# CASE STUDY

## Award-winning construction noise management

# The Crossrail Project, London – C501 Moorgate Shaft

Project C501 Moorgate Shaft is part of the Crossrail infrastructure project that will create a new rail link across London from west to east. Over 42km of underground tunnels will link London's main business centres in a project that is expected to start operation in 2018 and be fully operational in 2019.

Brüel & Kjær worked closely with the project team to implement Noise Sentinel, a robust and effective system for managing the noise impact of construction. Noise Sentinel has continuously monitored noise around the site since November 2011 and has exceeded both the expectations of the City of London and the contractual requirements of Crossrail. The main contractor, BAM Nuttal Kier JV, has been awarded Crossrail's Green Line Scheme award for the project. In addition, Noise Sentinel has been shortlisted for the Environmental Initiative of the year at the 2013 International Tunnelling Awards.


Brüel & Kjær

## Introduction

*Almost in the centre of the picture, you can see the NoiseMonitoring Terminal mounted on the scaffolding*

The C501 Moorgate Shaft is a 35 x 35m, 55m deep hole excavated right next to the existing Moorgate Station. 60 metre deep reinforced concrete panels are being installed to form a box below ground. This will house the new western underground ticket hall serving the new Crossrail station.

## Why was noise monitoring necessary?

The construction site is one of the most constrained on the Crossrail scheme. Evident from the picture on the front page, the site is surrounded on all sides by commercial, residential, educational and London Underground premises. Operating conditions, established with the City of London, are complex in order to both limit noise impact and provide periods of respite to the different stakeholders throughout the working day. Permitted noise levels vary up to 12 times throughout the day. The main project contractor, BAM Nuttall Kier Joint Venture (BNK JV), needed to be sure that the priorities and expectations of stakeholders were met while enabling the project team to make progress with construction and fulfil obligations to the Local Authority and project owners, Crossrail. With advice from consultants, Anderson Acoustics, BNK JV chose Noise Sentinel to help manage noise impact.

Chosen for its ability to perform real-time measurement and alerting, Noise Sentinel delivers the immediacy necessary to help manage site activity. Noise Sentinel was recommended because of its high reliability. Financially, Noise Sentinel delivers too, with low establishment costs and a fixed monthly subscription fee over the life of the project.

**"We use the real-time monitoring function of Sentinel for operations out of hours in order to satisfy ourselves we are not breaching the agreements made with the Local Authority "**

***Steve Lowder, Project Manager***
***C501/BAM Nuttall Kier JV***

## The Noise Sentinel solution

*Inside the site office investigating noise levels and alerts*

Noise Sentinel is a web-based noise management service which continuously assesses noise levels and alerts designated people, enabling them to take immediate action should levels exceed defined limits. The system comprises three real-time noise monitors stationed at key locations around the site that are constantly recording data. A further fourth terminal is located at the centre of the site to help determine if noise exceedances are the result of construction activity.

Construction shift teams are equipped with a duty phone that receives warnings or alerts from Noise Sentinel via email and SMS so that they can react quickly and proactively rather than reactively to potential noise breaches.

The system uses cloud-based computing allowing any member of the team to have access to web pages that detail real-time noise levels, historical noise data and amber (warning of a potential breach) and red (indicating a breach) alerts.

## Reporting

At the Site, construction teams are equipped with a duty phone which receives alerts via SMS, allowing them to take immediate action should a breach occur. Daily noise reports are delivered to project and environmental managers showing noise history and detailing each alert. Every month, a summary report is provided to the City to show the site's noise performance.

## Noise challenges

A particular challenge at C501 is the close proximity of other buildings and the wide variety of neighbours to consider regarding noise nuisance. Adjacent to the site is Moor House, one of London's largest office buildings and there are also hotels, a school and an exclusive apartment building nearby. In such a built-up area there are also many sources of noise other than the construction at Moorgate. Air, road and rail transport create significant noise disturbance as well as other nearby construction sites. This makes it not just a challenge to keep construction noise levels below limits but also, should a breach occur, to determine the cause. Noise Sentinel addresses this issue by recording the audio when levels are high. This allows users to investigate noise breaches by replaying the noise and thereby determine if it was construction-related, and take action to address it. With Noise Sentinel, it's easy for the project team to manage the noise issues transparently and cooperatively with the stakeholders.

**"The visual display, text and email alerts for triggers are now seen as essential tools to warn that we will breach maximum levels if we continue at same volume. The ability to listen to sound bites of the triggers is very useful and helps us defend our corner when we get complaints of noise we did not create"**

***Karin Vickery, Environmental Manager***
***C501/BAM Nuttall Kier JV***

## Noise Sentinel promotes engagement and transparency

The history of noise data from Noise Sentinel is provided to the City on a monthly basis to show the site's noise performance. More detailed data forms the basis of regular engagement meetings with local Environmental Health Officers.

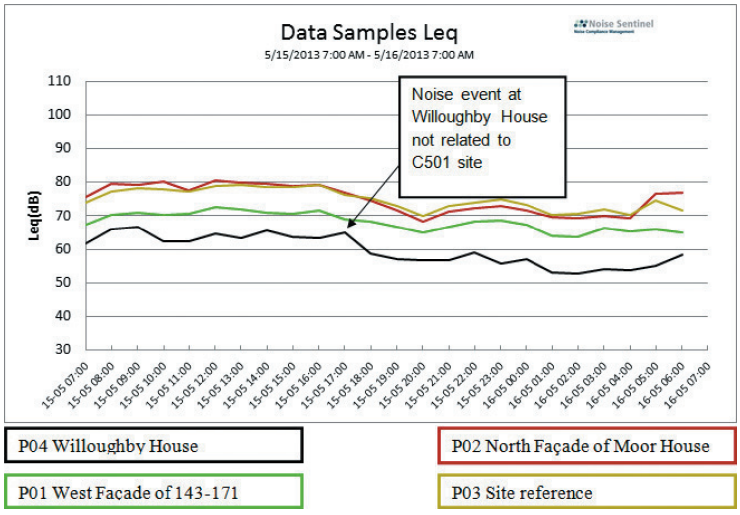
Additionally, daily noise reports are sent out to project and environmental managers showing noise histories and detailing any alerts. This keeps noise at the foreront of everyone's mind. They can see the impact of the operations and adjust future plans accordingly to ensure compliance and reduce future noise impact.

The robustness of the Noise Sentinel service has allowed the project team to develop an open relationship with the City of London. The reassurance gained by having a continuous monitoring regime has allowed the City to run trials for certain activities before an official variation or dispensation is granted enabling the project team to gather accurate monitoring data.

Without Noise Sentinel the complexity, cost and effort required to achieve a similar outcome would be impractical.

As the system is cloud-based, all the information is available at any time to team-members for recall using a web browser. Reports and graphs can be used as part of complaint investigations and enquiries and are a great way to show transparency to ensure that concerns about noise impact are understood and being addressed.

*Example of a daily noise chart from C501 showing construction-related noise as well as unrelated noise*



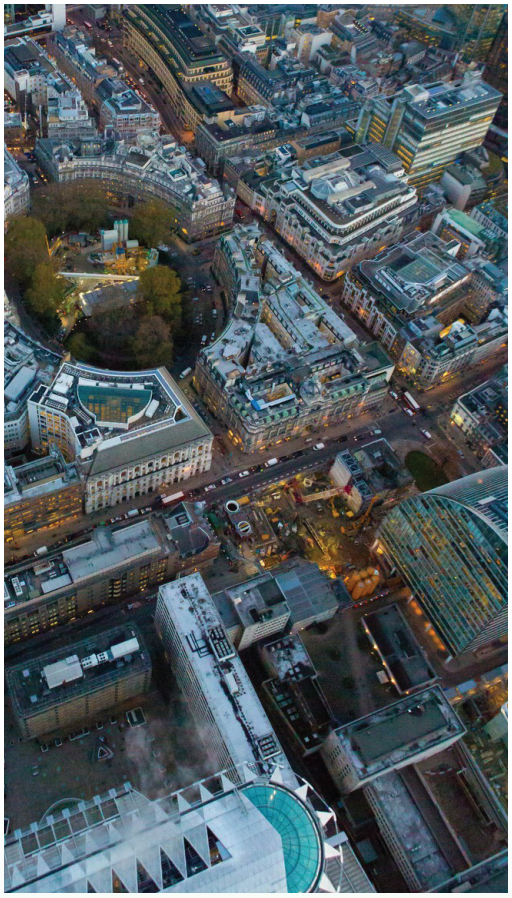
## How has Noise Sentinel benefitted the project?

Noise Sentinel is a full service solution designed to take away the headache of monitoring from the construction team. The solution was installed and is operated by Brüel & Kjær experts. Equipment is routinely calibrated, traceable to international standards and all measurement follows accepted best practice. Noise Sentinel is constantly monitored by Brüel & Kjær and any equipment failure is identified and quickly rectified by Brüel & Kjær without the involvement of the project team. This delivers the highest measurement accuracy with the greatest possible data completeness. With Noise Sentinel, Brüel & Kjær focuses on its expertise – noise management technology, leaving the contractor team to focus on theirs – construction.

Noise Sentinel has reassured external stakeholders, giving confidence that stated noise limits are being met by the construction. This is reinforced by the depth of data available to the project team to engage with site managers, Environmental Health Officers and the public. The construction team is seen to be a "good neighbour", which will work well for future construction bids.

Daily data from Noise Sentinel has helped to engage the project team on noise issues and to manage noise concerns transparently with external stakeholders. A daily summary of the previous day's noise performance helps to keep the project team aware of noise impact and its importance to the project. Measurement technology operated independently by Brüel & Kjær has built trust with stakeholders and reduced the risk of schedule/cost overruns caused by noise complaints and challenges to working practices.

**Aerial view of Liverpool Street and the C501 construction site**



Finally, Noise Sentinel has increased construction performance and cost efficiency. The construction team can get more done because they know what their real noise impact is; they don't have to be conservative for fear of breach. The team can work to the noise limits safe in the knowledge that should they approach them, they will be alerted and can change activities before a breach occurs. Noise Sentinel is a subscription service with low establishment costs and fixed fees over the life of the project. As it includes everything needed to operate the noise monitoring, the project team can be certain of the cost.

**"Given the scale of this construction and constraints, a key requirement was high reliability of the noise monitoring system. Experiencing failures that could require construction work to be stopped are not an option. The capability to present the data in the right place at the right time was critical"**

***Andy Knowles, Managing Director***
***Anderson Acoustics***

London, environmental noise, noise monitoring, construction

Photos courtesy of Crossrail Ltd, photographer Paul Thurlow



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