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Results from The Quiet Project- UK Acoustic Community's response to COVID19

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ABSTRACT

The COVID-19 Lockdown created a new kind of environment both in the UK and globally, never experienced before or likely to occur again. A vital and time-critical working group was formed with the aim of gathering crowd-source high quality baseline noise levels and other supporting information. The acoustic community were mobilised through existing networks engaging private companies, public organisations, and academics to gather data in accessible places. A website was designed to advertise the project, provide instructions and to formalise the uploading of noise data, observations, and Soundscape feedback. The data was collected at 99 locations by 80 acousticians (64 male, 16 female) using professional grade calibrated instrumentation with 83% of measurements including spectral data. The locations covered 19 urban, 61 suburban, and 19 rural sites. The Lockdown 1 dataset consisted of a total of 1.6 GB of measurements and material (video, photos) covering 834 days between 1st April and 14th July 2020. This makes the award winning Quiet Project the largest ever noise and soundscape database ever recorded. The paper presents the quietest places in the UK and Ireland. As a government funded research project the databank will be made publicly available to assist future research.

1. INTRODUCTION

The COVID-19 lockdown created a new kind of environment both in the UK and globally never experienced before or likely to occur again. The Quiet Project was conceived by the realisation that environmental noise levels had changed dramatically as communities across the country followed the UK Government's advice to "Stay home". The first COVID-19 outbreak occurred on 17th November 2019 and arrived in the UK on 29th January 2020. The UK Lockdown occurred on 23rd March 2020. Hence, the Quiet Project was setup on 6th April 2020 as a time-critical data gathering respond to collect and collate baseline noise data across the nation; table 1 shows the timeline of the UK outbreak.

The UK currently has no permanent city-based high-quality monitoring installation and therefore was acoustically under-prepared for the outbreak. If such a system was available, then the noise evolution during Lockdown could have easily been monitored on a city scale. However, the situation provided the impetus and the opportunity to create a project to survey

the entire country. Development of the survey required a rapid response which was only possible due to the acoustic community's willingness to participate to deliver what would be called the Quiet Project [1]. A working party was immediately formed comprising of consultants, government agencies, and academics. This working group defined the scope of the data to be gathered and, with the endorsement of the Institute of Acoustics, Association of Noise Consultants, Noise Abatement Society, and UK Acoustics Network (UKAN), a network of acoustic professionals was mobilised in record time.

	17 Nov 2019	29 Jan 2020	23 Mar 2020	11 May 2020	1 June 2020	15 June 2020
Event	1st Case in the World	1st UK Case	Lockdown Starts	Easing	Schools reopen for Year 5 and 10	Non-essential shops open
Status	Level 1 Normal Life	Level 1 Normal Life	Level 4 Stay at Home	Level 4 Stay Alert	Level 4 Stay Alert	Level 4 Stay Alert

Table 1: Lockdown 1 status of the UK

2. METHODLOGY

The full methodology is given in [2] but has been summarised as follows. Quality measurements were prioritised and hence smartphone collected was dismissed. Instead, the strategy of utilising a large number of furloughed acousticians was pursued. This provided the opportunity to utilise their expertise and spare time to undertake measurements and observations. The impact of COVID19 on the acoustics industry has been recently documented by a survey of over 200 UK acoustics companies by Lincoln [3].

The immediate issue was that as Lockdown happened overnight instrumentation was not readily available. This was solved by utilising UKAN to cover the shipping costs and leaning on the good will of leading acoustic instrumentation companies to organise the equipment, which was very kindly provided free of charge. Again, a key proviso was that only those on the contact list of the hire companies would be shipped the instrumentation.

A pamphlet was produced which outlined how the measurements were to be taken, of course it was critical that all equipment was handled in line with government safety guidance. Hence only locations where explicit permission had been granted were used. Promotion of the project was from the Institute of Acoustics through their weekly Zoom meetings.

A website, theQuietProject.co.uk [1], was designed which supplied the templates for data formatting and observations as well as hosting the databank. Measurements were to be taken using a calibrated and certified Class 1 or Class 2 noise monitoring equipment [4] for a period of at least one week and preferably longer in accordance with BS7445 [5]. A longer survey with good quality supporting information would minimise sources of potential uncertainty. Finally, acoustic related UK news items were gathered to provide further evidence of the environmental impact of COVID-19.

3. DATA COLLECTION

Noise measurements were made at 15-minute intervals, starting on the hour, as this matched how transportation data, Transport Research Information Service (TRIS), is collected in the UK by Highways England [6]. As to the acoustic parameters: LAeq, LAMax, LA10 and

LA90 were to be recorded. In addition, optional spectral data would be collected. Addition information was added to the Excel template which included location description, GPS position, free field condition, measurement height, as well as time and date information.

In addition, a writeable PDF observation sheet was produced. This PDF included contact details, instrumentation details, calibration information, location description selection, the normal primary noise source, a note section to include daily weather observations such as wind speed, wind direction, temperature, and precipitation. Finally, during the upload process, participants were asked to complete a series of dropdown soundscape questions adapted from Questionnaire (Method (A) of Annex C3 ISO / TS 12913-2: 2018 [7].

The last step is an optional procedure to upload supporting information including photographs of the measurement environment as well as short audio/video clips to illustrate the aural environment for later Soundscape analysis. For example, Figure 2 shows examples of urban, suburban, and rural locations taken in during good weather conditions.

Figure 2. Examples of rural, suburban, and rural measurement locations

4. QUIETEST RESULTS

The website now has over 125 individual user accounts, as of 15th June 2020. However, not every user uploaded data as such data was collected at 99 locations by 80 acousticians (64 male, 16 female) using professional grade calibrated instrumentation with 83% of measurements including spectral data. The locations covered 19 urban, 61 suburban, and 19 rural sites. A breakdown in occupation is given in Figure 3.

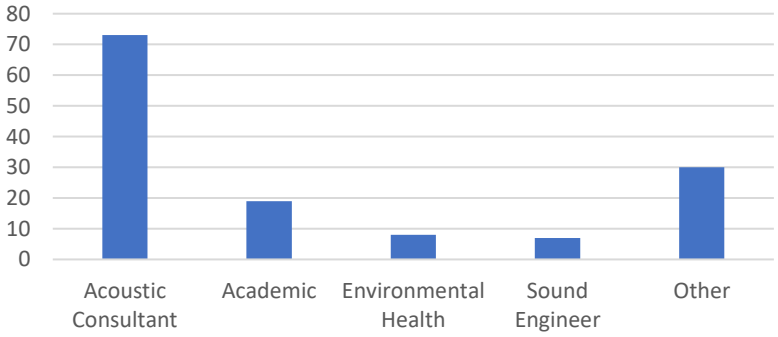

Figure 3. Number of registered users (15th June 2020)

The quietest locations were found using the minimum LAeq, 15mins and time of day for rural, suburban and urban environments (96 measurements per day). The Top 5 in each category is given in Figure 4 and Table 2.

Table 2: Shows the summarised data for the 5 quietest locations (Rural, Suburban, Urban)

	Start of Measurement	Data Points Collected	Minimum $L_{Aeq,\ 15\ min}$	Minimum $L_{A90,\ 15\ min}$	Minimum $L_{A10,\ 15\ min}$	Time Taken	Date of Measurement
1	06/05/2020	2110	13.1	20.0	20.0	11:15	27/5/2020
2	01/05/2020	670	15.6	15.2	16.0	00:45	7/5/2020
3	02/05/2020	890	17.8	16.2	18.2	01:15	8/5/2020
4	05/05/2020	1013	18.0	17.4	18.3	01:45	15/5/2020
5	07/05/2020	213	19.8	17.3	21.5	01:44	8/5/2020
6	2/5/2020	743	16.7	15.8	17.5	02:00	3/5/2020
7	22/4/2020	2292	16.7	16.5	16.9	20:30	22/4/2020
8	12/5/2020	346	17.7	12.4	19.1	01:15	16/5/2020
9	22/4//2020	485	19.6	18.1	20	01:11	3/5/2020
10	23/4/2020	2976	19.9	18.0	20.0	02:15	27/4/2020
11	14/05/2020	208	24.1	27.5	40.3	02:25	20/5/2020
12	07/05/2020	1345	28.7	28.1	29.2	02:40	10/5/2020
13	21/04/2020	772	32.5	26.9	35.0	03:15	27/4/2020
14	12/05/2020	1153	33.6	28.3	36.5	03:15	3/6/2020
15	21/04/2020	192	36.0	35.1	36.9	01:44	22/4/2020

Table 2 provides the evidence identifying the quietest location across the survey. Surprisingly, the quietest time was not solely in the wee small hours (Location 1 and 7). The sound levels indicate that a Class 1 sound level meter is required to prevent underloading when measuring rural and suburban environments, <20 dBA noise floor. The difference in the parameters LA90 and LA10 was small for the rural and suburban setting indicating a very stable environment with a maximum difference of 6.7 dB (Location 8). Rural average difference between LA10 and LA90 was 1.6 dB and for Suburban 2.5dB This was not seen in the urban dataset with a maximum difference of 12.8 dB (Location 11) and an average difference of 6.4 dB. The recorded sound levels are significantly lower than found typically rural is 25 dBA, suburban 30 dBA and urban 35 dBA [10,11]

Figure 4 illustrates the geographical spread of the quietest locations. This provides the evidence to demonstrate that the survey covered the British Isles, for more information see [2]. Figure 5 shows the rank order (Quietest to Noisiest based on minimum $L_{Aeq,\ 15\ min}$) for the 3 settings broken down into Rural, Suburban, and Urban. As there were multiple files for some locations 76 separate locations were measured split into 18 rural, 12 urban and 46 suburban, a 24%, 16%, 60% breakdown. It is clear that rural was the quietest location, closely followed by suburban then urban settings.

Figure 4. Location of the 5 Quietest Locations (Rural, Suburban, Urban) Google ©

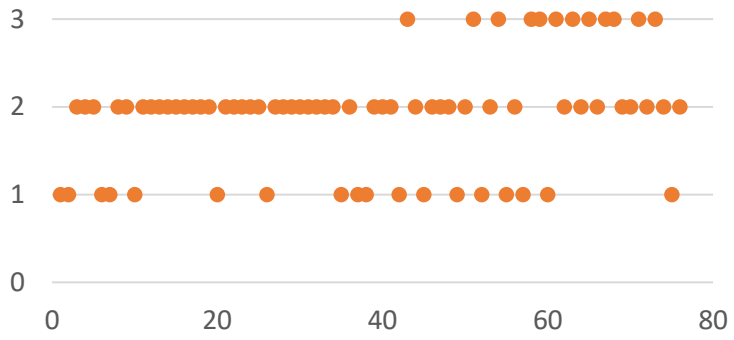

Figure 5. Ranked Quietest to Noisiest for the 3 Settings: 1) Rural, 2) Suburban, 3) Urban

5. LONGITUDINAL MEASUREMENTS

One site provided long term day-time (09:13-10:42) measurement data, Pre-During-Post Lockdown, covering March 2017, 24th March 2020 (Lockdown), and September 2020 Easing – Level 3 Alert). Measurements were taken at six locations over 100 minutes under free field conditions. The major noise source was the M4 motorway, see Figure 6.

Figure 6. Location of the West Michel longitundal measurements ◄► Street Map ©

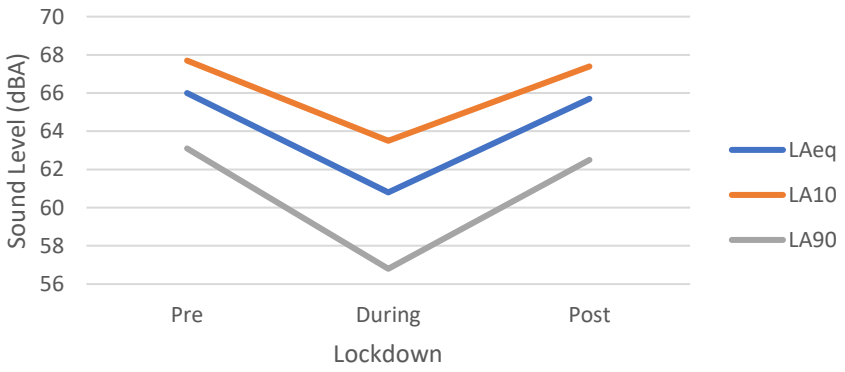

Figure 7. Measured sound level averaged over 100 minutes pre-during-post lockdown in West Wichel

From figure 7 it is clear that noise levels returned to pre-pandemic levels (L_{Aeq}, L_{A10}, L_{A90}). There was a drop in noise levels 5.2 dB±0.7, 4.2 dB±1.0 and 6.3 dB±0.9, then an increase 4.9 dB±0.7, 3.9 dB±1.0, 5.7 dB±3.6, respectively. This was consistent with the results found by Dance and McIntyre for Case Study 2 (Trunk road) [2] where Lockdown recovery was measured as schools returned in the first week of June 2020 with an increase in L_{Day} 2.5 dB±1.0, 3.5 dB±0.9 and 4.9 dB±2.3 measured over that week. The L_{A90} parameter

consistently showed the greatest change and the least consistency. By analyzing the difference in L_{Aeq} and L_{A10} the traffic conditions maybe deduced, Abbott and Nelson [8] stated a 3 dB difference between L_{A10} and L_{Aeq} values for free flowing traffic, and from figure 7 it can be seen that there was a 1.7 dB difference both pre and post Lockdown on the M4, but a 2.7 dB difference during Lockdown. We know that at 9am motorway traffic is not necessarily free flowing. However, during Lockdown road traffic was significantly down [9] and hence much more likely to be free-flowing. This was confirmed by TRIS data [6], see below.

Figure 8 compares TRIS data for March 2017, March 2020 and September 2020 on the Eastbound M4 motorway at Junction 15, the closest junction to the measurement location. At the time of the Lockdown measurements there were 2319 vehicle (V) movements compared to three years earlier, 4084 vehicles, and during the recovery month 3631 vehicles. This would lead to a theoretical drop in noise level, based on $20\ log(V/V_0)$ if the vehicles are considered a point sources, of 5.0 dB (measured L_{Aeq} drop 5.2 dBA), and an increase post Lockdown of 3.9 dB (measured L_{Aeq} increase 4.9 dB). Excellent agreement between two independent datasets. From the TRIS data it may be possible to predict the sound level for the same time during the last day in March, 1091 vehicle movement, which would result in an 11.5 dB drop compared to pre-pandemic noise levels, 54.5 dBA. Finally, by taking the minimum vehicle movements on the M4 over a 100 minute period in the early hours, 130 vehicle movement, a 29.9 dBA reduction, a prediction can be made of the noise level, L_{Aeq} 36.2 dBA. A very similar value as Location 15 in Table 2, L_{Aeq} 36.0 dBA. This all assumes that motorway traffic is the dominant sound source.

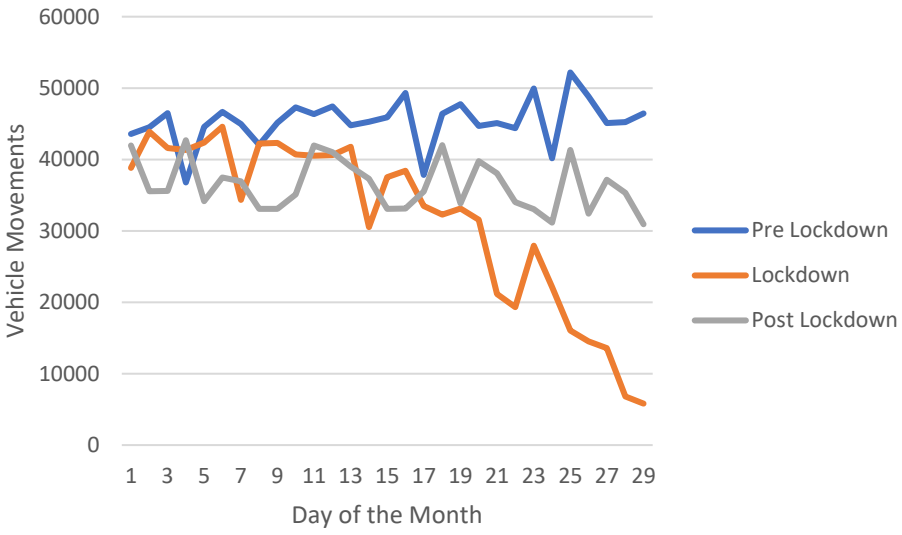

Figure 8. Vehicles March 2017, March 2020 and September 2020 M4 Jn 15 Eastbound

6. CONCLUSIONS

The Quiet Project has created a unique high quality dataset suitable for in-depth analysis as part of an open research project to investigate environmental conditions, pre-during-post

Lockdowns. The quietest locations across the UK and Ireland have been identified clearly showing the need to use high quality instrumentation to measure exceedingly low noise levels, < 15 dBA, as found for both rural and suburban environments. The instrumentation requirement in urban settings would be less severe, a 25 dBA noise floor would enough for monitoring.

A case study using longitundal data found that noise levels were reduced by 5 dB (LAeq, LA10) during the initial Lockdown with a greater reduction in background noise levels (LA90) compared to previously recorded noise levels, confirming earlier result [2]. In September 2020, post Lockdown noise levels had returned to pre-pandemic values. A cross analysis with TRIS traffic data found excellent agreement between vehicle movements and noise levels (LAeq) for both Lockdown and post-Lockdown periods. Finally, we believe the Quiet Project has produced a valuable dataset could be used to inform future WHO studies and guidance documents [10,11].

7. ACKNOWLEDGEMENTS

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