

DERBYSHIRE AND DERBY MINERALS LOCAL PLAN

CONVENTIONAL OIL AND GAS SUPPORTING PAPER

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1 Introduction and Background

- 1.1 This is one of a series of papers providing background, supporting information to accompany the preparation of the new Minerals Local Plan. The new Plan will include strategies and policies concerning the winning and working of hydrocarbon based energy minerals. This paper provides information about oil and gas obtained from conventional sources whilst corresponding papers focus on unconventional sources such as gas from coal and shale gas. The production of separate papers reflects the issues that have been raised in previous consultation exercises and the views expressed to the County and City Councils in response to publicity for individual planning applications. Some of the issues and legislative provisions are common to all three forms of hydrocarbon developments and therefore there is some level of duplication in the papers but this is necessary to ensure that each one provides a comprehensive review of the issues for those who read them individually.
- 1.2 Oil and gas (forms of hydrocarbons) are important sources of energy in the UK where they are primarily used as fuel, although some components are also used as a raw material for the petro-chemical industry and in the manufacturing of drugs and plastics. Oil and gas are regarded as minerals and development proposals to extract them from sites in Derbyshire (excluding the Peak District National Park area) are the responsibility of Derby City Council or Derbyshire County Council as the respective Mineral Planning Authority. There are numerous methods of extracting oil and gas and each has different land use planning implications. This paper focuses on the issues involved in extracting oil and gas from conventional sources.

2. Oil and Gas Related Policy

- 2.1 This section provides a summary of recent and current national policy and guidance concerning planning issues for the extraction of oil and gas. The earlier policy documents were written at a time when operations were focused on obtaining oil and gas from conventional sources, and these are included as a brief historical context, whereas the later documents also include guidance relating to emerging technologies used to obtain oil and gas from unconventional sources.

2.2 **Circular 2/85**

Government policy for the extraction of oil and gas was previously set out in Circular 02/85: Oil and Gas, 1985, wherein it encouraged the exploration and production of the country's own oil and gas reserves, both off and on shore, as supplies of home produced fuel on the basis that it would be more secure than imported supplies. It stated an intention to maximise the economic exploitation of these reserves over time, and only in exceptional circumstances would the environmental implications be so great as to prevent working on a particular site.

2.3 **Minerals Policy Statement 1: Planning and Minerals 2006**

The advice in Circular 2/85 relating to conventional oil and gas was replaced by Minerals Planning Statement 1 which repeated the earlier message about the essential nature of minerals to the nation's prosperity and quality of life, not least in helping to create and develop sustainable communities. It stated that it was essential to provide a steady supply of material to provide the infrastructure, buildings and goods that society, industry and the economy needs, but that this provision should be made in accordance with the principles of sustainable development.

Annex 4 focused on the issues relating to on-shore oil and gas and the underground storage of natural gas, setting out Government planning policy at the time. It referred to the current energy policy as stated in the White Paper, Our Energy Future: Creating a low carbon economy, 2003, which sought to cut carbon dioxide emissions whilst maintaining the reliability of supplies and ensuring that every home is adequately and affordably heated. One of its aims was to maximise the potential of the UK's conventional oil and gas reserves in an environmentally acceptable manner.

2.4 **National Planning Policy Framework**

MPS 1 was rescinded by the publication of the National Planning Policy Framework (NPPF) in March 2012. It recognises that minerals are essential to support sustainable economic growth and our quality of life and that it is important, therefore, that there is a sufficient supply of material to provide the infrastructure, buildings, energy and

goods that the country needs. It also recognises that minerals are a finite resource so it is important to make best use of them to secure their long term conservation.

According to Paragraph 147 of the NPPF, "Minerals planning authorities should also... when planning for on-shore oil and gas development, including unconventional hydrocarbons, clearly distinguish between the three phases of development (exploration, appraisal and production) and address constraints on production and processing within areas that are licensed for oil and gas exploration or production..."

2.5 National Energy Policy

There have been several important stages in the evolution of current national energy policy (from all fuel sources). The Department of Trade and Industry paper, Meeting the Energy Challenge, 2007 stated that the Government would make the most use of the UK's reserves of oil and gas but noted that production had hit a peak and was declining, as were the remaining reserves.

The draft National Policy Statement for Energy, published in 2009, builds on the 2007 Energy White Paper. Together they form an evolving international and domestic energy strategy in response to the changing circumstances in global energy markets. They set out to address the long-term energy challenges of security of supply, whilst acknowledging the implications of climate change. Whilst recent emphasis has been on the development of renewable energy supplies the Government recognises the important and continuing role that indigenous sources of coal, oil and gas will play in meeting national energy requirements.

This policy is set against the background of recent changes in the sources of our energy requirements. By 2004 the United Kingdom became a net importer of natural gas and a net importer of oil in 2010. By 2020, it was then estimated that the UK is likely to be importing about three-quarters of its energy supplies.

On 27 June 2013 the Government announced its long-term infrastructure investment plans which included measures to unlock investment in cleaner energy and

investment in new sources of energy, including a package of reforms to enable shale gas exploitation. The Government recognised that the simultaneous announcement of the extent of potential reserves required further appraisal but consider that shale gas has the potential to contribute significantly to the UKs' energy security, inward investment and growth.

The statement indicated that a key role for gas is consistent with the need to decarbonise our economy. It is regarded as the cleanest fossil fuel, and much of the new gas capacity needed would be replacing the ageing coal capacity. Gas is also seen as important for balancing the increasing levels of intermittent and inflexible low-carbon energy on the system.

2.6 Energy Act 2013

The Energy Act received final assent on 18 December 2013. The Act has several objectives and in relation to hydrocarbons it seeks to make provision for the setting of a decarbonisation target range and duties in relation to it; or in connection with reforms to the electricity market for purposes of encouraging low carbon electricity generation, or ensuring security of supply. It is also about the designation of a strategy and policy statement concerning domestic supplies of gas and electricity. It does not actually prescribe a new strategy or policy at this stage but instead sets the procedural requirements for doing so. It is likely however that future policy and strategy will reflect the overall objective of the Act to reduce our carbon footprint and in turn this will affect the future demand for minerals including fossil fuels.

2.7 National Planning Practice Guidance, March 2014 (NPPG)

The National Planning Practice Guidance was published in March 2014 and contains revised and updated planning practice guidance on a wide range of planning issues. It complements and expands on the policies in the National Planning Policy Framework and replaces a suite of previous guidance, including Planning practice guidance for onshore oil and gas, DCLG, July 2013, although it broadly repeats the advice in these documents relating to the extraction of energy based hydrocarbons.

The NPPG states that mineral resources make an essential contribution to the country's prosperity and quality of life. This reflects the guidance in the July 2013 publication wherein it stated that oil and gas (hydrocarbons) underpin key aspects of modern society, supplying energy to power industry, heat for homes, fuel for transport to carry goods and people all over the world, and raw materials to produce everyday items. In addition, that guidance also stated that hydrocarbons will remain an important part of the UK's energy mix whilst the country transitions to low carbon energy supplies.

The NPPG provides advice on the planning issues associated with the three separate phases which are involved in the extraction of hydrocarbons (exploration, appraisal and production) and should be read alongside the NPPF. The guidance addresses some of the technical issues associated with hydrocarbon working and provides a description of the different operations involved in each phase. It includes an explanation of the role of the planning system in obtaining permission together with a summary of the role of the other official regulators also involved in the process.

In terms of new guidance it encourages mineral planning authorities to make appropriate provision for hydrocarbons in local minerals plans, based on emerging information, to allow them to highlight areas where proposals for extraction may come forward, as well as managing potentially conflicting objectives for the use of land. Minerals local plans should include criteria based policies for each of the three phases, setting clear guidance for the location and assessment of hydrocarbon extraction within their areas. Existing hydrocarbon extraction sites should be identified in local plans, through the local plan site allocation process, where appropriate, and mineral planning authorities may include new locations should the oil and gas industry wish to promote specific sites. In contrast to the practice established for other minerals resources, the guidance does not advocate the need for the creation of formal safeguarding areas for hydrocarbons due to the depth of those reserves, the ability to use drilling equipment and the small surface area required for the installations.

With regard to the determination of development proposals, mineral planning authorities are advised to assess applications for each phase on their respective merits and applications for the exploratory stage should not involve the consideration of the potential impacts of extraction. Mineral Planning authorities should not consider demand or alternatives to oil and gas when determining applications. The guidance advises mineral operators to look to agree a programme of work with the mineral planning authority, which takes account, as far as possible, of the potential impacts and mineral planning authorities are advised to use appropriate conditions to mitigate those potential impacts for which they have responsibility. Operators and mineral planning authorities are also encouraged to seek appropriate restoration schemes for sites once mineral extraction is completed. The guidance includes a set of model conditions for mineral planning authorities to consider using, where appropriate, on planning permissions for all forms of hydrocarbon extraction developments.

2.8 Derby and Derbyshire Minerals Local Plan

The current Minerals Local Plan states that all proposals for the extraction of oil and gas will be considered against the general policies set out in the Plan, and the detailed criteria in Policy MP35 Oil and Gas which states that:

Proposals for the development of oil and gas, including facilities associated with the production, processing or transporting of oil or natural gas will be permitted only where they can be carried out in an environmentally acceptable way, and provided that:

- any irreparable damage to interests of acknowledged environmental importance is outweighed by a proven need for the development in its proposed location
- the proposal is consistent with an approved overall scheme for the appraisal of, or production from the area
- the proposed location of the development is the best having regard to geological, technical And environmental considerations

- satisfactory arrangements have been made for the avoidance of seepage pollution, the off-site disposal of drilling mud and other drilling residues and the flaring and disposal of unwanted gas.

3. Geology

- 3.1 Oil and natural gas originate in petroleum source rocks, i.e. sedimentary rocks that were deposited in very quiet water, usually in still swamps on land, in shallow quiet marine bays, or in deep submarine settings. Source rocks are comprised of very small mineral fragments. In between the mineral fragments, are the remains of organic material, usually algae, small wood fragments, or pieces of the soft parts of plants. When these fine-grained sediments are buried by depositions of later, overlying sediments, the increased heat and pressure resulting from the burials turns the soft sediments into hard rock strata. If further burial ensues, then temperatures continue to increase. When temperatures of the organic-rich sedimentary rocks exceed 120° Centigrade, the organic remains within the rocks begin to be 'cooked' and oil and gas are formed from the organic remains expelled from the source rock. It takes millions of years for these source rocks to be buried deeply enough to attain these maturation temperatures and additional millions of years for sufficient volumes of oil and gas to form commercial accumulations as the oil and gas are expelled from the source rock into adjacent reservoir rocks. Oil and gas formed in this manner are referred to as thermogenic oil and gas.
- 3.2 If the organic material within the source rocks is mostly wood fragments, then the primary hydrocarbon generated is natural gas. If the organic material is mostly algae and the soft parts of land plants, then both oil and gas are formed. By the time the source rock is buried deeply enough so that temperatures are above 150° Centigrade, the organic remains have produced most of the oil they are able to. Above these temperatures, any oil remaining in the source rock or any oil that has been trapped in adjacent reservoirs will be broken down into natural gas.

- 3.3 Some organic-rich sedimentary rock can generate gas through bacterial processes at shallow burial depths before thermal maturation temperatures are attained. In this process, referred to as biogenic gas generation, the organic-rich source rocks are never buried deeply enough and do not attain temperatures necessary for the thermogenic production of gas. Instead, anaerobic bacteria generate gas in shallow source rocks that are generally located around the basin margins. Biogenic processes produce less gas per unit of sediment than thermogenic processes. Gas wells associated with biogenic gas are usually low volume. Most accumulations of biogenic gas occur at depths of less than 200 feet.
- 3.4 Oil and gas reservoir rocks are porous and permeable. They contain interconnected passageways of microscopic pores or holes that occupy the areas between the mineral grains and the rock. When oil and gas have been naturally expelled from the source rocks, they enter or migrate into the adjacent reservoir rocks. Most oil and gas reservoir rocks are sandstones, limestones or dolomites.
- 3.5 Potential source rocks for hydrocarbons (oil and gas) occur in many areas of the UK, including the best known, the Kimmeridge Clay formation found offshore in the North Sea and which extends across southern England to the south coast. This resource has provided the UK with major oil and gas reserves that have been exploited since the early 1970s. However, oil and gas have only been discovered and produced in commercial quantities from specific sedimentary basins onshore. These are where the required reservoir rocks and source rocks that gained adequate maturity were deposited and where trapping structures now exist (impermeable caps halting the movement of the reserve enabling the formation of a reservoir).
- 3.6 The eastern part of Derbyshire is on the western margin of the East Midlands oil and gas province. This province comprises a series of major Carboniferous rift basins (Silesian sandstones and fractured Dinantian limestones), within which sequences containing important source and reservoir rocks were deposited during Namurian and Westphalian (late Carboniferous) times. Also known as the East Midlands Petroleum

Province, it covers the petroliferous geological area across the north-eastern part of the East Midlands region.

- 3.7 Early exploration led to the discovery of oil at Kelham, Nottinghamshire in the 1920s with further reserves in Eakring (also Notts) in 1939. Oil and gas have both been exploited in Derbyshire at Heath and Calow (gas), and Hardstoft (oil) and exploratory wells have been sunk at four other sites at Whitwell, Bramley Moor, Golden Valley and Sawley. At the end of 2009 it was estimated that the remaining recoverable reserves of oil in the East Midlands province was almost 22 million barrels.
- 3.8 Geological conditions are such that it is possible that further oil or gas accumulations, in commercial quantities, could be found in the area east of Calow, Hardstoft and Ironville. The area to the west is somewhat less prospective, as the main East Midlands reservoir sandstones (the Crashaw Sandstone and the Chatsworth Grit) are absent or only shallowly buried.

4. Regulatory System

4.1 Key Regulators

Anyone seeking to carry out operations for the extraction of hydrocarbons, from conventional or unconventional sources involving traditional or new technologies, has to obtain approval from the appropriate regulatory bodies. The key regulators for all hydrocarbon extraction operations are identified below. Licencing and working issues are addressed in other sections of the paper.

- **Department of Energy and Climate Change** – issues Petroleum Licences, gives consent to drill under the Licence once other permissions and approvals are in place, and have responsibility for assessing risk of and monitoring seismic activity (where relevant), as well as granting consent to flaring or venting. Further details of the licencing regime are provided below.
- **Oil and Gas Authority** - as of 1 April 2015 certain function passed from the Department of Energy and Climate Change to the Oil and Gas Authority (OGA) a newly created Executive Agency of DECC. It works with Government and industry

to make sure that the UK gets maximum economic benefit from its oil and gas reserves. It is now responsible for regulating offshore and onshore oil and gas operations relating to licensing, exploration and production, fields and wells, infrastructure and carbon capture and storage licensing.

- **Minerals Planning Authorities** – grant planning permission for the location of any wells and well pads, and impose conditions to ensure that the impact on the use of the land is acceptable.
- **Environment Agency** – protect water resources (including groundwater aquifers), ensure appropriate treatment and disposal of mining waste, emissions to air, and suitable treatment and manage any naturally occurring radioactive materials, and
- **Health and Safety Executive** - regulates the safety aspects of all phases of extraction, in particular responsibility for ensuring the appropriate design and construction of a well casing for any borehole.

Other bodies which may be involved in the consenting of the process include:

- **The Coal Authority**, whose permission will be required should drilling go through a coal seam
- **Natural England**, who may need to issue European Protected Species Licences in certain circumstances
- **The British Geological Survey**, who need to be notified by licensees of their intention to undertake drilling and, upon completion of drilling, must also receive drilling records and cores, and
- **Hazardous Substances Authorities**, who may need to provide hazardous substances consents.

Additional consents and orders, such as stopping up rights of way or temporary road orders, may also be required.

4.2 **Obtaining Planning Permission and Other Approvals**

Apart from a few exceptions, all works associated with the extraction of hydrocarbons require planning permission. The process of obtaining planning permission to drill a well is the same whether the well is targeted at conventional gas resources or

unconventional gas (e.g. shale gas). The process involves three separate stages; exploration, appraisal and extraction, and planning permissions are required for each stage, although an applicant can seek approval for two or more stages in one application.

The exploratory phase seeks to acquire geological data to establish whether hydrocarbons are present. The appraisal stage takes place when the existence of oil or gas has been confirmed, but where the operator needs further information about the extent of the deposit or its characteristics to establish whether it can be economically extracted. The production stage normally involves the drilling of a number of wells and may also involve the installation of ancillary equipment such as pipelines, processing facilities and storage tanks.

In order to undertake any works related to gas extraction an operator has to have a licence which is issued by the Department of Energy and Climate Change (now OGA). Licences are issued in competitive offerings (Licence Rounds) which grant exclusivity to operators in the licence area. The licences however do not give consent for drilling or any other operations.

The Department of Energy and Climate Change publication, Onshore Oil and Gas Exploration in the UK: Regulation and Best Practice, December 2013, contains the following checklist which identifies that before commencing drilling operations for all onshore oil and gas development the operator must have:

- obtained a petroleum exploration and development licence (PEDL) from DECC or petroleum licence (PL) from the Department of Enterprise, Trade and Investment (DETI)
- secured a lease from the landowner
- submitted relevant Petroleum Operations Notices (PON) to DECC/DETI
- satisfied DECC/DETI that effective operational and environmental management systems are in place
- secured planning permission
- discharged any relevant conditions placed on the planning permission

- obtained a permit from the Coal Authority if the well will encroach on coal seams
- informed the British Geological Survey of the intention to drill
- completed the necessary consultation processed with all the statutory/relevant consultees
- obtained the necessary permits from the Environment Agency
- notified HSE of the intention to drill (minimum 21 days' notice)
- provided HSE with details of the proposed well design that have been examined by an independent and competent well examiner (minimum 21 days' notice)
- agreed data-reporting methods with DECC/DETI
- agreed a method for monitoring induced seismicity and fracture growth height with DECC/DETI, (where hydraulic fracturing is planned)
- received approval for an outline fracturing programme from DECC/DETI (where hydraulic fracturing is planned).

This checklist predates the introduction of the Oil and Gas Authority and does not reflect any changes that may follow. Further details of this process are summarised below.

The submission of an application to the mineral planning authority triggers the need to determine if an Environmental Impact Assessment (EIA) is required. An EIA will be required if the scale of the proposed development exceeds certain thresholds, or if, depending on the nature, scale and location, the development may have significant environmental impacts. If an EIA is required, it must be completed by the applicant and submitted to the mineral planning authority before the authority decides on the application. Operators are encouraged to engage in pre-application discussions with the mineral planning authority where the need for an EIA and the matters to be addressed in it can be determined before an application is prepared and submitted. Government policy also encourages would-be applicants to undertake community engagement. Applicants are advised to inform local communities about their proposals and, where appropriate, amend those proposals in response to the feedback they receive.

Following a consultation in September 2013 and Government response in January 2014, changes were made to the system of how landowners and tenants should be notified by applicants of applications for onshore oil and gas development. The requirement to serve notice on individual owners and tenants of land on the above ground area where works are required was retained, but the requirement for owners of land beyond this area i.e. the owners of land where solely underground operations may take place, was removed. This was implemented by the Town and Country Planning (Development Management Procedure and Section 62A Applications) (England) (Amendment No.2) which came into force from 13 January 2014.

Once the LPA has granted planning permission to drill, and at least 21 days before drilling is planned, the Health and Safety Executive (HSE) must be notified of the well design and operation plans to ensure that major accident hazard risks to people from well and well related activities are properly controlled, and are subject to the same stringent regulation as any industrial activity. HSE regulations also require verification of the well design by an independent third party. Notification of an intention to drill has to be served to the environmental regulator under S199 of the Water Resources Act, 1991.

DECC (now OGA or any successor) will then check that the other regulators have no objections before consenting drilling operations. If hydraulic fracturing is intended, DECC (OGA) will require that a fracturing plan to address the risk of induced seismicity is submitted, and will review this plan before these operations are permitted.

If the operator wishes to drill an appraisal well or propose to start production operations, they start again with the process described above; the landowner's consent, permissions and planning consent, which may require EIA and approval from the Environment Agency, the HSE, and finally a decision from DECC (OGA).

The Planning and other regulatory regimes are separate but complementary. The planning system controls the development and the use of the land in the public interest and, this includes ensuring that new development is appropriate for the

location taking account of the effects, including cumulative effects, of pollution on health, the natural environment, general amenity and the potential sensitivity of the area or proposed development to adverse effects from pollution (see paragraphs 120 and 122 of the NPPF). The focus is on whether the development is an acceptable use of the land, and the impacts of those uses, rather than the control of the processes involved and health and safety. The information above briefly outlines the regulatory responsibilities for these issues.

All planning applications have to be assessed on the individual merits of the case, taking account of national and local policy. This applies to all proposals for oil and gas extraction from both conventional and unconventional sources using traditional or new techniques. In the early part of 2013 media coverage of proposals for hydraulic fracturing for shale gas led to concerns that such developments would be dealt with by the fast-track route for nationally significant business and commercial development proposed in the Growth and Infrastructure Bill by submitting applications to the Planning Inspectorate rather than to local councils. However, on 19 July 2013 in a Ministerial Statement, Baroness Hanham confirmed that “... responsibility for the determination of planning applications for onshore oil and gas, including for the exploration of shale gas, will be with the local authority. Decisions will therefore continue to be taken in accordance with local plans and the National Planning Policy Framework.”

The situation changed following the publication on 13 August 2015 of a joint statement from the Department of Energy and Climate Change and the Department for Communities and Local Government in which the new measures include:

- The Communities Secretary actively considering calling in on a case by case basis shale planning applications and considering recovering appeals
- Identifying councils that repeatedly fail to determine oil and gas applications within the 16 week statutory timeframe requirement (unless applicants agree to a longer period). Underperforming council’s gas and oil planning applications could be determined by the Communities Secretary

- Adding shale applications as a specific criterion for recovery of appeals, to ensure no application can ‘fall through the cracks’
- Ensuring planning call ins and appeals involving shale applications are prioritised by the Planning Inspectorate
- Taking forward work on revising permitted development rights for drilling boreholes for groundwater monitoring.

Coverage of recent hydrocarbon operations in the press and media, especially those involving hydraulic fracturing, have focused on a number of important issues, including seismic risks and the chemical content of hydraulic fracturing fluid. The National Planning Practice Guidance states that whilst these issues may be put to the mineral planning authority, the responsibility for assessment rests with other regulators. Mineral planning authorities have to assume that these other regulators will carry out their duties and responsibilities. They do not have to undertake their own assessments and should rely on the assessments of these regulators. Prior to granting planning permission, however, the mineral planning authority will need to be satisfied that these issues can and will be adequately addressed by taking advice from the appropriate regulator.

5. Licensing of Oil and Gas Exploration and Development

5.1 The Petroleum Act 1998 vests all rights and ownership of the petroleum resources (oil and gas) of Great Britain and the United Kingdom territorial waters in the Crown. The Secretary of State for Trade and Industry (DTI) (or successor) grants licences to persons that confer exclusive rights to ‘search and bore for and get’ these resources. The Department for Energy and Climate Change (successor to DTI) has a regular timetable of licencing rounds, with generally one onshore round per year. Licences are awarded to those bids promising to optimise the exploitation of the UK’s petroleum resources. This function has now passed to the OGA.

- 5.2 The main objectives of the licencing regime are to secure the comprehensive exploration and appraisal of UK oil and gas resources and the economic development of discovered reserves. The rights granted by landward licences do not include any rights of access, and the onus is upon the licensee to obtain all the relevant authorisations and planning permissions from the respective authorities and landowners.
- 5.3 As a result of the long history of legislation, several types of onshore licence existed. To simplify things, the DTI in 1996 commenced the issue of Petroleum Exploration and Development (PEDL) Licences at the 8th Licensing Round. These carry a three-term lifetime: a six-year Initial Term allows completion of an agreed Work Programme, which is a pre-condition of entry into the five-year Second Term. Successful completion and approval of a development plan is a pre-condition of entry to the Third Term for production, which is granted for a period of 20 years, although the Secretary of State has the discretion to extend this period if production is continuing.
- 5.4 Following the announcement of a new round of licensing offers, applications are made for a PEDL over unlicensed areas (blocks) which correspond to the 10 km by 10 km Ordnance Survey grid. Many licences cover more than one block. Licensees are entitled to surrender a Licence, or part of the acreage covered by it, at any time after the Initial Term and the Work Programme have been completed, with a minimum relinquishment required at the end of the Initial Term. Details of the existing licence areas and those to be conferred under the 14th Onshore Oil and gas Licensing Round can be obtained via the following link: <https://www.gov.uk/government/news/new-onshore-oil-and-gas-blocks-to-be-offered>.

6. Exploration, Assessment, Working and Reclamation

- 6.1 The production of oil and gas is subject to the same planning controls which are applicable to any other mineral development. The National Planning Practice Guidance, March 2014 (as updated), provides a comprehensive summary of the latest planning procedures relating to the winning and working of oil and gas from both

conventional and unconventional sources and the inter-relationship of the planning regime with other regulatory systems which have a role in the overall determination of such proposals (see Regulatory System above).

6.2 The three phases of all hydrocarbon extraction operations are exploration, appraisal and production. Planning permission is required for each phase, although some initial seismic work may have deemed planning consent under the relevant provisions of the Town and Country Planning (General Permitted Development) (England) Order 2015.

6.3 **Exploration**

The exploratory phase seeks to acquire geological data to establish whether hydrocarbons are present. The main method of determining whether an area has potential traps for petroleum is seismic exploration. Seismic sections provide images of the sub surface. Once detected, a potential trap can be mapped in detail using 3-D seismic data to define its shape and thickness of petroleum-bearing parts of the reservoir. Porosity and permeability of the reservoir rock determined by direct measurements of exploration-well samples then allow the volume of oil and gas that can be recovered to be estimated.

Geological data can also be obtained by exploratory drilling. For onshore situations, exploratory drilling is a short-term, but intensive activity. Typically, site construction drilling and site clearance (if no further development) will take between 12 to 25 weeks. Oil drilling rigs are generally capable of drilling through several thousand metres of rock. They require a power source to rotate the drill and drive the pumps needed to circulate drilling mud (slurry) through the drill bit and well casing to cool and remove the rock cuttings while a well is drilled.

6.4 **Appraisal**

The appraisal phase takes place following exploration when the existence of oil or gas has been proved, but the operator needs further information about the extent of the deposit or its production characteristics to establish whether it can be economically exploited.

This phase can take several forms, including additional seismic work, longer-term flow tests, or the drilling of further wells. This may involve additional drilling at another site away from the exploration site or additional wells at the original exploration site.

6.5 Working (extraction)

The production phase normally involves the drilling of a number of wells. This may be wells used at the sites at the exploratory and/or appraisal stages, or from a new site. Associated equipment such as pipelines, processing facilities and temporary storage tanks are also likely to be required.

Primary recovery of oil occurs in two stages; 1) the oil flows to the surface through natural reservoir pressure and 2) following initial flow and after the natural pressure is depleted, oil is pumped to the surface using, often using the familiar beam pumping units, commonly referred to as 'nodding donkeys'. Primary recovery methods produce up to 30% of the oil present but normally this method retrieves only 10% of the oil.

Secondary recovery refers to simple water flood to displace and drive out remaining oil, or reservoir pressure maintenance through re-injection of natural gas often produced at the same time. Water or gas is injected as a continuous force to the reservoir formation to maintain reservoir pressures. Many oilfields now routinely inject sour gas (containing a proportion of H₂S) back into the reservoir to enhance oil recovery. A growing option is the injection of gases such as nitrogen and CO₂. These dissolve in the oil, lowering the viscosity and increasing mobility. These techniques can boost oil recovery to about 20%.

A third stage (Tertiary) of enhanced oil recovery may be carried out, potentially increasing the proportion extracted to 30 to 60%. This is a more expensive and utilises less conventional techniques, including thermal recovery (steam injection), chemical injection to increase the effectiveness of water flood or the use of detergents.

Gas is also obtained by drilling into the host rock. This is accompanied by a variety of techniques to help release the gas from the rock and to create the pressure required to drive the gas up the drill hole to the surface. One method is to re-inject dried gas free of condensate to maintain underground pressure and allow re-evaporation and extraction of more gas. Another method is to send electric charges down the well, which affect the rock around it. After the charges are set off, a highly pressurised liquid fracking solution is sent down the well which breaks up the rocks, releasing the gas.

6.6 Reclamation

When all the reserves have been extracted the equipment has to be removed and the site has to be restored to an appropriate condition and a beneficial use. The responsibility for restoration and subsequent aftercare rests with the operator and is normally a requirement of the relevant planning permission or as stipulated in a legal agreement such as a Section 106 Agreement.

The form of restoration is determined on a site-by-site basis where the original conditions and uses will be important factors. Typical restoration forms include, the creation of new habitats and biodiversity, uses for agriculture or forestry or recreational activities.

6.7 Processing

Crude oil (see terminology below) is essentially a mixture of hydrocarbons with varying molecular weights and differing from one another in structure and properties. These various forms are separated into groups, or fractions by a process of distillation called oil refining. The oil is first heated to a vapour, and then passed upwards through a tower containing trays at various levels. The vapours are very hot at the bottom, but become cooler as they rise, so that different fractions condense in the trays at different heights. The lighter the fraction the higher it condenses. On average, crude oil fractions, beginning with the lightest, are: dissolved gases, petroleum ether, gasoline, kerosene, gas oil, lubricating oils, fuel oils and asphalt.

Further breaking down of the larger heavier molecules of the heavier fractions can be achieved in a process called 'cracking', whereby these fractions are subjected to higher temperatures and pressure or a chemical catalyst. This enables the creation of high octane blending components from low octane naphtha's (e.g. paraffins and olefins).

At the end of 2008 nine major and three minor refineries were in operation in the UK with a capacity of approximately 91 million tonnes per year (682.5 million barrels), which was somewhat higher than the country's consumption. The refineries occupy large sites strategically distributed around the coast at sites where they can receive large oil tanker ships. The network of storage facilities is more urban based, closer to the product users.

Gas extracted from the ground normally contains some impurities which have to be removed to ensure a consistent product in a usable condition. Impurities include water and water vapour and carbon dioxide which affect the calorific value of the gas. Some natural gases (sour gas) contain hydrogen sulphide. The gas has to be processed to remove these impurities. An initial stage of processing is undertaken at the well head to remove free liquid water and gas condensate. The gas is then normally transported via a pipeline to a larger, industrial scale processing plant to remove any further impurities.

7. Economic, Social and Environmental Issues

7.1 In accordance with the advice in the National Planning Policy Framework and the National Planning Practice Guidance, the new Minerals Local Plan will address economic, social and environmental issues. All three dimensions of sustainable development will be reflected in the new Plan and, where relevant, will be taken into account in the determination of development proposals. This section concentrates on the principal environmental issues of hydrocarbon extraction that should be addressed by mineral planning authorities. In addition, it provides a summary of the main issues to be addressed by other regulators.

7.2 Potential Impacts of Oil and Gas Developments

Oil and gas developments are subject to regulatory controls in addition to those of the planning system. Some of the potential environmental impacts fall to the other regulatory bodies to administer and the planning system can only address those issues which are within the scope of planning legislation. The NPPG advises that the principal issues (potential impacts) that mineral planning authorities can and should address, bearing in mind that not all issues will be relevant at every site, to the same degree, are those which have been identified in the Local List (Local list of information requirements required to support planning applications). The issues identified in the Local List of Information Requirements operative in Derbyshire and Derby address the following topics:

- Noise associated with the operation.
- Dust.
- Air quality, including odour emissions.
- Lighting.
- Visual intrusion into the local setting and the wider landscape caused by the placement of any building or structure within the application site area.
- Landscape character.
- Archaeological and heritage features.
- Traffic.
- Water and water resources, including foul and surface water drainage.
- Risk of contamination to land.
- Soil resources.
- The impact on the best and most versatile agricultural land.
- Flood risk.
- Land stability/subsidence.
- Internationally, nationally or locally designated wildlife sites, protected habitats and species, and ecological networks.
- Nationally protected geological and geomorphological sites and features.
- Site restoration and aftercare.

Generally, the site area required to facilitate the extraction of onshore oil and gas is significantly different from other forms of mineral extraction. In most cases the site area required to accommodate the drilling equipment and the well-head, together with the limited level of ancillary facilities, is very small compared to developments for the extraction of other minerals such as limestone or sand and gravel. This may affect the scale and nature of impacts created by the respective developments. Information compiled by the British Geological Survey indicates that the oil and gas developments in Derbyshire during the first part of the 20th century were small scale with erratic production records and, in some cases, short term operations but there are no records of the impacts of these developments.

Irrespective of the duration of the extraction period, the drilling activities are normally a continuous operation, where drilling occurs 24 hours per day for the duration of that activity. This has the potential to generate unacceptable levels of noise, particularly at night time. Additional noise could be generated by other ancillary on-site activities and also off-site from lorry movements. Due to the small sites areas involved, the level of ground disturbance is modest compared to other mineral extraction operations and this should reduce the potential for dust emissions, although dust emissions could be an issue for some specific operations.

The visual impact of developments is an important consideration. The drilling equipment and well-head structures are normally several metres in height and these could be visually intrusive in sensitive or exposed locations. The choice of location for the surface operation will be influenced by the need to maximise the volume of oil and gas that can be extracted, taking account of the geological conditions between the surface and the resource, but where there is some flexibility, the final choice of site could be selected to minimise any visual intrusion. This flexibility could also be used to minimise any adverse impact on landscape, ecological or archaeological features in the area.

The NPPF advises that mineral extraction development proposals should be formulated to avoid or minimise any adverse impact on areas of high quality agricultural land, areas at risk of flooding and any important features of ecological value. In some cases it may not be possible to completely avoid all biodiversity interests, and in cases where the benefits of the development outweigh such adverse impacts, the replacement of such features should be an integral part of the restoration plans.

The NPPG indicates that other potential adverse impacts which are particularly associated with oil and gas developments are those concerning pollution risks. Pollution risks include the spillage of oil at the surface, seepage pollution from below ground to the surface and the disposal of drilling mud and other drilling residues which could be contaminated. An additional issue is the potential need to dispose (probably flare) unwanted gas. The management of these issues are mainly the responsibility of other regulators but they are matters of relevance to the planning process.

7.3 Issues to be Addressed by Other Regulators

The National Planning Practice Guidance identifies those issues which are the responsibility of other regulatory regimes and states that mineral planning authorities should assume that these regimes will operate effectively. It acknowledges that some of these issues may be relevant to minerals planning authorities in specific circumstances. For example, it refers to the Environment Agency having responsibility for ensuring that risk to groundwater is appropriately identified and mitigated but acknowledges that, where an Environmental Statement is required, mineral planning authorities can and do have a role to play in preventing pollution of the water environment from hydrocarbon extraction, principally through controlling the methods of site construction and operation, robustness of storage facilities, and in tackling surface water drainage issues.

It states that whilst some of these issues may be put before minerals planning authorities, they should not need to carry out their own assessment and can rely on

the assessment of other regulatory bodies. However, before granting planning permission they will need to be satisfied that these issues can or will be adequately addressed by taking the advice from the relevant regulatory body. The following are some of the major issues which are the responsibility of other regulators:

- Mitigation of seismic risks – this falls to the Department of Energy and Climate Change and is administered through the licence consent regime (now OGA).
- Well design and construction – this falls to the Health and Safety Executive (or any successor body).
- Well integrity during operation - again HSE.
- Operation of surface equipment on the well pad – also HSE.
- Mining waste – this falls to the Environment Agency through the environmental permit regime.
- Flaring or venting – this falls to the Department of Energy and Climate Change (now OGA).
- Well decommissioning/abandonment – falls to the HSE.

8. Production, Consumption and Reserves

8.1 Global

In 2012, global production of oil was approximately 85.5 million barrels of oil per day, equivalent to some 4 billion tonnes over the course of the year. Proved reserves of oil stood at some 1669 billion barrels; 53 years of current production.

In 2012, global production of gas was approximately 3.36 trillion cubic metres (3.0 billion tonnes of oil equivalent). Proved reserves of gas stand at some 187.3 trillion cubic metres; about 56 years of current production. These figures were obtained from the BP Statistical Review 2013.

8.2 National

Prior to the first onshore oil being discovered at Hardstoft in Derbyshire in 1919, Britain had an important oil shale industry in the Midland Valley of Scotland, which was established in 1851 and continued until 1962. Peak production was during the

First World War. The systematic search for onshore oil began in 1918, following concerns about supplies from overseas due to the disruption experienced during the war. Modest oil fields were discovered in a number of regions, particularly those in the East Midlands.

This situation changed in the mid-1960s when significant reserves of oil and gas were discovered offshore, most notably in the North Sea. Thereafter the production of oil, gas liquids and liquid products increased markedly over the next few decades to a peak of 137 million tonnes (1027.5 million barrels) in 1999, of which crude oil production was 936 million barrels. Production has since declined to 44.6 million tonnes in 2012.

Most UK oil and gas activity is concentrated offshore in the UK Continental Shelf where production has been in decline in recent years. Figures obtained from Oil and Gas UK Activity Survey 2014, indicate that production declined by 31% between 2010 and 2012, although the rate of decline itself fell in 2013 when the area produced an average of 1.43 million barrels of oil equivalent per day (boepd). Of this, 0.86 mboepd was oil/liquids and 0.57 mboepd was gas. The survey indicates that exploration has also slumped in recent years. Proven reserves have decreased significantly from 7.1 billion boe in 2013 to 6.6 billion boe in 2014.

One of the most significant areas for onshore production is Dorset where initial searches were in the 1930s and the first commercial discovery was at Kimmeridge in 1959. The discovery of a significant oilfield at Wytch Farm in 1973 intensified the search for further oil throughout southern England. The extent of reserves discovered in the Wytch Farm area (including those under Poole Bay) led to it becoming the most productive onshore field in Europe, reaching output levels of 110,000 barrels per day, although this has now fallen to 10 – 20,000 barrels per day (Bournemouth, Dorset and Poole Minerals Core Strategy). Other major commercial onshore oilfields are found in an area between central Nottinghamshire and north-west Lincolnshire.

8.3 **Derbyshire**

Derbyshire is of historical importance as a source of onshore oil, and to a lesser extent, gas. It was one of the first areas in Britain to be explored for oil in an attempt to shore up the nations supplies during the First World War. Oil and gas have been exploited in Derbyshire at Heath and Calow (gas), and Hardstoft, near Pilsley (oil). Recent developments have been intermittent and small-scale. The scale of resources remaining underground in Derbyshire are also very limited in national and global terms, but the need to maximise the development of indigenous sources of energy and the move towards carbon reduction means that future development proposals are likely and remain an issue for the new Minerals Local Plan to address.

9. Other Issues

9.1 Need for Oil and Gas

The UK economy is highly dependent on oil and gas as primary sources of energy. They are also of great importance to our everyday lives as the major sources of energy we use in our homes, the products we use and how we move about.

Whilst the contribution from renewable sources is increasing, most of our energy needs are still met by fossil fuels. Natural gas is used to generate electricity. In 2010 the proportion of overall electricity generated in the UK with gas as the fuel was 40%, although this fell to only 23% by 2012 due to the sudden increase in the price (UK Minerals Forum, February 2014). Products derived from petroleum continue to be used to satisfy the requirements of modern society. Petrol, diesel and kerosene obtained from oil are essential fuels for transport and both oil and gas used for domestic heating. Many everyday products are made from the chemical processing of oil and gas, many of which may not be immediately obvious.

The discovery of oil and gas in the North Sea, combined with the supply of indigenous coal, enabled the UK to provide for its own energy needs. The supply of oil and gas from the offshore resources peaked in the late 90s but has been in steady decline since 2000. After 30 years of self-sufficiency, including a period when the UK was a net exporter of oil and gas, the country became a net importer of gas in 2004. Most of our

energy requirements are increasingly reliant on imported supplies. Gas and oil (as well as coal) are now world-wide commodities and prices can fluctuate significantly and very quickly which has implications for our economic competitiveness.

9.2 **Storage Capacity**

Whereas crude oil has to be processed before it can be used for energy production and in manufacturing, which has led to the development of a substantial storage infrastructure system, the position with gas is very different. Extracted gas requires comparatively little processing and treatment prior to use and has been supplied in a more direct manner from the offshore extraction facilities. As a result the volume of gas stored onshore is very limited, equating to about 15 days supply only. This makes the industry particularly vulnerable to fluctuations in the scale and price of imported supplies.

9.3 **Alternatives to Oil and Gas**

Part of our current energy requirements are met from alternatives to oil and gas and the contribution from these sources is likely to become an increasingly important issue in the overall debate about our future energy policy. Other fossil and non-fossil fuel sources of electricity generation include coal, nuclear power and renewable energy sources such as hydroelectricity and wind power. The long-term availability of coal, the ability to increase our supplies from renewable sources and the respective benefits and environmental impacts of all these forms of energy production will be elements of that debate.

Natural gas is a favoured fuel for electricity production because it has a lower sulphur content compared to coal and produces lower carbon dioxide emissions per unit of electricity produced. This balance may change if Carbon Capture and Storage (CCS) technologies are perfected and prove to be commercially viable options for modifying existing coal fired power stations and the construction and use of new ones. New technologies and ways of generating electricity from renewable sources are being advanced but as yet these facilities do not have the capacity to meet our energy demands. Oil and gas are finite resources but as a result of the complexion of the

current energy infrastructure and the long lead-in time for replacements, it is inevitable that they will continue to form a major part of our energy supplies for the foreseeable future. The security and price of these resources are therefore very important aspects in the formulation of the national energy policy.

Alternative fossil fuels, sometimes known as unconventional hydrocarbons (see terminology section above), may present a viable, if only partial alternative to conventional fuels. Information concerning these fuels is presented in another Support Paper. In summary the alternatives fall into three distinct types. The first is methane from coals, including gas recovered from active and abandoned mines, as well as methane recovered from undisturbed coal seams (known as coal bed methane). The second is shale gas, which is a natural gas recovered from mudrocks and shales. The third source of gas involves combustion of underground coal seams in situ to produce synthetic gas known as 'syngas'. This process is commonly known as underground coal gasification. Information about the scale of these resources and how much will prove to be commercially recoverable is increasing but remains limited at present.

9.4 Transportation

Oil is generally pumped to the surface for short-term storage prior to it being transported via lorry, rail or possibly by pipeline. In some places oil produced at small satellite fields is piped or taken by road tanker to gathering stations for onwards transport to the refineries. Gas is more readily usable in its natural state and presents fewer transport issues. It may be used directly on site to generate electricity for the National Grid or piped to another generating station.

The use of rail or pipelines will reduce road traffic but there may be other environmental impacts, particularly where it involves the construction of a new pipeline. The economic viability of these alternatives will also be an important issue.

9.5 Underground Gas Storage

Set against rapidly depleting UK gas reserves, it is predicted that UK gas consumption will rise, resulting in an increasing import dependency and raising issues over security of supply. Depleted oil and gas fields can be used to store natural gas (which have a proven capability to retain hydrocarbons for millions of years) providing safe, strategic long-term storage capacity. However, UGS is only possible in certain geological strata and these are present in only a limited number of locations onshore in the UK. There is no known capacity in Derbyshire.

Glossary of Hydrocarbon Related Terms

Hydrocarbon – in organic chemistry a hydrocarbon is an organic compound of hydrogen and carbon. The majority of hydrocarbons found on earth naturally occur in crude oil, where decomposed organic matter provides an abundance of carbon and hydrogen which, when bonded can catenate (linkage of atoms of the same element into longer chains) to form seemingly limitless chains. The number of carbon atoms in a hydrocarbon compound determines its physical properties. For example, simple compounds such as methane have boiling temperatures below 0 degrees Centigrade and are therefore gases under ambient conditions. Larger, more complex hydrocarbon compounds, are liquids under ambient conditions, whilst even larger compounds with a high molecular weight can form waxy solids.

Conventional Hydrocarbons - are oil and gas where the reservoir is sandstone and limestone.

Unconventional Hydrocarbons - refers to oil and gas which comes from sources such as shale or coal seams which act as the reservoir.

Crude Oil - is the term for unprocessed oil as it comes out of the ground. Crude oil varies in viscosity, from a water level of consistency to almost a solid. Typically, crude oil consists of 84% carbon and 14% hydrogen.

Total Resources – the estimated total volume of oil and gas physically contained in the rock. One measure of total resources used commonly, including by the British Geological Survey, is the Gas in Place (GIP) which is an estimate of the total amount of gas that is trapped within shale rock.

Reserves – the amount of resources that are deemed to be technically and commercially recoverable.

Technically Recoverable Resource – the estimated volume of oil or gas that it possible to extract from the total resource if not constrained by economics (and therefore larger than the reserves estimate).

Petroleum – literally translates from Greek origins as ‘rock oil’. The name petroleum covers both naturally occurring unprocessed crude oil and petroleum based products that are made up from refined crude oil. In base form it is a naturally occurring, yellow-to-black liquid found in geological formations beneath the earth’s surface. After water, it is the second most abundant liquid on earth. Petroleum consists of hydrocarbons of various molecular weights and other liquid organic compounds. Petroleum is a fossil fuel and is formed when large quantities of dead organisms, usually zooplankton and algae, are buried beneath sedimentary rocks and subjected to intense heat and pressure.

Fossil Fuels – are formed by natural processes such as anaerobic decomposition of buried dead organisms. The age of fossil fuels is typically millions of years, and sometimes exceeds 650 million years. Fossil fuels contain high percentages of carbon and include coal and natural gas.

Coalification – the formation of coal from a variety of plant materials via biochemical and geochemical processes.

Natural Gas - is a form of fossil fuel and is formed when layers of buried plants and animals are exposed to intense heat and pressure over thousands of years. The energy that plants originally obtained from the sun is stored in the form of chemical bonds in natural gas. Most natural gas was formed by one of two mechanisms: biogenic and thermogenic.

Biogenic Gas – is gas created by methanogenic organisms in marshes, bogs and shallow sediments.

Thermogenic Gas - is also created from buried organic material but deeper in the earth at greater pressure and temperature. Natural gas is found in deep underground rock

formations or associated with other hydrocarbon reservoirs in coal beds and as methane clathrates (chemical substance consisting of a lattice that traps or contains molecules).

Barrel of Oil Equivalent (BOE) – a term used to summarise the amount of energy that is equivalent to the amount of energy found in a barrel of crude oil. There are 42 gallons (USA gallons) in one barrel of oil, which will contain approximately 5.8 million British Thermal Units (MBtus) or 1,700 kilowatt hours (kWh). The term is used frequently when exploration and production companies are reporting the amount of reserves they may have and allows an assessment of the total amount of energy that a firm has access to, without breaking it down into barrels of crude oil, or the cubic feet of natural gas.

Porosity – or void fraction is the measure of the void spaces in a material, and is a fraction of the volume of voids over the total volume, between 0 and 1 or as a percentage between 0 and 100. The porosity of coal bed reservoirs is usually very small, ranging from 0.1 to 10%.

Adsorption Capacity – the adsorption capacity of coal is defined as the volume of gas adsorbed per unit of coal, usually expressed in SCF (standard cubic feet, the volume at standard pressure and temperature conditions) gas/ton of coal.

Fracture Permeability – acts as the major channel for gas to flow. The higher the permeability, the higher the gas production.

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