be different, giving slightly different results.

6.10 Even around an individual quarry, differing explosive charges will cause marked variations in vibration: a higher charge weight causes greater vibration. The most relevant factor is the weight of the MIC. Charges are usually detonated with slight time delays between them, so they are not all fired at the same instant. It is the greatest of these discrete charge weights within a single blasting operation which governs the maximum vibration. By measuring the vibration at various distances and from various charge weights, it is possible to predict the vibration at different distances and for different charge weights.

6.11 **c) PREDICTING GROUND VIBRATION LEVELS**

It is therefore possible to identify the distance to which a given level of vibration will be transmitted from a given quarry. Factors other than MIC also cause variations in vibration. These factors include:

- Type of explosive used;
- Geometry or design of the blast;
- Geological variations within and around the rock being blasted.

These produce finer variations than charge weight, but nevertheless cause measurements to vary. Regression analysis can still identify the rate of decay, but in many cases actual vibration levels will be above that predicted value.

6.12 In order to ensure adequate protection, it is necessary to protect against the maximum, rather than the average, impact of ground vibration. This is achieved through identifying a limit which would contain at least 90% of all blasts. It is from this 90% confidence level that acceptable limits on either distance (for separation from an existing quarry) or on charge weight (for controlling a new quarry) can be identified.
6.13 To protect against such nuisance, a Peak Particle Velocity (PPV) of 8.5mm per second is used as the 'nuisance threshold' for calculating whether blasting operations are reasonable. This level takes account of British Standard BS6472-2:2008. This figure is intended to relate to 90% of blasts; the remainder should not exceed 12.75mm per second.

6.14 d) OTHER BLASTING IMPACTS

Audible noise is atmospheric pressure variations at frequencies greater than 20Hz (Hertz) and does not usually present significant problems. However, it is relevant to the public perception of the other effects of blasting, so it is important to control this through careful blast design.

6.15 Air-overpressure is the lower (normally inaudible) frequencies of the noise spectrum. It is transmitted through the atmosphere, so meteorological conditions such as wind speed and direction, cloud cover and humidity will affect the intensity of the impact. In view of this, it is difficult to predict its likely impact upon the surrounding area.

6.16 Fly-rock incidents are the unexpected projection of material from the blast site to any area beyond the danger zone identified by the shot firer. Such incidents, although potentially dangerous, are relatively rare as HSE regulations ensure that, as far as practicable, blasts are implemented exactly to the design specification.

6.17 e) MEASUREMENTS OF BUFFER ZONES

The Council measures actual impact from blasting, extrapolates the likely effects at different distances and for different levels of explosive, and compares these findings with recognised thresholds of nuisance. The calculations are precise, but there remains the risk of an occasional exceptional blast which will exceed expectations. Whilst this cannot be fully provided for, the Council also favours measures of extra protection which increase the confidence level of the calculations. One such safeguard is measuring from permission boundaries, even though in some cases they may not be reached. It is recognised that some (though not all) operators prefer to leave a margin for access around the outer edge of their quarries, but this ‘bonus’ is invariably used to provide a safety margin to the buffer zone calculations, especially in cases where the Council cannot require the margin to be left.

6.18 In some circumstances, the Council has been able to reduce the area affected by buffer zones following the signing of legal agreements with the quarry operators which limit the area which may be quarried. An example of this was at Taffs Well Quarry where the buffer zone was reduced following the signing of an agreement in 1998 that prevented further working on the southern and eastern rims of the quarry. The planning permission, therefore, provides the only legally valid limit on
the area which can be quarried, and the only boundary on which a buffer zone can be based.

6.19 f) HOUSING ALREADY LOCATED WITHIN BUFFER ZONES

As Cardiff is a densely populated country, there is already housing within some buffer zones. It is impractical to remove either the housing or the quarry, but the problem should not be intensified by permitting more houses or an extension to the quarry.

6.20 Within buffer zones three types of residential developments can occur:
- A large built-up area;
- A small group of houses; or
- A single house.
Examples of single houses occur in every buffer zone, but the existence of a single house cannot justify the building of more houses within the buffer zone next to it. The view that the Council has consistently taken is that the problems caused by small groups of existing houses within the buffer zones should not be compounded by allowing more. At the other extreme, it would be unreasonable to prevent infilling or redevelopment of a site within an existing built-up area, for example, one additional house within an existing development of several hundred. An extension on the far side of an existing built-up area would have no greater impact upon mineral reserves than the built-up area itself, but an extension nearer the quarry would lead to greater inhibitions placed upon quarrying operations and would not be favoured.

7. LIMESTONE AREAS IDENTIFIED FOR PROTECTION IN POLICY MIN1

7.1 Policy MIN1 identifies two limestone resource areas (as shown on the Proposals Map) which will be safeguarded from development which would prevent their extraction at:
- a. Creigiau Quarry; and
- b. Ton Mawr Quarry.

7.2 The methodology by which these two resource areas were identified for safeguarding is outlined below. A two stage sieve technique was used. Firstly, all parts of the County subject to a primary set of constraints were deleted from consideration, and secondly, those areas remaining (study areas) were analysed in depth against a secondary set of constraints.
PRIMARY CONSTRAINTS

7.3 Mineral working is only possible where commercially useful materials exist and is only feasible where those minerals are accessible. Planning permission for working is not likely to be granted where it would cause significant harm to the environment or where it would be likely to inhibit other important land uses.

7.4 The following primary constraints were used to identify those parts of the County which:
   A. Lie within outcrops of potentially useful limestone resources;
   B. Do not contain land of high agricultural quality (Grades 1,2 and 3a);
   C. Are not occupied by permanent buildings except non-residential farm buildings;
   D. Are not within 300m of any residential property;
   E. Do not contain or affect areas designated for special protection;
   F. Do not contain or lie close to land with a valid planning permission for incompatible development.

7.5 CONSTRAINT A
   The primary data source for the identification of potentially useful limestone resources is the BGS/DETR 'Mineral Resource Information for Development Plans in South Wales' which identifies all potential commercially useful carboniferous and Liassic limestone resources. In many parts of the County limestones underlie deposits of boulder clay and other younger material. Whilst this could potentially be worked, the cost of removing the overlying material can diminish the commercial viability of working. For the purpose of this exercise, the prospect of such working has been discounted.

7.6 The commercial value of the limestone resources themselves has not been assessed as this depends upon commercial analysis and judgement, market conditions and physical and chemical investigations beyond the scope of this process.

7.7 CONSTRAINT B
   This protects the best and most versatile agricultural land. The mineral beneath such land would remain available for future generations, but in line with current national guidance its agricultural quality takes priority at present. Land of grades 1, 2 and 3a as classified by the Agricultural Land Classification is considered to be the best and most versatile and such land is excluded from consideration.

7.8 CONSTRAINT C
   This recognises that underlying mineral resources will normally be lost for good once they have been built upon. In built-up areas the pressure to redevelop brownfield sites in preference to greenfield sites and to protect properties from the effects of mineral working will continue to reduce the likelihood of built-up areas becoming available.
for mineral working. The same effect occurs, although to a lesser extent, as a result of individual buildings, especially houses, in rural areas. Although it is occasionally possible for mineral companies to buy individual properties on, or close to, mineral resources this cannot be relied upon and has been discounted from consideration. Agricultural buildings can generally be re-sited more readily than other buildings and their presence need not act as a permanent inhibition to mineral working.

7.9 **CONSTRAINT D**
Nearby development which is sensitive to the impact of mineral working can prevent mineral working taking place in the same way as development on the resources themselves can. Paragraph 71 of MTAN1 sets a minimum distance for buffer zones around hard rock quarries of 200m. However, in advance of detailed measurements being taken, the impact of new mineral workings can only be estimated. It is unlikely that the effect of new working would be less than that of the least intrusive of the existing sites. The buffer zones at the three least intrusive sites are:
- Blaengwynlais (313m);
- Creigiau (284m); and
- Ton Mawr (270m).
The average of these is just under 300m, so this minimum dimension has been used as a separation distance between existing housing and potential new working.

7.10 **CONSTRAINT E**
This embraces all the statutorily designated areas including Special Protection Areas, Special Areas of Conservation, Sites of Special Scientific Interest, National Nature Reserves, Conservation Areas, Ancient Monuments and Listed Buildings.

7.11 **CONSTRAINT F**
Some land may already have planning permission for development which would conflict with mineral working. To make the best use of scarce resources, development that is unlikely to proceed should not be allowed to sterilise mineral resources unnecessarily. Conversely, it would be unreasonable to fail to give adequate protection from the effects of mineral working to land which will be developed for an incompatible use.

**SECONDARY CONSTRAINTS**
7.12 The resultant Study Areas were then analysed in detail. A secondary set of constraints were applied to the Study Areas to eliminate areas which:
- Straddle important highways;
- Are in visually prominent areas;
- Contain Ancient Woodlands, woodlands important in the landscape or subject to a Tree Preservation Order;
J. Contain or form part of a Local Nature Reserve or a Site of Importance for Nature Conservation;
K. Contain or form part of important landscape features;
L. Are of insufficient size or configuration;
M. Are particularly difficult to access;
N. Are of significant recreational value.

These Secondary Constraints were applied to the study areas identified as a result of the Primary Constraints being applied.

7.13 The two stage sieve technique outlined above resulted in two limestone areas being identified. These adjoin existing quarries at Creigiau and Ton Mawr. The two identified limestone resource areas have been shown on the Proposals Map and will be safeguarded from development which would prevent their extraction, in line with policy MIN1.

8. SAFEGUARDING AREAS

8.1 Paragraph 13 of MPPW states that it is important that access to mineral deposits which society may need is safeguarded. Furthermore, areas to be safeguarded should be identified on the Proposals Map and policies should protect potential mineral resources from other types of permanent development which would either sterilise them or hinder extraction.

LIMESTONE RESOURCE

8.2 All potential commercially useful limestone resources were identified by the BGS/DETR ‘Mineral Resource Information for Development Plans in South Wales’. These have been shown on the Proposals Map and will be protected against all forms of permanent development under policy M9.

COAL RESOURCE

8.3 Coal resources were identified on the BGS ‘Resource Maps’. These have been shown on the Proposals Map and will be protected against all forms of permanent development under policy M8.

LAND-BASED SAND AND GRAVEL RESOURCE

8.4 Cardiff has a small area of sand and gravel resource in the east of the City. It is unlikely that it would prove commercially viable to work this resource at the present time, as marine dredged aggregate sources provide an adequate supply to meet the majority of demand in Cardiff. However, concerns are growing regarding the long-term sustainability
of supplying aggregates from marine sources. The sand and gravel resource has been identified on the Proposals Map and Policy M7 provides a long-term strategy to protect what may become a strategic resource in the future.

MARINE DREDGED SAND AND GRAVEL

8.5 The South Wales Regional Technical Statement advises that existing and potential wharves should be identified for protection in the LDP to safeguard marine sand and gravel/hard rock/secondary aggregate existing and potential flows into the area. Existing wharves are, therefore, shown on the Proposals Map and safeguarded by policy M6.