Kimmeridge Oil & Gas Limited

Objection to amendment of planning permission to drill at

Broadford Bridge, West Sussex

By

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Summary

Kimmeridge Oil & Gas Limited (hereinafter the Applicant) holds the PEDL234 licence inherited from Celtique Energie Weald Limited in 2016. The Applicant claims that it also thereby inherited permission to drill and test its Broadford Bridge-1 well, and is now seeking an extension for a further year of exploration.

This response demonstrates that the Applicant has materially breached the terms of the planning permit originally granted to Celtique Energie. Therefore the current permit should be declared void. A new planning application should be submitted to West Sussex County Council; alternatively the Applicant should surrender the licence.

The Applicant further asserts that the drilling operation is conventional in nature. Although Celtique Energie's approved target was conventional (a Triassic sandstone trap mapped below the wellsite), the Applicant's target of low permeability ('tight') Kimmeridgian shales and limestones is clearly unconventional. There is no defined trap (another criterion for defining a conventional hydrocarbon resource), and any resulting large-scale oil production would require fracking. Oil-mature Kimmeridgian shales are only found further north within the PEDL area, meaning that the current well is situated at an unsound location for the purpose.

The Applicant's claim that so-called 'mobile light oil' in the Kimmeridgian underlies a large area of the Weald, based on its flow testing results from Broadford Bridge-1, its new sidetrack Broadford Bridge-1z, and Horse Hill-1 near Gatwick, is both absurd and disingenuous. The Kimmeridgian of the Weald does indeed possess 'light tight oil' (LTO) - a fact known for 30 years or more. But the Applicant appears to have chosen highly unusual localities for its drilling, that is, within fault zones. That accounts for the local mobility of the LTO.

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1 Introduction

Kimmeridge Oil & Gas Limited (KOGL; hereinafter the Applicant) holds the PEDL234 licence inherited from Celtique Energie Weald Limited in 2016. The Applicant claims that it has also thereby inherited permission to drill and test its Broadford Bridge-1 well.

The Applicant further asserts that the drilling operation is conventional in nature.

This response demonstrates that the exploratory drilling carried out by the Applicant to date is so distant from the original planning permit granted to Celtique Energie in character, geological target and subsurface location, that it has breached the terms of the permit.

This response also highlights aspects of the technical failings of the Applicant.

2 The original exploration proposals and planning permit

Celtique Energie Weald Ltd applied to drill and explore for hydrocarbons (Application number WSCC/052/12/WC) at Wood Barn Farm, Broadford Bridge in July 2012. It identified the 'Willow Prospect', a conventional hydrocarbon trap, with the reservoir being prognosed as Sherwood Sandstone (Triassic age) at 2100-2400 m depth. It lies to the north of, and is bounded by, a fault which I call the Broadford Bridge Fault (Fig. 1). The proposed site is one of seven possibilities examined in the Alternative Sites Assessment. Because the trap is finite in extent there was a limited area within which surface sites for drilling may be searched for.

The Broadford Bridge-1 site lies over the trap (Fig. 1). Proposed drilling would have involved a slightly deviated well, such that the bottom of the well would lie some 950 m north of the surface location.

WSCC granted planning permission on 11 February 2013, as follows:

> "*... they PERMIT the following development, that is to say :-*
>
> *The siting and development of a temporary borehole, well site compound and access road including all ancillary infrastructure and equipment, on land at Wood Barn Farm, Broadford Bridge, for the* ***exploration, testing and evaluation of hydrocarbons in the willow prospect.*** *At Wood Barn Farm, Adversane Lane, Broadford Bridge, Billingshurst, West Sussex*" [my highlight].

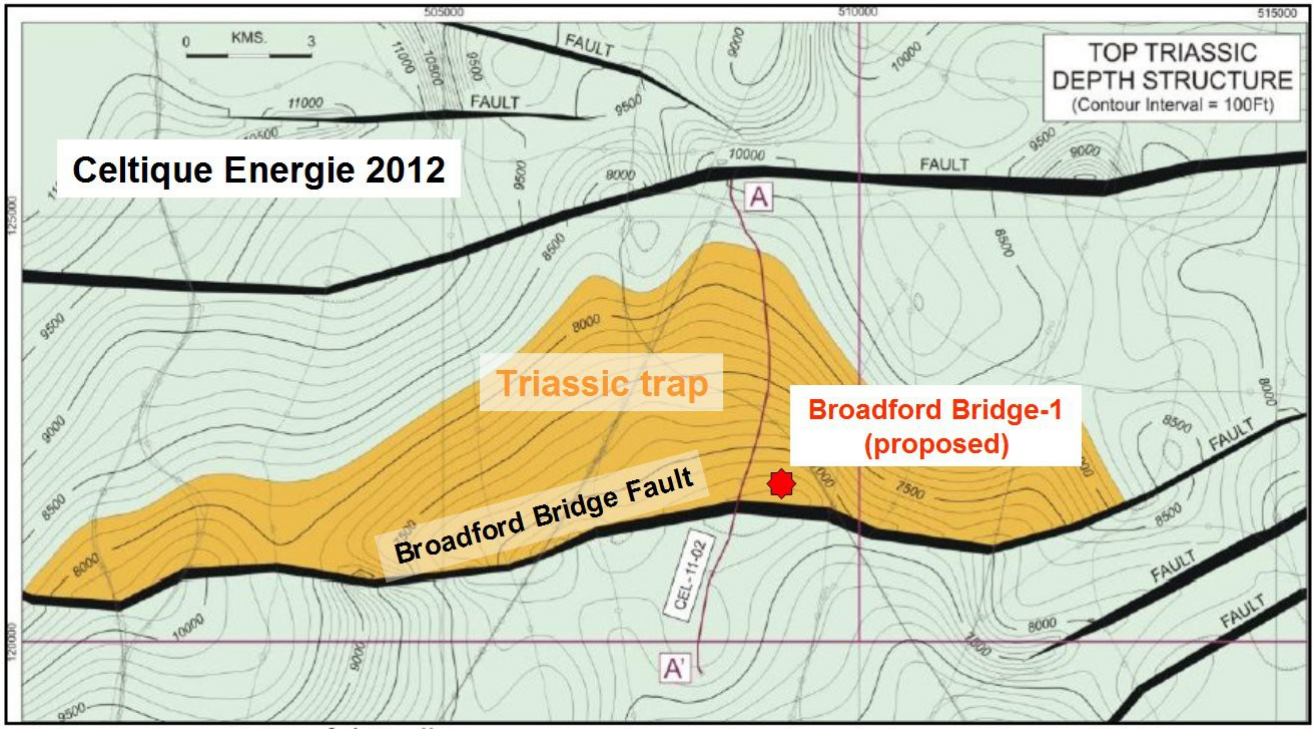

Figure 1. Celtique Energie conventional Triassic sandstone target trap at Broadford Bridge.

Celtique had only the single target in mind, as the following extracts from its Environmental Statement make clear:

> *"2.10 ...To enable the exploration of the Willow Prospect, the Applicant has identified a "bottom hole target" (i.e. the calculated depth to which the borehole will drill that will hopefully lead into the "target" oil or gas reservoir). The target is located approximately 800m to the north of the Application Site and the Applicant proposes to use deviated drilling from the Application Site to the bottom hole target.*
>
> *...*
>
> *4.36 The Applicant plans to drill to the target formations, log the well and if hydrocarbons are found, run a short duration Well Test."*

For the avoidance of doubt, there is only a single instance of the words 'Kimmeridge' or 'Kimmeridgian' occurring within Celtique's application documents, as follows:

> *"4.27 ... Then the 12¼" hole is drilled to the top of the Upper Lias at which point 9⅝" casing is then run and cemented to surface to isolate the Kimmeridge, Corallian and Oxford Clays."*

Also for the avoidance of doubt, there is no mention of micrite.

3 Drilling of Broadford Bridge-1

The Applicant acquired the PEDL from Celtique in 2016, but has now gone ahead with drilling in a completely different manner from that approved by WSCC in 2013.

Firstly, in contrast to Celtique's well-defined conventional target, the Applicant's target, the Kimmeridge Clay Formation (KCF), is found below the whole of the licence area (Figure 2). There is no geological requirement or justification for using the existing well pad at Wood Barn Farm. Therefore the Alternative Sites Assessment carried out by Celtique, which is a material part of the planning approval, is superfluous, since the KCF is now the target.

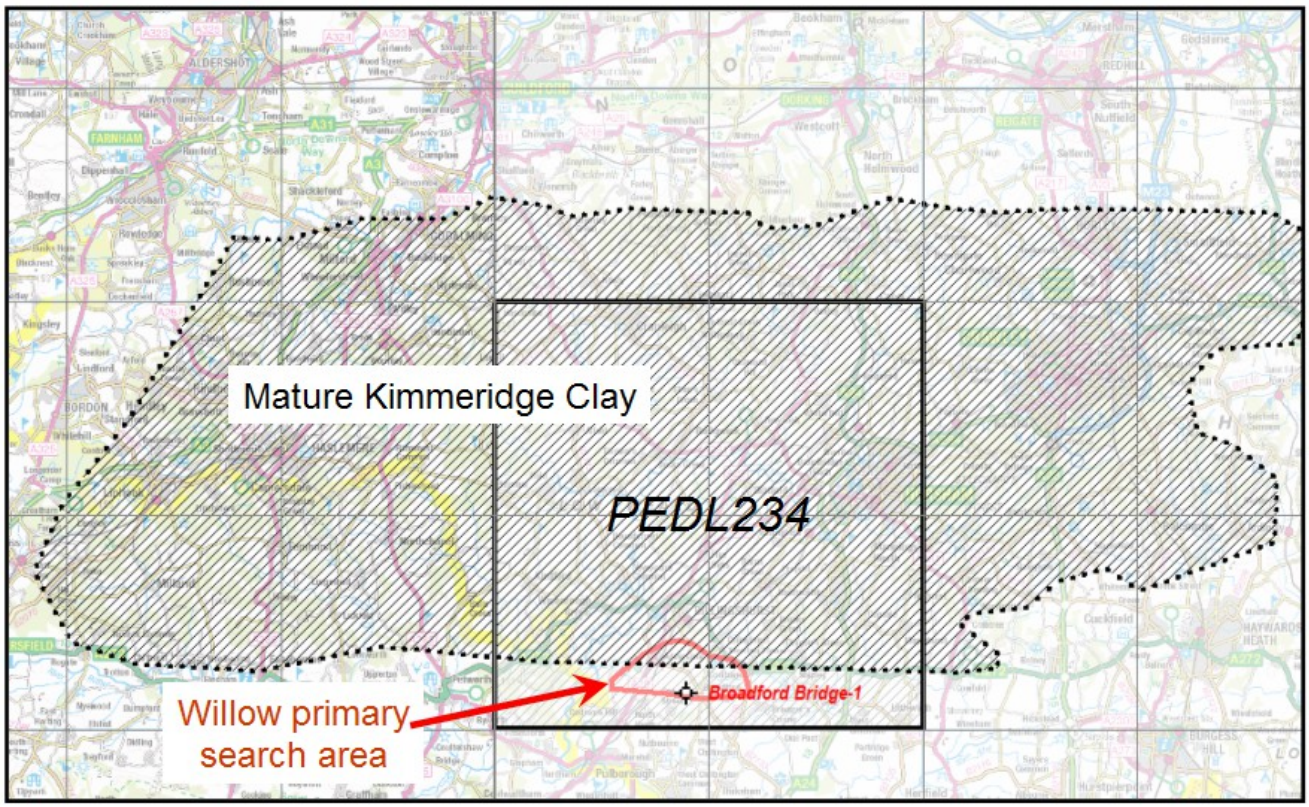

Figure 2. Celtique's Willow Prospect search area (red), compared with the search area available within PEDL234 if mature Kimmeridge Clay Formation is the target.

4 Comparison of old and new targets

In 2015 Celtique Energie submitted a geological log prognosis of its proposed drilling (*HSEC-BB-PD-01 Environmental Method Statement Drilling*). The geological column from figure 4.2 of this document is shown in the left-hand side of Figure 3. Depths in feet on the left are driller's depths, i.e. along the somewhat deviated well, and not vertical depths. A complete stratigraphic succession was expected to be encountered, except where the drill

would penetrate the Broadford Bridge Fault at around 1500 m (5000 ft) vertical depth. Some of the Corallian and Great Oolite would therefore be missing, as indicated by the horizontal black line highlighted within the red rectangle.

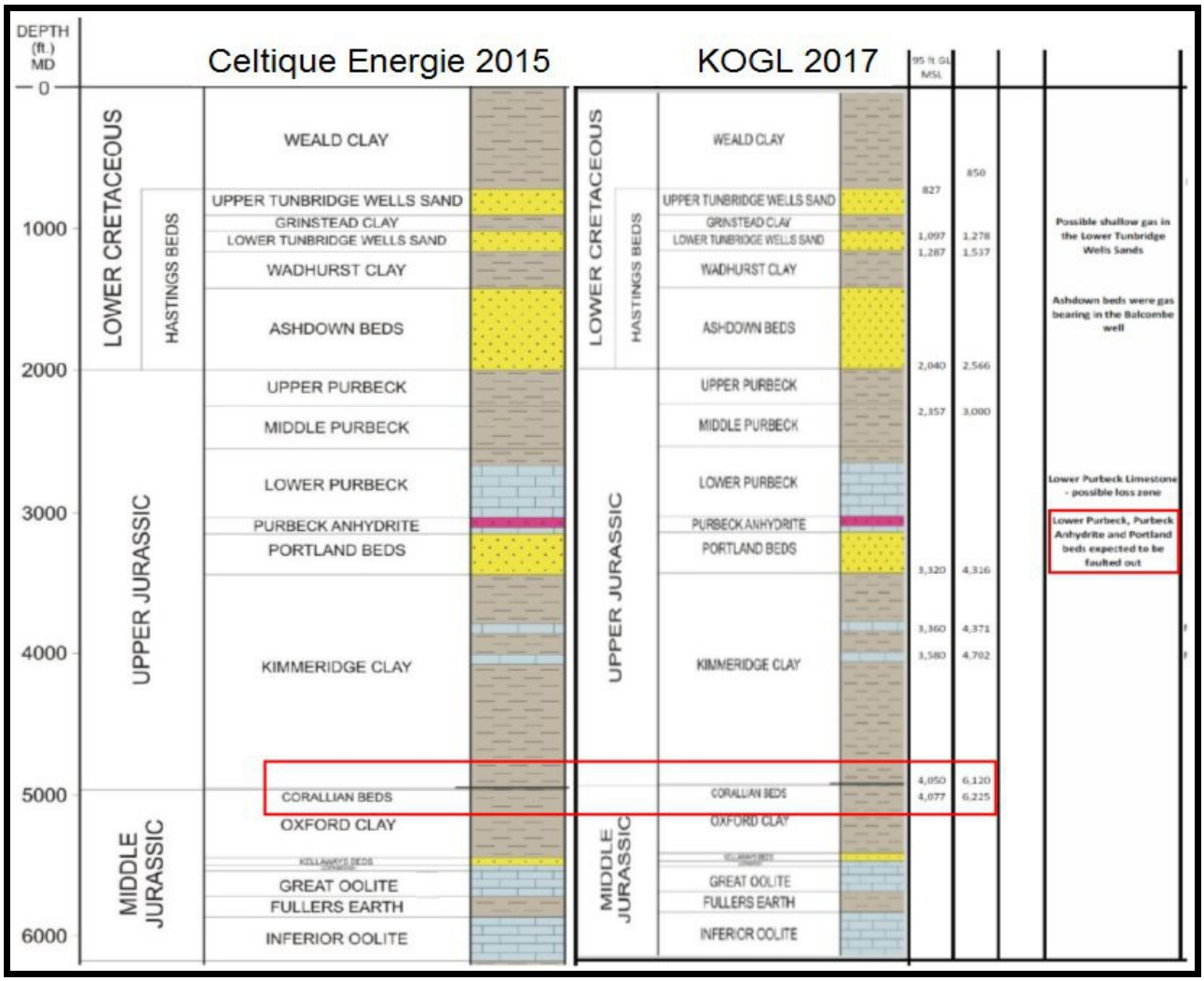

Figure 3. Comparison of the original Celtique Energie well prognosis with the Applicant's prognosis. Red boxes indicate (a) the fault zone predicted by Celtique where section would be missing, and (b) text on the right where the Applicant expected to penetrate a fault zone.

The right-hand side of Figure 3 shows that the Applicant simply re-used the same old Celtique Energie diagram (the Applicant's Waste Management Plan, 17 February 2017, fig. 2.1), but with different depth figures shown on the right. Here there are two columns; the true vertical depth, and the driller's depth measured along the hole, on the left and right, respectively. The Applicant has drilled a highly deviated hole. It also expected to penetrate a fault zone, where it states (as highlighted in the red rectangle of Figure 3) "*Lower Purbeck,*

Purbeck Anhydrite and Portland beds expected to be faulted out". These layers, shown in light blue, crimson and yellow in the middle of the geological column, should therefore have been omitted from the column. In contrast, the rock layers correctly omitted by Celtique in its column on the left (within the lower red rectangle) should properly have been included in the column on the right. The Applicant's prognosis is therefore misleading.

Figure 4 is a Celtique Energie cross-section with the Applicant's new well track projected onto the image. This geological interpretation is based upon seismic line CE-11-02, the location of which is shown in Figure 5 below. The proposed Celtique well would have penetrated nearly vertically to about 1.5 km, then pass through the Broadford Bridge Fault into the footwall side on the north. The traversing of this normal fault accounts for the missing section (along the wellbore) between the upper Corallian and the Upper Lias (Fig. 3 above). The well path would then turn nearly vertical again to attain its target of the Sherwood Sandstone (the yellow stippled layer).

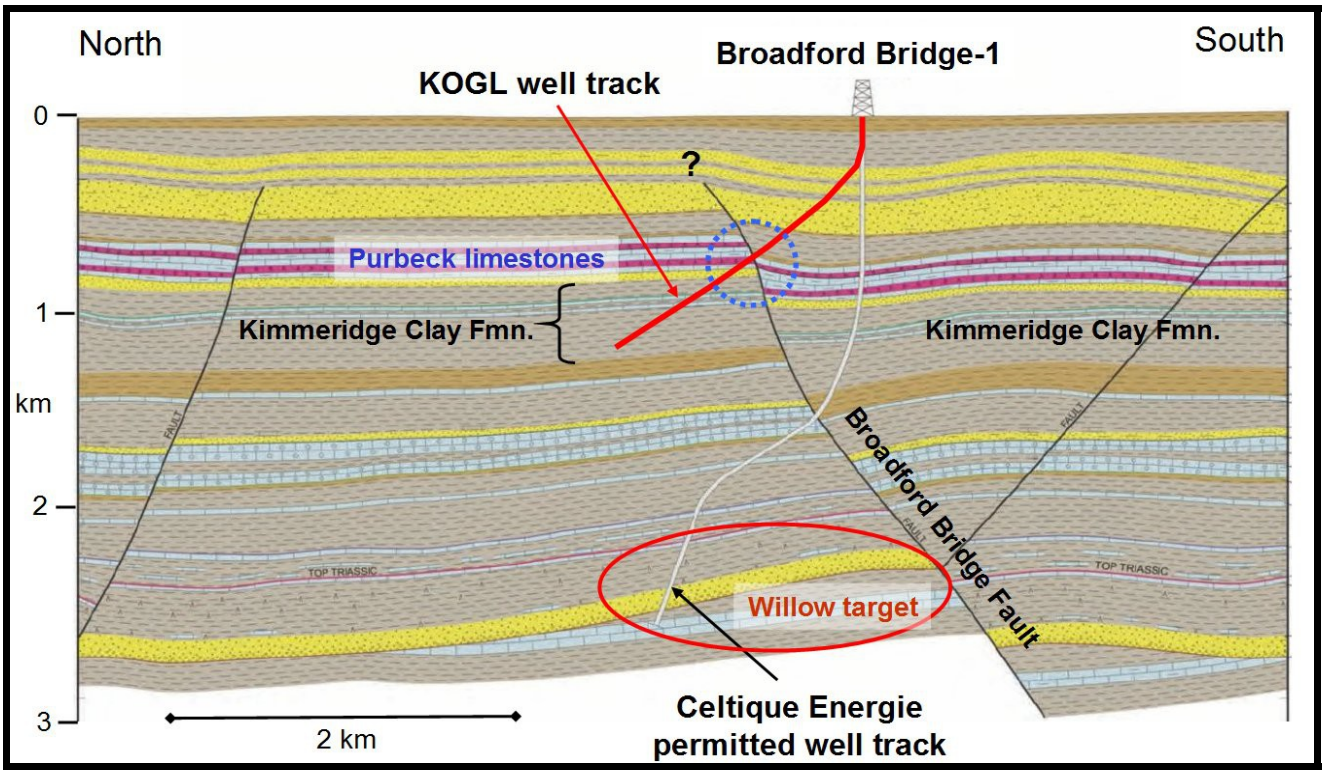

Figure 4. Celtique Energie interpretation of geology along section AA' (Fig. 1) showing original planned well track (grey) and actual projected welltrack (red) drilled by the Applicant. The Willow prospect was the permitted sandstone target (yellow layer) to be drilled by Celtique Energie. The reported washout zone in the 8½ inch open hole is located within the blue dashed circle where the hole traverses the faulted Purbeck limestones.

The Applicant's well, in contrast, deviated significantly from the vertical just below the surface, and then passed through the Broadford Bridge Fault at a much shallower depth than Celtique Energie's proposed wellbore. It then penetrated the Kimmeridge Clay Formation (KCF), with its two thin so-called limestone beds, at an oblique angle of around 44° to the vertical.

Figure 5 shows that the azimuthal direction of drilling was to the NE (red welltrack), in contrast to Celtique Energie's proposed track to the NNW (blue welltrack).

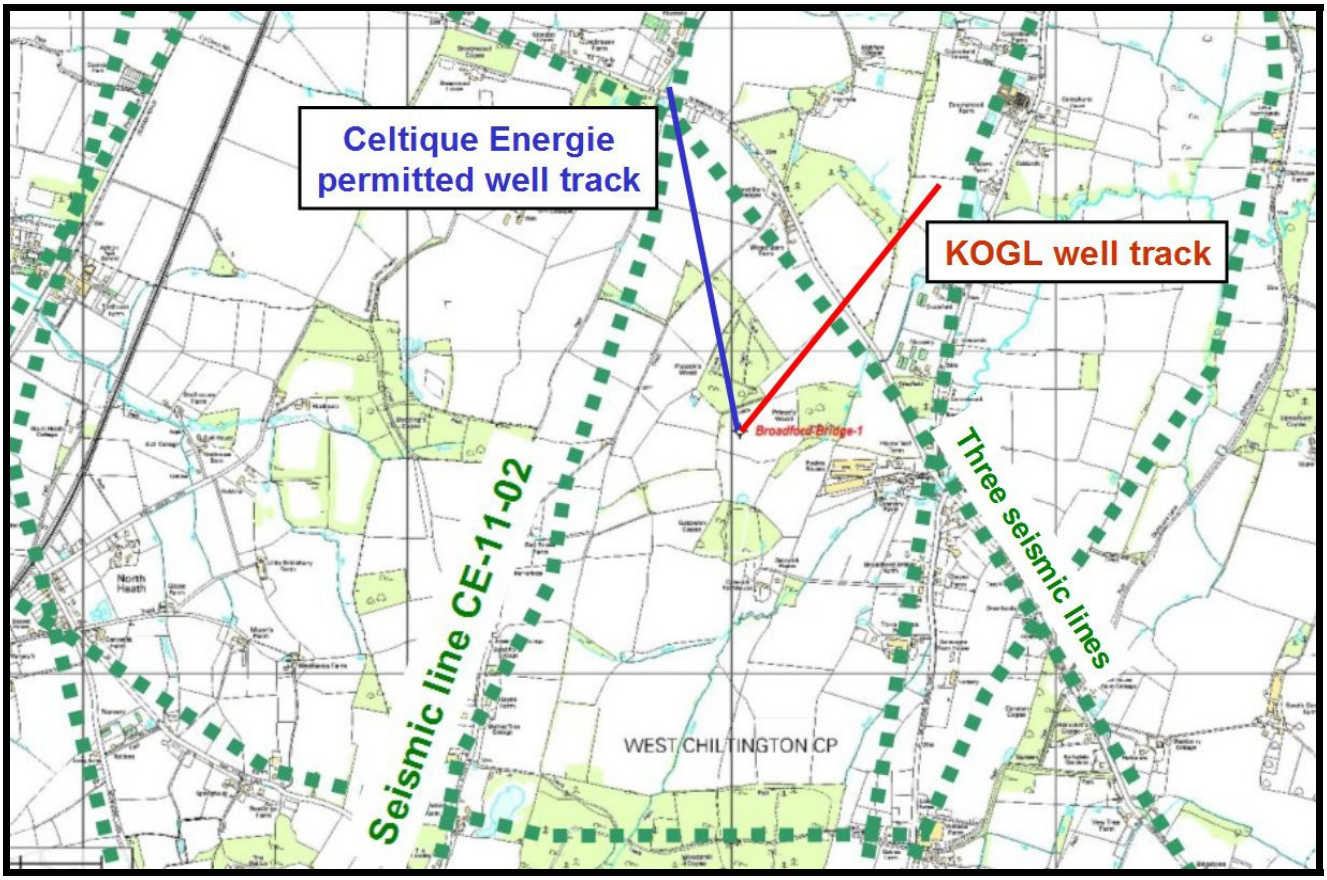

Figure 5. Generalised locations of seismic reflection data (dotted green lines) around Broadford Bridge-1. Grid is at a 1 km interval. The proposed Celtique well track is shown in blue; the well track drilled by UKOG in red. OS map base copyright acknowledged.

The new target zone that the Applicant is currently testing is the Kimmeridge Clay Formation (KCF) on the north side of the Broadford Bridge Fault (Fig. 4). In particular, it wishes to test two so-called limestone layers, commonly referred to in the hydrocarbon industry as micrites, within the shales of the KCF. These are depicted in Figure 3 by the light-blue layers. There are two additional thinner layers beneath, also within the KCF. The micrites of the KCF are very impure limestones, being composed as much of shale or mudstone as of carbonate,

and thus they could equally well be termed calcarous mudstones. There are three or four of these thin layers (of 30 m or less in thickness) throughout the KCF. Within each layer there is a varying percentage of limestone. These so-called micrites of the Weald do not feature in the BGS lexicon of recogised rock types. They can be traced eastwards on well logs from the classic Kimmeridge Bay outcrop on the Dorset coast, where the equivalent formation is seen in cliff faces as an interbedded layering of shales (including oil shale) with thin (sub-metre) bands of limestone. Both the micrites and the shale have extremely low permeability, and will require to be fracked if oil is ever to be exploited commercially from the KCF.

The Applicant has drilled through the Broadford Bridge Fault at around 800 m depth (Fig. 4), but at a location some 500 m east of the seismic line on which Figure 4 is based. The interpretation of the geology by Celtique Energie, shown in Figure 4, is based on the seismic line CE-11-02 which they acquired in 2011. The location of this line is shown in Figure 5. The Applicant's well crossed three near-coincident seismic lines some 400-500 m NE of the pad, but these lines are of very limited use since they cross the wellpath at an angle of about 80°.

It has been reported (RNS Number 6747N, UK Oil & Gas Investments PLC, 10 August 2017) that the original well developed a washout zone, where the hole diameter is larger than the 8½ inch open hole, and where drilling fluid was being lost. This zone is located within the blue dashed circle (Fig. 4) where the hole traverses the Purbeck limestones, and which are in turn faulted by the Broadford Bridge Fault. The problem was so serious that a new sidetracked well (Broadford Bridge-1z) has been drilled to bypass the washout.

5 Discussion

There is no evidence that the Applicant has made the effort to undertake a preliminary study of the local and regional geology, for example, by tying the well data from the two nearest pre-existing wells to the wellsite. This kind of work is an essential prerequisite to drilling, and is normally carried out before planning applications to drill are submitted. The Applicant appears to have simply re-badged and slightly modified (in a geologically inconsistent manner, as shown in Figure 3 above) the original drilling plans submitted by Celtique Energie. New diagrams, including a new well design with formation tops based on a proper evaluation of the geology, are required.

The Wood Barn Farm wellpad is a poor location for testing the KCF, because it lies 1.2 km south of the limit of mature Kimmeridge shale as defined by the BGS (Figure 2). The only reason for the Applicant to have continued work at Wood Barn Farm seems to be the

presence of the existing wellpad prepared by Celtique Energie. This is not a rational basis on which to pursue exploration work granted by the extension of the PEDL period, which would otherwise have expired in June 2016. A new study of suitable search areas should have been carried out.

The Applicant stated in a Stock Exchange press release (RNS no. 2127D, 5 July 2016):

> "*Broadford Bridge ("BB") PEDL234 (Company interest 100% via ownership of Kimmeridge Oil and Gas Ltd): A two-year extension of the Initial Term of the licence to June 30th 2018. The Licence contains a constructed well pad and regulatory permissions to drill the BB-1 Kimmeridge Limestone well, a look-alike Kimmeridge prospect to the Horse Hill-1 Kimmeridge Limestone oil discovery.*"

This statement appears to mislead both shareholders and the public. Permission was never granted to drill a so-called 'Kimmeridge Limestone' well. The Applicant has merely taken the previous well prognosis of Celtique Energie, intended for a completely different hydrocarbon type and target, and has pasted on a new set of depth figures, as I have shown in Figure 3. **This is a fundamental change of exploration plan, for which planning permission has not been granted.** I consider this to be both irresponsible and technically incompetent.

Alongside the Applicant's well schematic (KOGL Non-Technical Summary, document BB-PR-Q02, page 5) there is drawn a well construction schematic, and at the bottom of the diagram there is a proviso:

> "*The above casing design is subject to change following a review of the formation tops and a casing design being carried out and signed off as part of the basis of well design*"

But all the contingent work on formation tops and casing design referred to above should have been carried out before the request to the EA for a variation, submitted in March 2017. The EA was being asked to approve in advance an ill-conceived and internally inconsistent drilling plan, which may or may not be revised (if the Applicant chooses to see fit) at some future date. This is unacceptable.

Apparently there exists an Amended Waste management Plan dated 26 July 2017, which presumably replaces the original one dated 17 February 2017. But it has yet to be placed on the WSCC website for consultation, so cannot be considered as material to the consultation.

The new sidetrack 1z well is claimed to be better sited to encounter *"a potentially higher degree of natural fracturing associated with a nearby significant fault"* ((RNS Number 6747N, 10 August 2017). So the Applicant claims, on the one hand, that it has discovered "*mobile*

light oil" by drilling into fractured KCF adjacent to a "*significant fault*" at Broadford Bridge. It is similar to the drilling history at Horse Hill-1, where this vertical well flowed highly, because it also was drilled into a fault zone. But on the other hand the Applicant then interpolates the information from the two drilled fault zones to assert that this "*continuous oil deposit therefore likely underlies the entire PEDL234 licence and a significant area of the wider Weald Basin, including the Horse Hill-1 Kimmeridge oil discovery some 27 km to the north east*". Such a claim is absurd, given that the fault zones providing the exceptional flow at the two drill sites are not pervasive throughout the Weald. The surface area of such fault zones cutting any horizon within the KCF (thereby fracturing the rock and increasing the local fracture permeability) probably averages around 1% of the total area of the horizon. To make such a generalisation, as the Applicant has, based on its two unusual '1%' locations, is both disingenous and technically unsupportable. It also ignores the results from the dozens of other wells drilled in the Weald by reputable and experienced operators, such as BP, Shell, Conoco, and others. The Applicant's operations at Broadford Bridge and Horse Hill have merely served to confirm what has been well known for thirty years, that there is 'light tight oil' (LTO) in the Kimmeridgian of the Weald.

6 Conclusions

The Applicant has tried to hide behind the now-defunct plans of Celtique Energie for a conventional exploration drilling programme, when in fact its drilling is in pursuit of unconventional extraction. Given that the Kimmeridge Clay Formation, including its tight thin semi-calcareous bands, is an unconventional target, it will require fracking to exploit at full scale, even if no fracking is carried out at the test stage. The apparently good flow of oil (even though acidising is required - a form of unconventional 'stimulation' – to achieve this) is highly localised, being found only within fault zones, and the total reserves in such fault zones are probably tiny and therefore non-commercial.

The KCF exists throughout PEDL234. The Applicant has failed to demonstrate that the existing pad at Wood Barn Farm is the most suitable site for testing this formation. The Alternative Sites Assessment undertaken by Celtique Energie is inapplicable. A more suitable location, where the shale is mature for oil, would be somewhere within the northern half of PEDL234.

The Applicant submitted a technically incompetent well prognosis plan, being merely an annotated version of Celtique Energie's plan. It is also internally inconsistent, in that it does

not take into account the different geology encountered by the new wellbore.

The Applicant has drilled a highly deviated well northeastwards from the pad, with no seismic control. This is irresponsible, since it now has a poor grasp of the geology it is encountering along the wellbore. This gap in essential information probably contributed to the washout problem, necessitating the drilling of the new sidetrack. The juxtaposition of the Purbeck limestones with the Broadford Bridge Fault should have been foreseen as potentially dangerous, and is a further example of the technical incompetence of the Applicant.

The Applicant, should, if it wishes to persevere with its proposals for testing the KCF in PEDL234, first acquire additional 2D seismic data (or preferably a 3D seismic survey, as is currently being undertaken in several other PEDLs in England) and interpret them before deciding upon a suitable location for exploratory drilling. This location is unlikely to be at Wood Barn Farm.

The prior existence of the drill pad inherited from the previous licensee is no justification for using the same pad for a substantially different exploratory aim.

In conclusion:

- The transfer of the PEDL licence, the granting of an extension period, the request to the EA for a variation, the subterfuge of conventional exploration, the current request for an extension, the incomplete, technically sub-standard nature of the application, and the current washout problem requiring a new deviated well to be drilled, are all demonstrative of a hasty and speculative operation, which should never have been permitted.
- WSCC should therefore refuse the current requested amendment, AND
- In view of the material and serious breach of the permit, WSCC should immediately cancel the planning permit, which was originally awarded to Celtique Energie and is now wrongly being claimed by the Applicant to permit the current drilling and testing.
- The Applicant should either be required to submit a new planning application for exploratory drilling within PEDL234, or else surrender the licence.