

**Reference:** A303 / Stonehenge

**Project No:** 1918808

**Date:** 9th July 2019

Re: Highways England: A303 Amesbury to Berwick Down Project, Development Consent Order Application. Scheme Reference: TR010025

Responses to The Examining Authority's Second Written Questions and requests for information (ExQ2) on Tranquillity by Clive Bentley for the Stonehenge Alliance (Reference No. 2001870)

## Technical note

### LV.2 Landscape and visual

#### Question LV.2.4

To: Applicant and All Interested Parties

#### Tranquillity

The OED defines tranquillity as serenity, calmness; Chambers Dictionary as calmness, peacefulness; the GLVIA glossary as a state of calm and quietude associated with peace. Tranquillity is considered within ES Chapter 7: Landscape and Visual [APP-045], where the IAN 135/10 definition of tranquillity is adopted, as remoteness and sense of isolation [...] often determined by the presence or absence of built development and traffic. The analysis then relates largely to the perception of noise, although it touches on the perception of vehicles and settlements, and the panoramic extent of views. Figure 7.5 illustrates existing tranquillity across the study area as mapped by the CPRE.

i. **How is the CPRE analysis derived? Is it based on noise measurement or on other factors?**

See essay below for detailed description and critique of the CPRE method. There are, in fact 42 features which the CPRE method uses and each is considered along with a weighting to attempt to allow for relative importance of each. Noise and visual appearance are the two key features which are considered, but the way in which noise (or sound) is considered fails to take account of the importance of natural sounds. The method was valuable as a campaigning tool, but beyond that, is so flawed that it cannot reliably be used to assist with planning decisions. The essay in Appendix A below provides a detailed explanation of why this is so and considers, amongst other documents and studies, the Cranborne Chase and West Wiltshire Downs Area of Outstanding Natural Beauty (AONB) Office publication, "Tranquillity Mapping Ground Truthing Methodology & Interim Report".

#### Head Office

**Sharps Redmore** The White House, London Road, Copdock, Ipswich, IP8 3JH

T 01473 730073 E [contact@sharpsredmore.co.uk](mailto:contact@sharpsredmore.co.uk) W [sharpsredmore.co.uk](http://sharpsredmore.co.uk)

**Regional Locations** South England (Head Office), North England, Wales, Scotland

**Sharps Redmore Partnership Limited** Registered in England No. 2593855

**Directors** RD Sullivan BA(Hons), PhD, CEng, MIOA, MAAS, MASA; DE Barke MSc, MIOA; KJ Metcalfe BSc(Hons), MIOA

**Company Consultant** TL Redmore BEng, MSc, PhD, MIOA

ii. **Have attempts been made to map projected tranquillity with the Scheme in place?**

Yes, Clive Bentley's evidence provides such maps, although they only cover the area immediately around the henge.

Any attempt to use the CPRE method would be bound to provide an unreliable output since it does not take account of the sounds made by people, incorrectly deals with road traffic noise, has a grid size of 500 x 500m and fails to properly account for a number of other important factors which affect tranquillity.

iii. **Have attempts been made to analyse tranquillity in terms of serenity, calmness, and peace rather than the impact of noise, qualities which might be affected by the proximity to major road cuttings or junctions, whether or not accompanied by noise?**

Clive Bentley's method considers tranquillity per se. Although it uses sound level and character to do this, it has been found to provide a reliable indication of people's perceptions of tranquillity, rather than their perceptions of noise. The research behind the method compared values for the measured parameters against surveyors' subjective perceptions of tranquillity (taking all factors into consideration) and thus covers these descriptions.

iv. **Has the connection between tranquillity and the feeling of completeness of the landscape and the interconnectedness of its features been considered?**

No comment by Clive Bentley.

v. **Has the connection between tranquillity and the presence of astronomical features and light pollution in night skies, particularly important on this site, been considered? These points apply in relation to both the construction and operational phases of the Scheme.**

No comment

## **Ns.2 Noise and vibration**

### **Question Ns.2.1**

To Applicant, The Stonehenge Alliance, Wiltshire Council

## **Tranquillity**

The issue of tranquillity appears to remain in dispute in that the visitors to the WHS and particularly the Stones would appear to influence the degree of tranquillity at the Stones and in the vicinity of the Stones. As a consequence, the degree of effect from the current road is arguably reduced and the degree of benefit from its removal in respect of tranquillity in the area of the Stones may be regarded as less significant than suggested.

### **Do you consider that tranquillity will be achieved at the Stones as a consequence of the scheme?**

No. The level of sounds around the Stones is relatively high and the dominant source is the sounds generated by visitors: parties of schoolchildren, audio guides and just the general speech (at a normal level) from the sheer volume of visitors. Although the road is audible around most of the site, people do not seem to notice it (unless prompted) and this is not surprising as has been measured around the site at eleven locations at between 45 and 51 dB  $L_{Aeq}$ . The sounds of people at these same locations was between 49 and 65 dB,  $L_{Aeq}$ . (Time periods for measurements were between 5 and 10 minutes and each location was visited twice on a day which was described by the Site Operations Manager as “moderately busy”). Even ignoring the analysis of the data using the Natural Tranquillity Method, it is impossible not to conclude that the removal of the road traffic noise would have a negligible impact on tranquillity (or on noise levels) at the henge.

## Appendix A

### Essay 1 – reply to LV2.4. point i)

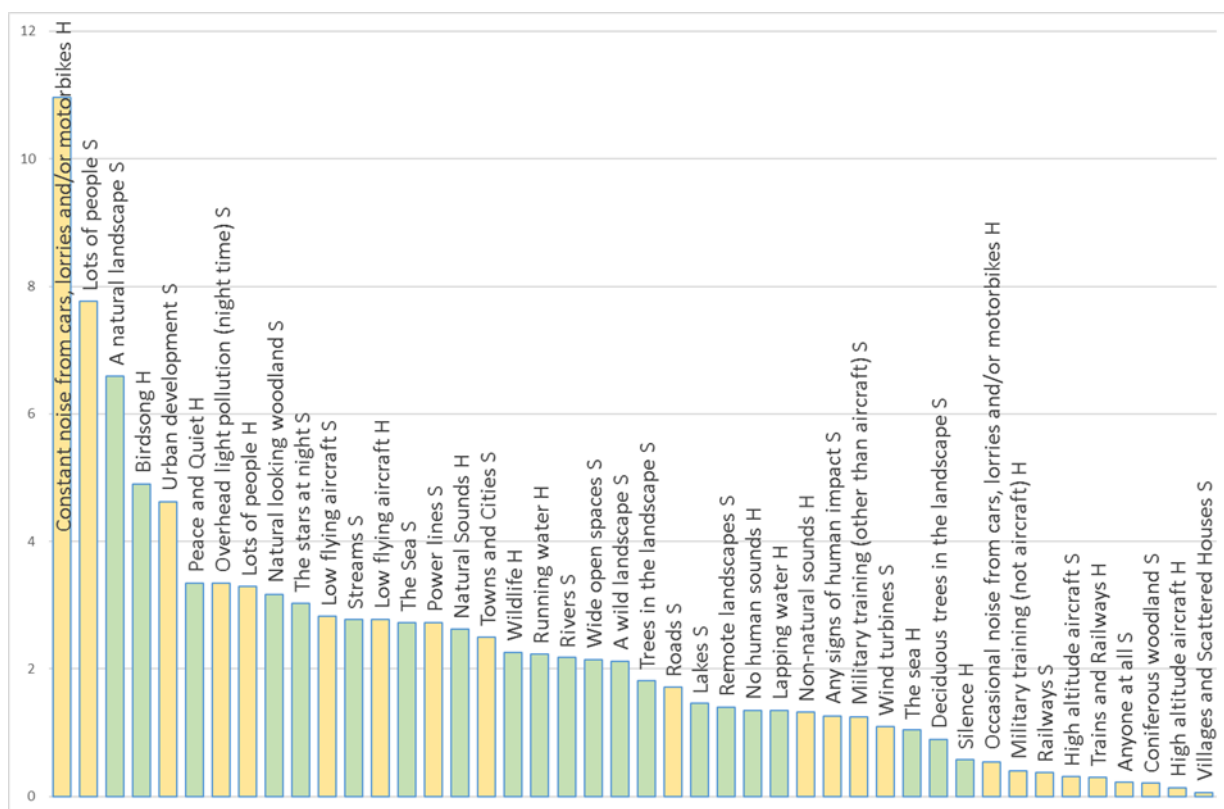
The “CPRE method” is based on research sponsored by the CPRE which led to production of a *Tranquillity Map for England* in 2006. The research was carried out by the Centre for Environmental and Spatial Analysis (CESA) and PEANuT (Participatory Evaluation and Appraisal in Newcastle upon Tyne) project at Northumbria University, in collaboration with Bluespace Environments, Durham and Newcastle Universities. This research built upon earlier research carried out in 2004 which attempted to evaluate tranquillity within the Chilterns Area of Outstanding Natural Beauty (AONB). This study was itself built on an earlier pilot study (also carried out in 2004) which began with a “Participatory Appraisal” seeking the views of people in the Northumberland National Park and West Durham Coalfield in County Durham to find out what factors visitors to these areas believed affected tranquillity.

Before 2004, the initial work which pioneered the concept of tranquillity mapping had been carried out by Simon Rendell and others in the 1990s. That work was later criticised for considering the sources of disturbance based solely on expert judgement and for failing to take into account interactions between factors, the influence of local geography and the relative values of the factors considered; in short, it was not sufficiently sophisticated. The research behind the CPRE method in 2004 sought to address these criticisms and to provide a more robust tranquillity map for England.

The work to develop the CPRE method was extensive and provided a valuable database of information about the factors which the people who were consulted described as influencing the tranquillity of a location. The end product, the *Tranquillity Map for England* (published in 2006 and updated in 2011), was an impressive achievement. When the UK Government revised its Planning Policy in 2012, it included a requirement to consider tranquillity in the planning process for the first time: this was largely due to campaigning work by the CPRE whose research and map seem to have formed the backbone of that campaign.

The mapping is produced using a Geographical Information System (GIS); a computer-based system for the integration, analysis, modelling and mapping of geographical data. It uses the Participatory Appraisal (PA) results to identify the significance of different features and then associates these features with nationally available datasets. Predictions are then made of the presence, level or amount of each feature based on information within the GIS dataset and these values are then weighted in the analysis (dependent on the PA survey results) to provide a tranquillity score for each 500 x 500 metre square grid.

The features identified and weightings given in the GIS system are shown graphically below (yellow indicates a negative effect on tranquillity, green indicates a positive effect). The weightings, which indicate the relative importance of each factor are shown on the y axis. The designation “H” refers to factors which affect “Hearing”, and “S” refers to “Seeing”.

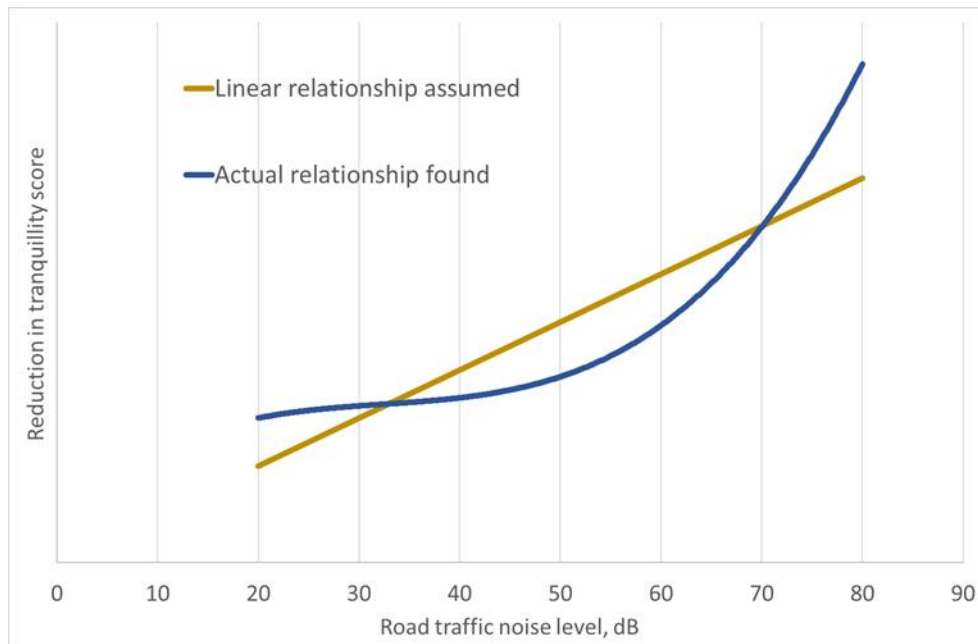


**Figure 1: Graphical representation of weightings given to features, based on CPRE research**

Much useful information can be drawn from the research which led to this method. Without doubt, the research was ground breaking and, if it had not been carried out, it is quite likely that there would be no policy requirement to protect tranquillity. Without this research, the Natural Tranquillity Method would not exist and before criticising it, it is important to recognise the extremely useful function which this innovative work has performed.

There are, however, a number of inherent problems and limitations which arise if the CPRE method is used to assess tranquillity on a local scale. Some of the more important of these are discussed below:

1. The method uses a 500 metre grid size so any area which is less than 500 x 500 metres would be given a single tranquillity value for the whole area. In fact, noise levels will normally vary significantly over such a distance and, since tranquillity is largely a function of noise, such a low resolution renders the method of little practical use for the consideration of most situations for planning or similar purposes.
2. People's response to road traffic noise is assumed by the method to be linear, and this is not a reliable assumption. The relationship between road traffic and reduction in tranquillity scores is not linear. The graph below illustrates the approximate relationship which has been found during research into the impact of road traffic noise on tranquillity (blue line) against the linear relationship assumed (orange line). This matches other research, such as that published by the World Health Organisation into the impact of noise on annoyance, although the WHO graph does not extend to levels below 45 dB.



**Graph illustrating relationships between road traffic noise impact and reduction tranquillity scores using different methods (the curve is indicative only)**

3. The only non-natural sounds which are considered in the CPRE method are those from transportation sources. A noisy site would not be considered to affect tranquillity if it was screened visually (by a natural tree belt, for example) according to this method. In fact, such a noisy site could potentially have a significant detrimental effect on tranquillity.
4. The method incorrectly assumes that birdsong, wildlife and other natural sounds (excluding the sounds of water and the sea) would only be present where noise from transportation sources is predicted to be low, and it considers low noise areas to be areas which experience a noise level from these sources of less than 25 dB. The method assumes that such low noise areas are places where:

“... there is an opportunity to hear non-human sounds that would otherwise be drowned out.”<sup>1</sup>

Whilst it is true that one may be able to hear these natural sounds in low noise areas, natural sounds are not only present in areas with very low transportation noise. To consider an example, it is quite possible for a country park to experience noise from birdsong and leaf rustle (due to a light breeze in the trees) at a level of 48 dB and distant road traffic to be producing 36 dB. In such circumstances, the CPRE method would predict that natural sound would be “drowned out” and the area would have relatively poor tranquillity. In reality, such a location may feel quite tranquil since the road traffic would probably not be audible and the natural sounds around would dominate.

<sup>1</sup> Jackson, S., Fuller, D., Dunsford, H., Mowbray, R., Hext, S., MacFarlane R. and Haggett, C. (2008). *Tranquillity Mapping: developing a robust methodology for planning support*, Report to the Campaign to Protect Rural England, Centre for Environmental & Spatial Analysis, Northumbria University, Bluespace environments and the University of Newcastle upon Tyne.

This may be the single biggest failing of the method since the balance between man-made and natural sounds has been found to be a crucial factor affecting how tranquil a location is likely to be perceived to be.

5. The predictions of noise levels from road traffic are unreliable. Air and ground absorption of sound is considered but no account is taken of local topography or the presence of any structures which might provide screening or reflection of sound. The calculations also assume certain flows and speeds for road traffic and these are likely to overestimate the noise levels from smaller rural roads (in some circumstances quite significantly) as it is assumed that all such roads have 1000 vehicles per day, all travelling at 60 miles per hour. In many rural areas, flows are much lower than this and speeds on smaller country roads will often not reach 60 mph. In such situations, the method will result in a considerable overestimate of the impact of road traffic noise.
6. The methods for assessing the contribution of rail and aircraft noise are unreliable. First, it is assumed that these two sources can be treated in the same way. In fact, it is generally agreed that rail noise is considerably less annoying than road traffic or aircraft noise (this is discussed in detail in Chapter 2). Second, the impact assessment for these sources assumes that all aircraft have the same noise level and are audible for two minutes when flying over and that all trains have the same noise level and take 30 seconds to pass a point. In fact, experience shows that the trains having the greatest impact on tranquillity are freight trains, which often take 75 to 90 seconds to pass a point; and that aircraft may have little impact if at high altitude but may have a significant impact at low altitude. Also, using a single value for source noise level is unreliable, since there is considerable variation between noise levels from, for example, a three-carriage suburban passenger train and a fast, inter-city train with 12 carriages. The same is true for aircraft: the differences in impact between a military jet and a propeller driven light aircraft at the same altitude, for example, is very significant.

The CPRE research states the assumption that, when modelling noise from transportation sources:

“The cut off figure for noise attenuation is 25 (dB), when noise diffusion of a given source has reached ambient noise levels, giving the maximum distance away from which the original noise cannot be heard.”<sup>2</sup>

This assumption is incorrect since, in the vast majority of locations around England, ambient noise levels are considerably above 25 dB.

7. The method assumes that the number of people present correlates directly with the intrusiveness of those people. However, the mere presence of people does not necessarily always detract from reported experiences of tranquillity. For example, a group of students quietly studying in an urban park would probably have little negative effect on the tranquillity of the space, whereas the same sized group of students playing football very possibly would.

Whilst it may be true that wilderness or other countryside areas are generally felt to be more tranquil when others are not present, many people who do not regularly visit or live in the countryside are accustomed to finding tranquil spaces which do have other people in them. Urban parks and gardens are the most obvious example of this. In such spaces, it is not the simple presence of other people which affects tranquillity, but their behaviour.

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<sup>2</sup> Ibid.

Surveys carried out in the development of the Natural Tranquillity Method have included observations and measurements at a number of “honey pot” sites within country parks and woodland areas around England and have found a considerable range of behaviours at similar types of site due to the different kinds of visitors who typically frequent them. Urban parks, country parks and woodlands that are full of people, including noisy family groups, are often considered “fairly tranquil” by those who visit them. The work of Liz O’Brien and others has shown that some people need to see and feel the presence of others around them, in order to feel secure, before they are able to experience tranquillity.<sup>3</sup>

The CPRE method will over emphasise the importance of the presence of others as a detractor from tranquillity in some situations.

The Participatory Appraisals which were conducted between 2004 and 2006, and established the list of factors, were virtually all carried out in areas which are highly rural. According to the researchers, this approach was,

“... based around the use of ‘participatory appraisal’ (PA), an approach to consultation focused on exploring people’s perceptions, values and beliefs and designed to allow participants to express these in their own words.”<sup>4</sup>

However, since the survey work took place almost exclusively in rural areas, the views expressed by participants may not be representative of the UK population as a whole.

The additional surveys carried out in 2006 took place at a range of rural locations, with sites being selected, as follows:

“Map based surveys were conducted to locate a range of types of sites at which large numbers of countryside users might be expected. These included visitor attractions, Areas of Outstanding Natural Beauty, Country Parks, Greenways, National Trust properties and privately owned houses and gardens, wildlife reserves and car parks and other sites linked with countryside use (for example those owned by the Forestry Commission).”<sup>5</sup>

CPRE researchers set out to canvass the views of users of the countryside. The answers given and weightings applied may therefore provide a reliable survey of the opinions of people who live in and visit the countryside. They do not necessarily reflect the views of the remainder of the population.

The reason that this may be important and may mean that the results cannot be applied reliably in areas other than the countryside is that many of the most important things people said needed to be present in order for a location to be described to be tranquil are not present in a city where there are few open views and no wild landscape. Also, in cities there is almost always some road traffic noise; there are almost always people present; there is, by definition, “urban development” all around and many other features which detract from tranquillity according to the views of those participating in the study. Nevertheless, you can visit many locations within cities and busier country parks which people say they value for their tranquillity.

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<sup>3</sup> Tabbush, P, and O’Brien, L. (2003). *Health and Well-being: Trees, Woodlands and Natural Spaces - Outcomes from expert consultations held in England, Scotland and Wales during 2002*. Forestry Commission.

<sup>4</sup> Jackson, S. et al., op. cit.

<sup>5</sup> Ibid.



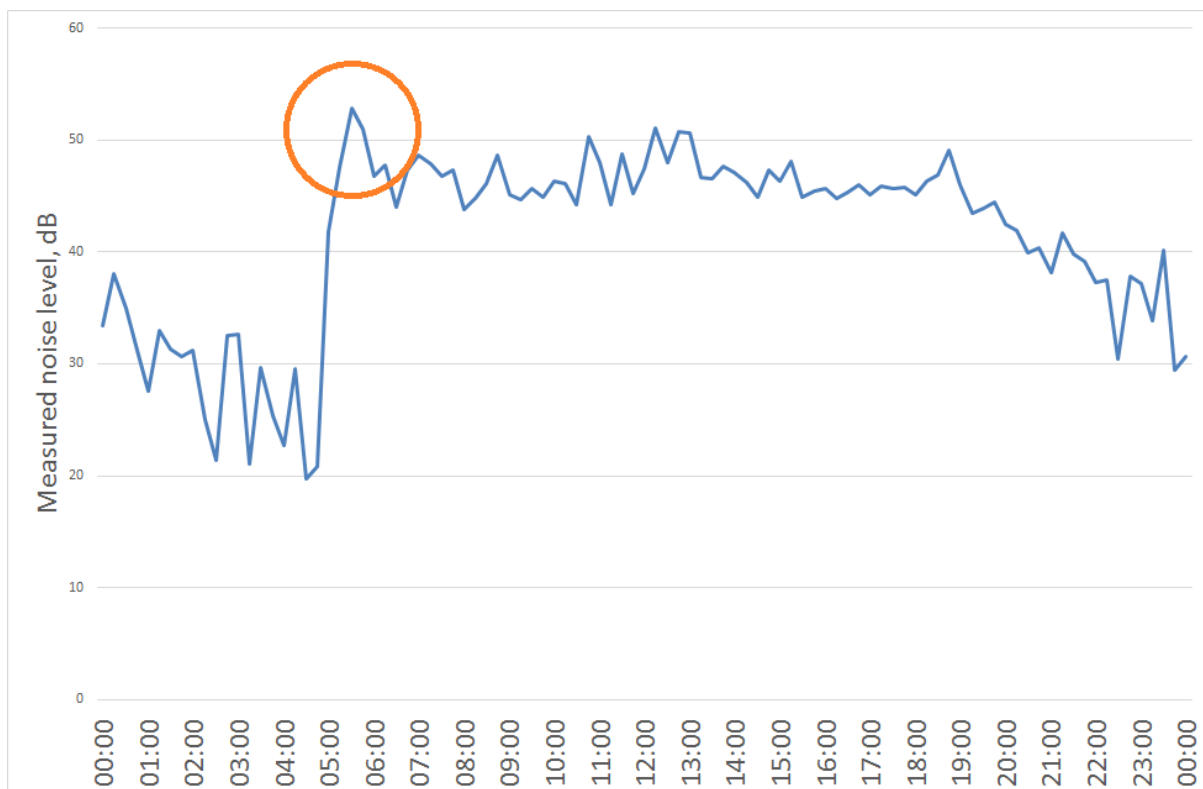
Thus, although the CPRE approach provides a useful means of identifying relative tranquillity across England, it is not so helpful for identifying how individuals will experience (or report) particular places.

### A note on birdsong

The presence of birdsong was identified in the CPRE research work as the second most important sound feature affecting perceptions of tranquillity (after hearing road traffic). Any method which does not account properly for this is unlikely to be reliable.

According to author Julian Treasure, there are three sounds which are beneficial to our well-being: wind, water and birdsong. He points out that the presence of birdsong is an indicator (often at a subliminal level) that we are safe. When danger approaches, birds will fly away, so when we can hear birds singing, we feel secure (without necessarily realising why). No academic research has been identified to support this, but the premise appears sound. Julian Treasure says that recordings of birdsong have been used in airports to provide a calm, relaxing environment; and that installing speakers relaying birdsong along a main street in the city of Lancaster in California has been claimed by the local politicians to have led to a significant, measurable reduction in crime.

Birdsong is often quite “loud”. Professional environmental noise consultants must be careful to take account of the dawn chorus, particularly in summer, as it can significantly change the measured night time noise level.



**Graph showing measured sound levels ( $L_{Aeq}$ ) over a day in a quiet village in Essex. Values on the x axis are hours – the period when the dawn chorus appears is circled in orange**

The graph above shows a survey of noise levels on the edge of a quiet village in Essex, on a Sunday in April 2015, at a location which was very well screened from road traffic noise. The dawn chorus appears at about 5.30 in the morning, causing a 15 minute average noise level of 52 dB at that time. Birdsong was the dominant sound source throughout the remainder of the day, resulting in levels typically between 45 and 50 dB.

In many locations in the UK, including many urban sites, birdsong will mask (at least partially) other non-natural sounds and for this reason it is very important that it is included in the assessment of tranquillity. A recent study found that birdsong effectively masks road traffic at lower sound levels (which it describes as <52.5 dBA), stating that,

“Adding birdsong can indeed increase the naturalness and pleasantness of the traffic noise environment at different distances of the receiver from a road.”<sup>6</sup>

### **Applying the CPRE approach**

Mapping of some areas using CPRE methods has been carried out and reported on at Cranborne Chase and West Wiltshire Downs AONB, the New Forest National Park and at the South Downs National Park. It is worth noting some of the comments made within the reports for these.

### **Cranborne Chase and West Wiltshire Downs AONB “ground truthing”<sup>7</sup>**

In 2010, the Cranborne Chase and West Wiltshire Downs Area of Outstanding Natural Beauty (AONB) Office released a report<sup>8</sup> which described a study carried out in the preceding years in the AONB, attempting to find out how well the CPRE method worked “on the ground”. A number of volunteers were asked to visit locations around the AONB and record what they actually saw and heard. Their response scores were compared with the scores which the CPRE method predicted.

The study found that, although there was some correlation (particularly at the extreme values of high or low tranquillity), there were a number of significant discrepancies where the CPRE method did not match what was found in the survey. It was found, in relation to rivers, streams and lakes, that

“... unless the water source was particularly large, or you were right next to it, it was difficult to hear.”

In relation to low noise areas, the following was reported:

“This is the factor for which there is by far the greatest differences. For the surveyed data, this factor has the greatest influence on positive tranquillity, whereas for the recorded data it rather strangely scores zero for every square. The definition for this factor is ‘Hearing natural sounds - i.e. Hearing birdsong, wildlife, no artificial or human sounds. Distant agricultural noises. Includes hearing silence.’ It is therefore reasonable to expect this factor to have a strong influence in an Area of Outstanding Natural Beauty.”

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<sup>6</sup> Yiyang Hao and Jian Kang, “Assessment of the masking effects of birdsong on the road traffic noise environment”, *The Journal of the Acoustical Society of America* 140, 978 (2016).  
<https://doi.org/10.1121/1.4960570>

<sup>7</sup> “Ground truthing” according to Wikipedia is “The collection of ground-truth data enables calibration of remote-sensing data, and aids in the interpretation and analysis of what is being sensed”.

<sup>8</sup> Jackson. S. et al., op. cit. t

And in relation to other non-natural sounds:

“It is worth noting the occurrence of ‘Hearing – low flying aircraft’ and ‘Hearing – non-natural sounds’ for the recorded negative factors. These have a low weighting value and therefore do not score highly overall, but do appear consistently. The non-natural sounds values apply to sounds such as distant artillery, and the low flying aircraft include military helicopters and jets; reflecting the proximity to Salisbury Plain.

Surveyors also noted other non-natural sounds which were prevalent, described by surveyors as being made by automatic detonations of crow-scarers, tractors and farm machinery and lawnmowers in distant villages.”

Overall, the study concluded that the CPRE method gave the following factors too much weight:

Seeing the Stars at Night; Seeing a Natural Landscape; Hearing Running Water; Seeing Streams and Rivers; and Seeing and Hearing Lots of People;

and gave the following factors insufficient weight:

Hearing Low Noise Areas; Seeing Urban Development; Seeing Overhead Pollution.

The failure to give natural sounds (included in “low noise areas” within the CPRE method) sufficient emphasis is consistent with the points made in point 4 above. Scoring “seeing a natural landscape, hearing and seeing running water, streams and lots of people” too highly is also as predicted by research for the Natural Tranquillity Method.

### **New Forest National Park Tranquil Area Mapping, 2015**

The New Forest National Park commissioned a mapping exercise in 2014, which included ground truthing and did not use the CPRE method published in 2006, preferring instead to use the CPRE’s 1996 approach, despite acknowledged criticisms. In relation to the more recent CPRE method the National Park felt that:

“... these new maps of tranquillity failed to capture some local significant effects on Tranquillity, and in the New Forest the positive effects of the natural land cover ‘dilute’ the negative effects from significant roads (particularly the A31 which cuts through the National Park) making the resulting map less meaningful on a local scale.”<sup>9</sup>

The fact that the CPRE method is unable to capture the positive effect of natural sounds is likely to be the main cause of this.

### **The South Downs National Park Authority Tranquillity Study, 2017**

In 2017, the South Downs National Park Authority published a report<sup>10</sup> setting out the results (to date) of the first phase of their survey work which aimed to map relative tranquillity within the national park using the CPRE method, adjusted to apply to the South Downs (rather than to England). The study has produced a map which the Authority says represents relative tranquillity within the Park’s boundaries well, and it believes should provide a good foundation for further work. It is intended to use this and subsequent maps to inform planning decisions in future.

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<sup>9</sup> *New Forest National Park Tranquil Area Mapping*. Report prepared by LUC London for New Forest National Park, 2014, revised March 2015.

<sup>10</sup> *South Downs National Park Authority Tranquillity Study* (2017). South Downs National Park Authority.

Some interesting points are mentioned in the report. It describes the difficulty of obtaining an idea of the view which may be present at a location where the view is partially obscured. The report says that where its surveyors,

“... were stopped on a footpath with hedges each side, they might struggle to be able to properly assess the range of factors that influenced the whole survey plot.”

Research for the Natural Tranquillity Method suggests that variations in the natural landscape have little, if any, impact on perceptions of tranquillity. It seems likely that, had the surveyors moved away from these hedgerows, they would not have found a significant change in tranquillity.

In relation to the initial outputs, the report states:

“Results so far indicate that the areas that are most susceptible to change are to a degree more tranquil than the original CPRE desk based study suggests.”

Again, since the CPRE method is not able to properly take account of the positive effects of natural sounds on perceptions of tranquillity it is to be expected that it will underestimate the tranquillity in many circumstances, particularly in areas where natural sounds are dominant and high levels of tranquillity may be present.

### **CPRE method in summary**

The CPRE maps for relative tranquillity across England have provided a helpful tool for identifying areas where the most tranquillity might be found. However, the process of turning the vast amount of data they used into these maps necessitated some significant assumptions and generalisations that do not (and, in fairness, do not claim to) give a great deal of reliability for specific locations. A result of this is that all cities and larger towns are uniformly classified as not at all tranquil and all areas which are remote from urban development and roads and which have pleasant views are classified as having relatively good tranquillity. Whilst this is a reasonable generalisation, local sources of noise in rural environments and areas of tranquillity within towns are hidden and this means that the maps cannot be used as more than a rough guide.